Gaynor Swamp Business Case Supporting Work

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Gaynor Swamp Business Case Supporting Information

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Project manager:	Andrew Sharpe
Author:	Andrew Sharpe
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Jacobs Group (Australia) Pty Ltd
ABN 37 001 024 095
Floor 11, 452 Flinders Street
Melbourne VIC 3000
PO Box 312, Flinders Lane
T +61 3 8668 3000
F +61 3 8668 3001
www.jacobs.com

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Contents

Executive Summary

The Goulburn Broken Catchment Management Authority (GBCMA) is investigating the feasibility of constructing regulating structures in Cornella Creek and in the existing isolation bank between Cornella Creek and Gaynor Swamp to allow it to deliver an environmental water allocation (EWA) to Gaynor Swamp. The environmental water allocation is needed to increase the frequency and duration of watering events in Gaynor Swamp to maintain and improve native wetland vegetation (specifically Cane Grass communities) and waterbirds (specifically Brolga). Under the proposed scheme, an EWA will be released from the Waranga Main Channel (WMC) into Cornella Creek; a new regulator at the northern end of Cornella Creek will force the EWA to back up in Cornella Creek and new culverts in the isolation bank between Cornella Creek and Gaynor Swamp will allow that backed up water to flow into and fill Gaynor Swamp.

SKM (2013) developed detailed designs for regulators that would allow the GBCMA to fill Gaynor Swamp to 105.0 m AHD. That level will inundate approximately 150 Ha of the Swamp to a depth of approximately 0.5 m. The regulators in the isolation bank can be used to hold water and if necessary adjust the water level in the Swamp independent of water levels in Cornella Creek to meet the requirements of target biota. The regulator at the northern end of Cornella Creek can be used to partially or completely drain Cornella Creek into Lake Cooper. The proposed regulators have been designed primarily to deliver the EWA, and the decision to proceed with the project will be based on the relative costs and benefits associated with that function. However, the structures could potentially be used to divert natural flows from Cornella Creek into Gaynor Swamp. Using natural flows has several benefits including reducing the demand on the GBCMA's EWA and watering Gaynor Swamp at a time when other cues in the landscape are likely to trigger specific ecological responses and lead to better environmental outcomes in Gaynor Swamp. Any benefits of using the regulators to manage natural flow events are considered a bonus and will not influence GBCMA's decision to apply for funding and approval to construct the regulators.

Potential project risks

The main concerns that are likely to be raised against the project are increased risk of flooding private land on the west side of Cornella Creek and adjacent to Gaynor Swamp, increased risk of saline groundwater reaching the surface and reduced recreational activities in Lake Cooper.

This report presents some draft operating guidelines that will meet the environmental watering needs and minimise the risk of flooding private property. The operating guidelines recommend that the regulators should be used to fill Gaynor Swamp over a 7-8 day window when there is spare capacity in the WMC and heavy rainfall is not expected to trigger a natural high flow event. At other times the gates in the regulator at the northern end of Cornella Creek should be kept open to allow any high flows to pass through Cornella Creek to Lake Cooper.

Gaynor Swamp has a history of salinity problems due to elevated groundwater levels. G-MW built the isolation bank at Gaynor Swamp and cut a drain at the northern end of Lake Cooper in the 1990s to lower groundwater and therefore manage salinity problems. Some stakeholders may be concerned that deliberately inundating and holding water in Gaynor Swamp may raise the underlying water table and bring salt back to the surface. A review of the underlying geology suggests that water from Gaynor Swamp is not likely to fill the underlying aquifer and is therefore unlikely to increase the risk of salt damage. Moreover, the volume of water that will be used to fill Gaynor Swamp is relatively small, and certainly much less than the volume that would be needed to fill Lake Cooper first, which would have naturally had to occur before Gaynor Swamp was inundated. Therefore, the risks to underlying groundwater and regional salinity are low.

Lake Cooper is currently used for water skiing and recreational fishing and some stakeholders may be concerned that the proposed regulators will reduce inflows to Lake Cooper and therefore reduce opportunities for recreational activities. The EWA to Gaynor Swamp is additional to natural flows that would occur in Cornella Creek and therefore diverting environmental water to the swamp will not reduce inflows to Lake Cooper. If anything, delivering environmental water to Gaynor Swamp will slightly increase water levels in Lake Cooper because once Gaynor Swamp is full, residual water in Cornella Creek may be released into Lake Cooper. Lake Cooper is much larger than Gaynor Swamp and therefore managed releases from Cornella Creek will have a very small effect on water levels. We estimate that Lake Cooper will rise by 1-2 cm for every 200 ML of additional water. Any future plans to use the proposed regulators to divert natural flows from Cornella Creek to Gaynor Swamp may reduce inflows to Lake Cooper. Gaynor Swamp holds approximately 1 GL of water when it is filled to its environmental water target of 105.0 m. Diverting that volume of natural flow into Gaynor Swamp may reduce the potential water level in Lake Cooper by 5-10 cm. That difference in water level is only likely to be significant in years when the lake level is close to the minimum threshold required for water skiing or other recreation activities. The GBCMA currently has no plans to use the regulators to divert natural stream flows to Gaynor Swamp; if those plans change in the future then it may need to consult with stakeholders that use Lake Cooper to determine when and under what circumstances they could divert natural stream flows.

Water savings associated with the project

Without the proposed regulators, the only way to water Gaynor Swamp would be to first fill Lake Cooper. Lake Cooper is much larger than Gaynor Swamp and it will take a significant amount of water to fill it or top it up to a level where it will force water into Gaynor Swamp. As an example, if Lake Cooper, Cornella Creek and Gaynor Swamp were dry it would take approximately 26 GL of water to fill Lake Cooper and Gaynor Swamp. It is clearly not viable to use 26 GL of environmental water to periodically inundate Gaynor Swamp. The proposed structures will allow Gaynor Swamp to be filled from dry with approximately 3 GL, regardless of the level of Lake Cooper. The swamp can be filled with less water if Cornella Creek already holds some water or if the bed of Cornella Creek and Gaynor Swamp are saturated. The proposed regulating structures therefore make it possible to inundate Gaynor Swamp with a moderate volume of environmental water, which means that Victoria's environmental water allocation can be used to meet the environmental needs of Gaynor Swamp as well as other high priority sites.

Environmental impacts and planning requirements

Constructing the proposed structures will involve some damage and disturbance to the land surface and native vegetation. A preliminary site assessment identified a single mature River Red Gum and a single Branching Groundsel as the only significant plants at the Cornella Creek site and patches of Cane Grass and Plains Grassy Woodland on low lying and more elevated ground at the Gaynor Swamp site. Most of the other vegetation consisted of common native species and weeds. The proposed works construction footprint, including areas for storing materials and manoeuvring construction vehicles, should avoid the River Red Gum tree and Branching Groundsel at the Cornella Creek site and should be located on the bed of the wetland close to the isolation bank at Gaynor Swamp. The works area at Gaynor Swamp will damage some Cane Grass, but the area affected is small compared to the cover of Cane Grass across the whole site. Moreover, the Cane Grass is expected to recover after it is inundated by the EWA. The construction works should avoid damaging the Plains Grassy Woodland community surrounding Gaynor Swamp.

The GBCMA will need to apply to the Campaspe Shire for a Planning Permit and a permit to remove native vegetation during construction works. We expect the permit to be granted because the total area of native vegetation that will be affected is less than 1.0 Ha and is therefore classified as a low risk. The GBCMA should discuss the possibility of using the expected improvements to vegetation in Gaynor Swamp as a result of the proposed environmental watering as an offset for the vegetation that will be removed during construction. The GBCMA will also need to conduct a quantitative flora survey in spring in the year before construction is due to begin to confirm that no significant species listed under the Victorian *Flora and Fauna Guarantee Act 1988* or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* will be affected. We understand that the GBCMA is conducting its own cultural heritage assessment of the site to determine whether a Cultural Heritage Management Plan is needed.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to evaluate the likely costs and benefits of constructing regulating structures to deliver environmental water to Gaynor Swamp and to provide information that will help the Goulburn Broken CMA progress the project to a potential construction phase in accordance with the scope of services set out in the contract between Jacobs and the Goulburn Broken CMA. That scope of services, as described in this report, was developed with the Goulburn Broken CMA.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Goulburn Broken CMA and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Goulburn Broken CMA and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

The Business Case presented in this report does not include a quantitative analysis of economic data. Rather it is a qualitative description of the anticipated benefits of the project; and the perceived social, economic or environmental risks associated with the project. The environmental assessment presented in the report is based on a desktop assessment of readily available reports and a brief site inspection by a trained botanist and aquatic ecologist. No formal environmental surveys have been conducted, but may be required in the future.

This report has been prepared on behalf of, and for the exclusive use of the Goulburn Broken CMA, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Goulburn Broken CMA. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

Gaynor Swamp is a 303 hectare deep freshwater marsh, located 7 km south-east of Corop in northern Victoria. The wetland is part of the Wallenjoe Wetlands, which are listed on the *Directory of Important Wetlands* in Australia (DoE, 2014). Gaynor Swamp is valued for its rarity, species diversity and waterbird habitat (GBCMA, 2012). When wet, it supports thousands of waterbirds, including international migratory species and the threatened Brolga (GBCMA, 2012).

Gaynor Swamp is connected to Cornella Creek and Lake Cooper and would have naturally filled when a full Lake Cooper forced water to back up in Cornella Creek. The natural overflow path of Lake Cooper is via Gaynor Swamp, which links to natural drainage lines feeding into the Wallenjoe Wetlands. Infrastructure has been installed to manage highly saline backflow from Lake Cooper and protect the freshwater system of Gaynor Swamp; however the natural water regime of the swamp has been highly modified.

The Goulburn Broken Catchment Management Authority (GBCMA) identified improving the water regime in Gaynor Swamp as a high priority (GBCMA, 2012). In 2010 Goulburn-Murray Water (G-MW, 2010) completed a scoping study that concluded the most effective way of delivering environmental water to Gaynor Swamp was from the Waranga Main Channel (WMC) via Cornella Creek.

SKM (2013) completed detailed designs for two structures that would allow water to be delivered to Gaynor Swamp via Cornella Creek:

- The first structure is a seven bay regulator that will span the northern end of Cornella Creek, near Willoughby Road (Site A in Figure 1-1). The Regulator will have a full supply level elevation of 105.0 m AHD so that it can be used to fill Cornella Creek and Gaynor Swamp independent of water levels in Lake Cooper. The bottom of the regulator will be flush with the streambed of Cornella Creek and therefore will not impede flow in Cornella Creek when the gates are open. It is expected that water will be released into Cornella Creek from the WMC; and the regulator will raise the water level in Cornella Creek and direct flow into Gaynor Swamp.
- The second structure will increase the flow capacity through the existing impoundment between Cornella Creek and Gaynor Swamp (site B in Figure 1-1) so that Gaynor Swamp can fill faster. The new structure includes three 1200 mm diameter concrete pipes and vertical lift gates. The gates can be opened to allow Gaynor Swamp to fill; and closed to hold water in Gaynor Swamp as Cornella Creek drains. The gates can be kept closed to allow the swamp to draw down through seepage and would operate in parallel with an existing water management structure, which can be used to more finely control water levels.

1.1 Project aim and purpose of this report

The GBCMA is yet to secure funds or relevant planning approvals to construct the proposed regulating structures and requires more information to better assess their feasibility. The GBCMA engaged Jacobs to prepare technical specifications that can be used to obtain accurate quotes to build the structures and to assess the environmental, social and economic benefits and risks associated with their construction and operation.

This report describes the proposed structures and expected construction footprint (Chapter 2), the environmental water objectives that the structures aim to meet (Chapter 3), proposed operating guidelines (Chapter 4), potential social and economic risks and benefits (Chapter 5), potential environmental impacts associated with the construction (Chapter 6), and the relevant planning and approvals legislation that may be triggered by the proposed works (Chapter 7). More detailed assessments of potential environmental impacts, planning requirements and estimated construction costs are provided in the Appendices.

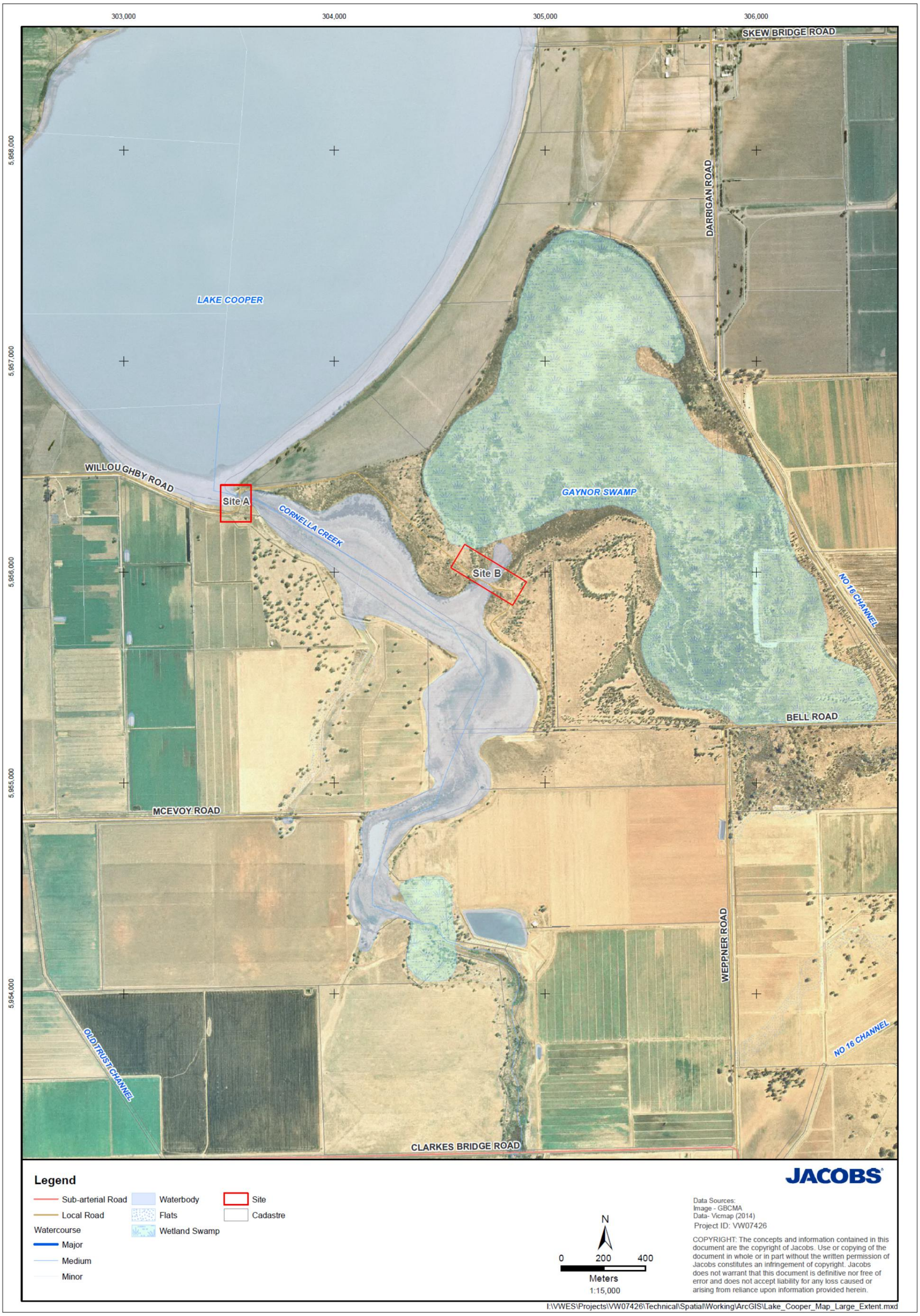

Figure 1-1: Map of Gaynor Swamp, Lake Cooper and Cornella Creek showing the location of proposed regulator structures.

2. Description of structures and expected construction footprint

2.1 Cornella Creek Regulator

The proposed regulator at the northern end of Cornella Creek is located at the confluence with Lake Cooper at a point where there is a natural narrowing of the creek. It is designed to raise the water level in Cornella Creek and divert water into Gaynor Swamp. Without this regulator, flow in Cornella Creek will not enter Gaynor Swamp unless Lake Cooper is nearly full.

The regulator will be built at the site of a derelict bridge, shown in Figure 2-1. The structure will have seven bays that span the width of the main channel (Figure 2-2). Each bay will be fitted with a manually operated combination (split leaf) gate to provide upstream level control between 104.0 and 105.0 m. The floor of the regulator will be flush with the current bed of Cornella Creek so that low flows are not impeded when the gates are open. The main waterway will be reshaped to match the regulator and the remains of the bridge approach embankment will be lowered slightly. The gates are designed to lift sufficiently clear of the floor so that when it is fully open, the site will have similar waterway conveyance to the existing situation.

The full supply level of the regulator will be 105.0 m AHD. This is sufficient to pond water to a depth of 0.5 m in Gaynor Swamp. The full supply level was chosen to provide a practical balance between the facility to control water, whilst limiting the size of the regulator and the extent to which it may restrict natural flood flows in Cornella Creek.

Figure 2-1: Photograph of the site of the proposed regulator on Cornella Creek at Willoughby Road

Construction vehicles will access the site from both the east and west sides of Cornella Creek as needed and the construction footprint and associated works area will extend up to 20 m either side of Willoughby Road and to the top of the banks on Cornella Creek as shown in Figure 2-3.

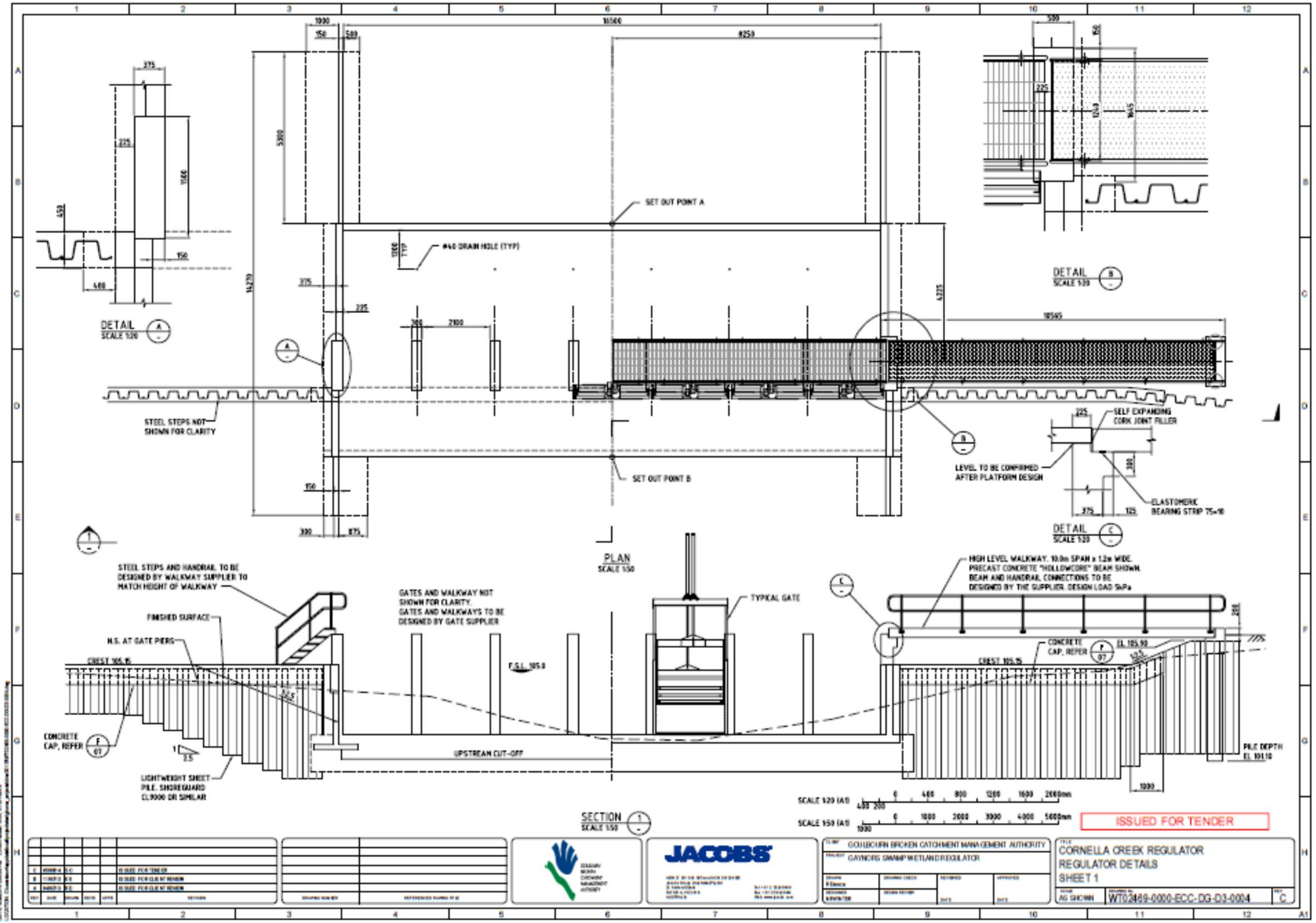

Figure 2-2: Detailed design drawing for proposed regulator on Cornella Creek.

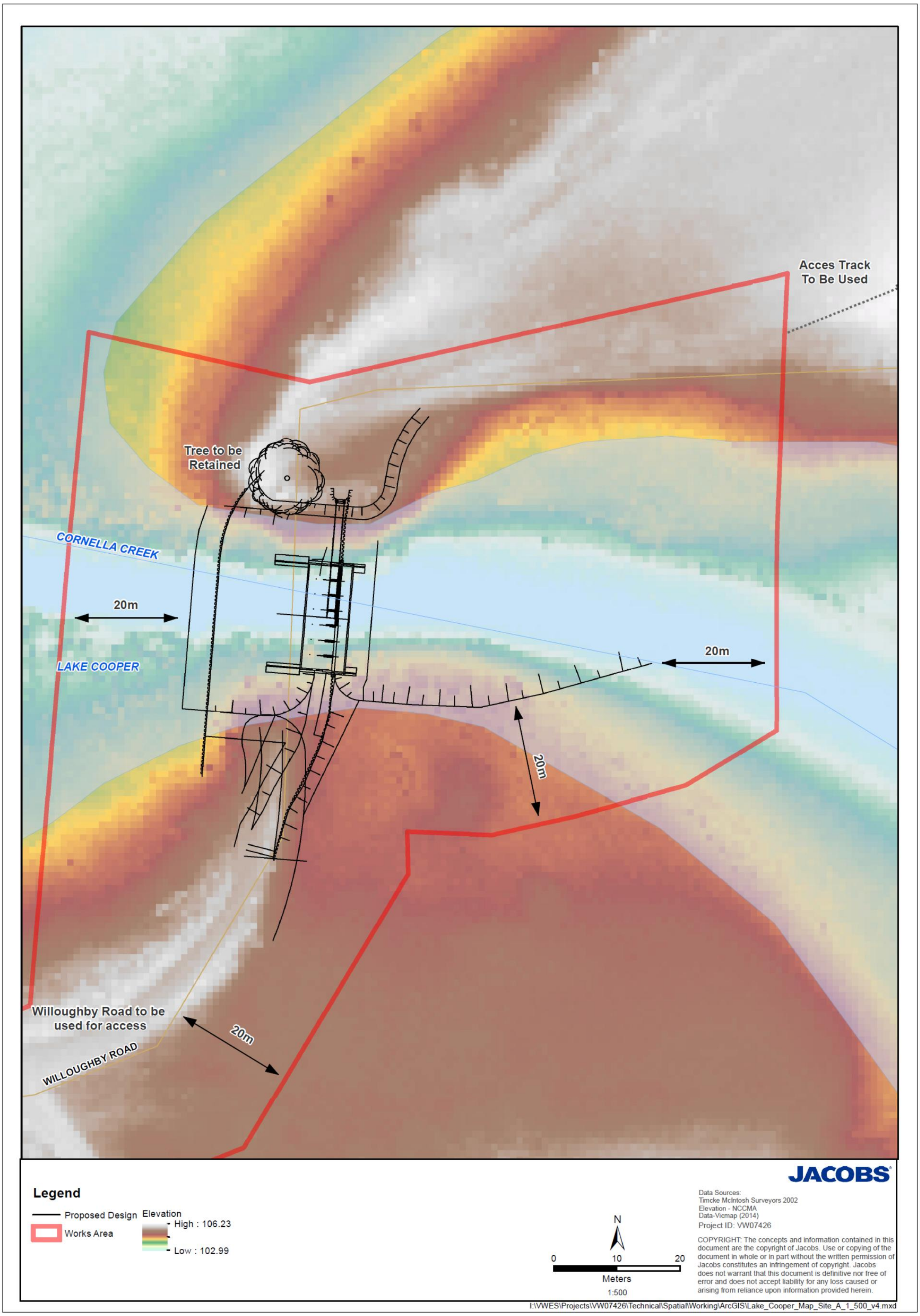

Figure 2-3: Plan view of the proposed regulator and associated works area on Cornella Creek at Willoughby Road.

2.2 Gaynor Swamp isolation bank culverts

In 1995-96 Goulburn-Murray Water built an embankment with a regulating structure at the junction between Cornella Creek and Gaynor Swamp to isolate the wetland from Lake Cooper and therefore help control water and salinity levels in the wetland. The new structure at Gaynor Swamp will supplement (**not replace**) the existing regulator and will consist of three 1200 mm diameter concrete pipes fitted with manually operated vertical lift gates (see Figure 2-4). The invert level of the culverts will be set at 103.73 m AHD, which is below the natural surface level at the inlet to Gaynor Swamp, and is necessary to allow water to readily flow into Gaynor Swamp. The top of the impoundment is approximately 105.70 m AHD.

The purpose of the culverts is to increase the hydraulic capacity between Gaynor Swamp and Cornella Creek. The culverts in the existing structure are too small and can impede the flow of water from the creek to the swamp. The existing culverts can also restrict the rate at which Gaynor Swamp drains to Lake Cooper during or after natural floods, for example when high flows pass down Ryans Floodway. The new regulator will allow more water to pass through the isolation bank in either direction. The gates can be opened as Cornella Creek fills to allow Gaynor Swamp to fill; then closed to hold water in Gaynor Swamp as Cornella Creek drains. The new culverts and gates will be operated in conjunction with the existing regulator, which will still be used to precisely control water levels in Gaynor Swamp.

The road along the top of the existing isolation bank will need to be repaired and it will form the main access route for construction vehicles. Vehicles and construction machinery will also need to access Cornella Creek and Gaynor Swamp either side of the isolation bank and may use low lying areas on either side of the embankment to store materials during construction as shown in the works area footprint in Figure 2-5.

Detailed design drawings and specifications for both structures are provided in the technical specification documents which have been prepared separately.

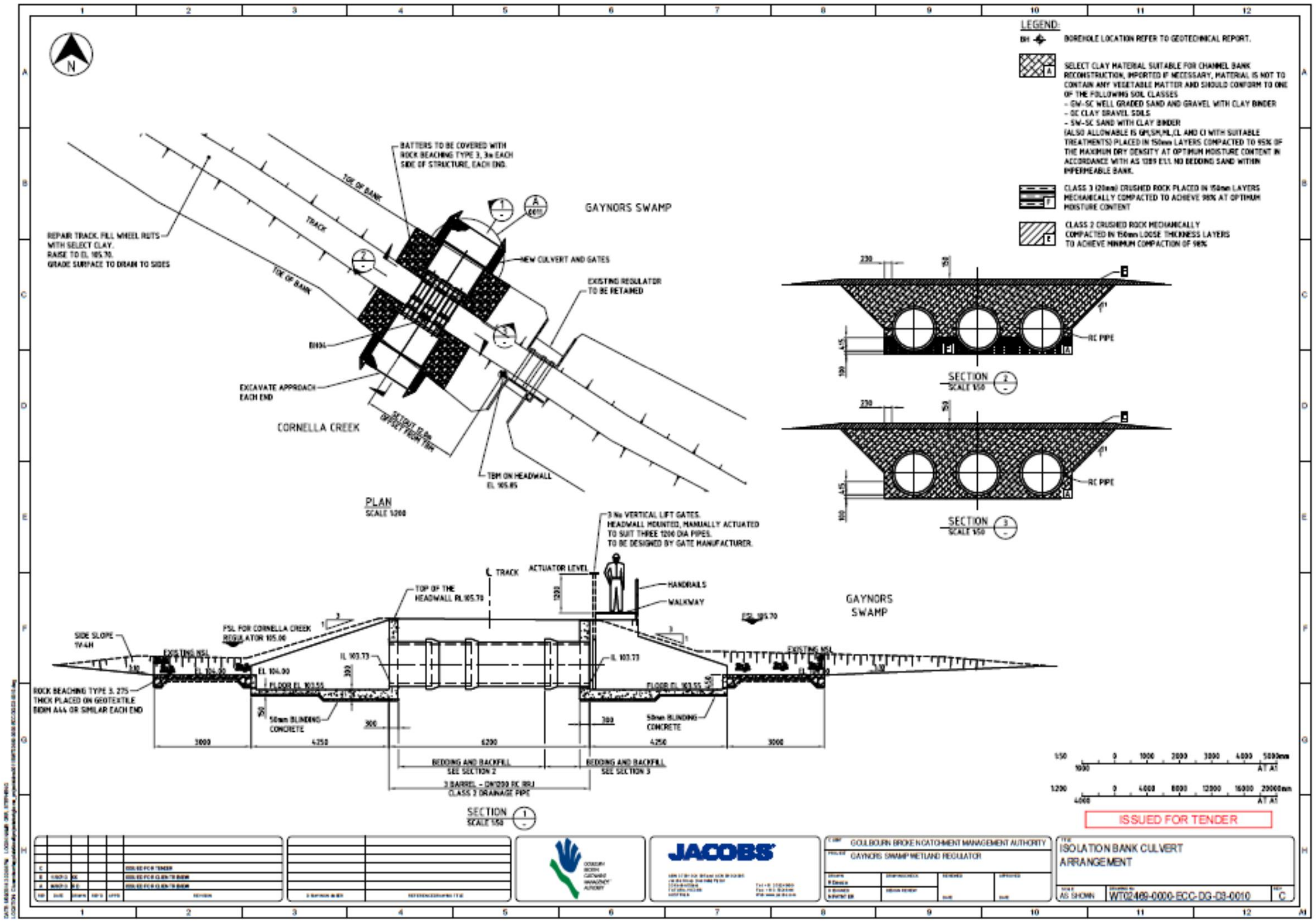

Figure 2-4: Detailed design drawing for proposed regulator through Gaynor Swamp isolation bank.

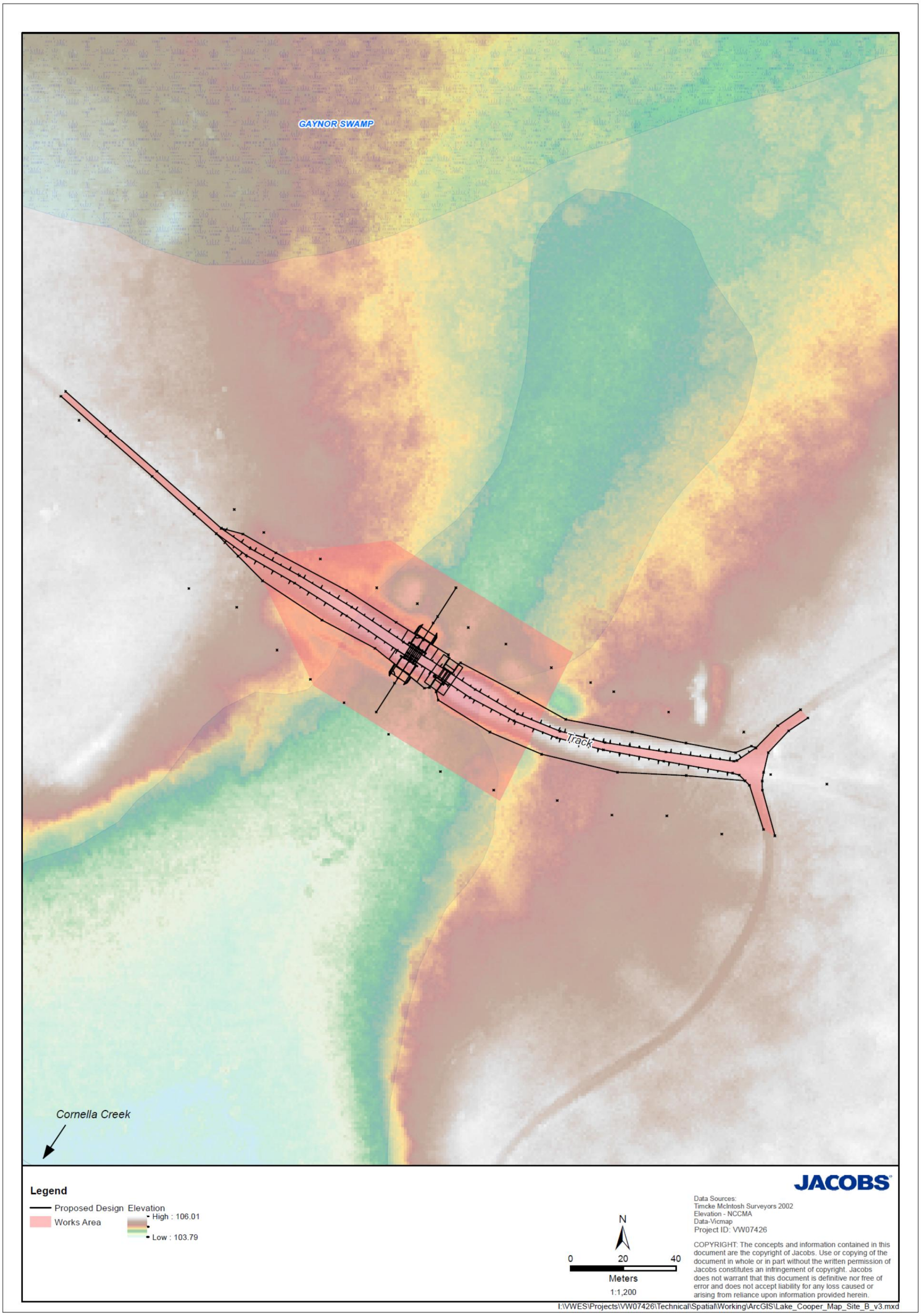

Figure 2-5: Plan view of the proposed regulator and associated works area at Gaynor Swamp isolation bank.

2.3 How the proposed works fit in with other environmental works in the area.

The proposed works may complement existing works that have been implemented in the area over the last two or more decades and new or ongoing works that are planned. Some of the existing and planned works include:

1. Revegetation along sections of Cornella Creek and improved fencing to exclude livestock from the main channel of Cornella Creek and its riparian zone will increase the likelihood that any environmental water delivered from the WMC to Gaynor Swamp will also have environmental benefits in Cornella Creek. While the proposed regulator at the northern end of Cornella Creek is primarily intended to direct water into Gaynor Swamp, it will also allow Cornella Creek to fill more frequently. These more frequent and higher flows may help to retain more permanent pools in Cornella Creek, which in turn may support populations of small native fish, frogs, turtles and macroinvertebrates. More frequent higher flows will also encourage more diverse native riparian vegetation to grow on the banks. The effects of these flows would be limited if stock had unrestricted access to the channel and riparian zone. The potential environmental benefits of using the proposed structures to water Cornella Creek are discussed in more detail in Section 3.4.

2. An overflow sill was installed at the east boundary of Gaynor Swamp as part of an Area Farm Plan. The sill is not an authority owned asset, but defines the natural spill level of Gaynor Swamp and maintains the natural drainage line that connects Gaynor Swamp to other sites in the Wallenjoe Swamp system.

3. The Greens Lake Ling Drain was constructed to allow the water level in Lake Cooper to be lowered to 105.0 m AHD to remove salt from the system and to lower the average water level in Lake Cooper. The construction of this drain is one of the main reasons why Gaynor Swamp fills much less frequently. If Lake Cooper held more water, then Gaynor Swamp would naturally fill more frequently. The proposed structures will allow Gaynor Swamp to be filled independent of water levels in Lake Cooper, and without jeopardising existing salt and flood mitigation programs.

4. Parks Victoria owns a small water right in the irrigation system that it currently applies to a drought refuge on the east side of Gaynor Swamp. The volume of the entitlement and size of the associated infrastructure are too small to fill Gaynor Swamp, but they could potentially be used in the future to replace evaporation or seepage losses in Gaynor Swamp once it has been filled via Cornella Creek. Top up water may be particularly important in helping to prolong inundation in Gaynor Swamp to achieve specific environmental outcomes such as successful waterbird breeding events.

3. Environmental objectives of the structures

3.1 Primary management objectives for Gaynor Swamp and the purpose of the proposed structures

The primary management objective at Gaynor Swamp is *To protect and enhance the flora and associated fauna of Gaynor Swamp* (DPI, 2010).

The objective is to be achieved by addressing the major threats of:

- Loss of native vegetation
- Drought; and
- Inappropriate flood regimes.

The major threat to the environmental values of Gaynor Swamp is an inappropriate flood regime, primarily as a result of prolonged drought and prolonged inundation. The modified flow regime in Gaynor Swamp represents a particular threat to the Southern Cane Grass (*Eragrostis infecunda*) community and Brolga populations that rely on Cane Grass and flooding for successful breeding (GBCMA, 2012).

GBCMA (2012) recommended minimum, optimal and maximum water regimes that need to be delivered to meet various ecological objectives for Gaynor Swamp:

- **Minimum** – Provide one to three flooding events in ten years, filling the wetland to variable depths to maintain EVCs with minimum water requirements to allow existing vegetation to survive.
- **Optimum** – Provide five to seven flooding events in ten years, filling the wetland to variable depths to provide EVCs with appropriate watering requirements, allow the regeneration and recruitment of species within the wetland body and encourage breeding opportunities for aquatic fauna.
- **Maximum** – Provide an annual flooding event over a ten year period, filling the wetland to variable depths to encourage growth of EVCs or breeding opportunities for aquatic biota.

The proposed structures have been designed to allow the GBCMA to use an Environmental Water Allocation (EWA) to deliver some or all of these water regimes and to improve the environmental condition of Gaynor Swamp. The structures will enable the EWA to be transferred to Gaynor Swamp from the WMC via Cornella Creek. G-MW can release the EWA from the WMC directly into Cornella Creek via existing infrastructure at Colbinabbin.

The structures will allow Gaynor Swamp to be filled to a maximum level of 105.0 m AHD. Gaynor Swamp has a relatively flat base and steeper edges. Filling the swamp to 105.0 m AHD will inundate approximately 150 Ha[1] of the Swamp to a depth of approximately 0.5 m. The volume, frequency and timing of environmental water delivery can be varied to meet specific watering needs and vary the level of inundation and regulators can be closed once Gaynor Swamp has filled to control the duration of inundation. The inundation duration is likely to be particularly important for breeding waterbirds that may abandon their nests if the Swamp drains before they have successfully fledged their chicks.

The proposed structures have been designed to primarily meet the environmental water requirements of Gaynor Swamp and the operating rules outlined in this report are based on that objective. However, the structures may also be used to control the water regime and improve environmental outcomes in Cornella Creek.

[1] The volume and area of water impounded by the proposed structures was estimated from historical plans (produced by Keel and Drape when the irrigation district was developed) during the initial design for the first isolation structure at Gaynors Swamp. The estimates were subsequently checked and verified against data from two transects that G-MW surveyed across Gaynor Swamp in 2002. Two sets of LiDAR data have been produced for the area in the last five years, but the first data set only covers part of Gaynor Swamp and the second data set was produced when Gaynor Swamp was inundated to 105.3 m AHD. LiDAR cannot 'see' through water and therefore the most recent data set provides no information about the shape or elevation of the bed of Gaynor Swamp. In order to confirm the specific area that will be inundated, we recommend that the GBCMA monitor inundation extent and depth in Gaynor Swamp during the first environmental flow delivery events, or undertake field bathymetric studies prior to construction or flow release.

3.2 Diversion of natural events to Gaynor Swamp

Cornella Creek is a naturally ephemeral creek, but it can carry high flows as a result of heavy rainfall in its catchment. High flows in Cornella Creek currently flow directly into Lake Cooper and will only water Gaynor Swamp (which has a higher bed level than Cornella Creek and Lake Cooper) if water levels in Lake Cooper are high. The proposed new regulators will potentially enable some natural flow events in Cornella Creek to be diverted into Gaynor Swamp.

In order to divert natural flow events to Gaynor Swamp, the proposed regulator at the northern end of Cornella Creek will need to be partially or fully closed when Cornella Creek is flowing or when a high flow event is expected. If the natural event is higher than expected, there is a risk that the regulator will impede flow in Cornella Creek and therefore cause minor flooding or adjacent land. This risk is considered small for two reasons. First, the landscape is very flat and therefore water levels in Cornella Creek are not likely to rise so fast that the regulator cannot be opened in time. Second, even if the regulator remains closed, the slow velocity floodwaters are likely to overtop the structure and flow into Lake Cooper before they can cause significant flooding on private land adjacent to Cornella Creek. Nevertheless, there is little hydraulic data to accurately predict the behaviour of natural flood flows in Cornella Creek and therefore if the proposed regulating structures are used to divert some natural flows to Gaynor Swamp, we recommend that water levels should be intensively monitored during the event and that operational staff be available to open the regulator if needed.

3.3 Water savings associated with using the proposed structures to water Gaynor Swamp

Gaynor Swamp cannot currently be filled without filling Lake Cooper. This would not be seriously considered as it is contrary to the broader objectives of the surface drainage strategy which aims to alleviate salinity and flooding issues caused by elevated water levels in Lake Cooper. Nevertheless comparing the volume of water that would be needed to fill Lake Cooper and then Gaynor Swamp provides a measure of the water savings, and therefore value, that the proposed structures offer.

As already discussed, the proposed structures aim to fill Gaynor Swamp to a level of 105.0 m AHD. If the proposed structures are not built then the only way that Gaynor Swamp could be filled to that level would be by filling Lake Cooper to 105.0 m AHD as well. Without accounting for transmission losses, it takes approximately 26 GL to fill Lake Cooper, Cornella Creek and Gaynor Swamp to 105.0 m AHD from empty. Lake Cooper needs to hold approximately 19 GL of water before any flow would back into Gaynor Swamp, and an additional 7 GL would be needed to fill the whole system to the target level. At its target level of 105.0 m AHD, Gaynor Swamp will hold approximately 1 GL of water. The proposed regulators will allow Gaynor Swamp and Cornella Creek to be filled to 105.0 m from dry with only 2.1 GL of water not allowing for losses. Even allowing for losses through seepage or evaporation, it should only take approximately 3 GL to fill a completely dry Cornella Creek and Gaynor Swamp to the target level.

It is unlikely that Lake Cooper will be completely dry when the GBCMA wants to water Gaynor Swamp and therefore it would probably take less than 26 GL to fill it and Gaynor Swamp to the target level. However, given environmental water is only being directed to Gaynor Swamp, it is very inefficient and not practical to use environmental water to first fill Lake Cooper. Environmental water is scarce and using anywhere between 10 and 26 GL of environmental water to water Gaynor Swamp cannot be justified given the other environmental water needs in the Goulburn Broken CMA region. Moreover, there is not enough spare capacity in the WMC to deliver anywhere near 26 GL of environmental water to Gaynor Swamp. The proposed regulators provide a practical means to achieve environmental watering objectives in Gaynor Swamp.

3.4 Potential environmental benefits in Cornella Creek

Cornella Creek previously held water for long periods, sometimes several years at a time. Work to lower the average level in Lake Cooper, combined with periods of drought means Cornella Creek is now dry most of the time and many of the values that relied on prolonged or near permanent inundation have been lost or degraded. The proposed regulating structures have the capability to increase the depth and duration of inundation in Cornella Creek, which may in turn deliver other environmental benefits. In particular, the structures and associated environmental water delivery will help maintain permanent or semi-permanent pools in the creek that may provide a refuge for native fish such as Southern Pygmy Perch. Much of Cornella Creek has also been fenced to exclude sheep and cattle. Some fenced areas near Clarkes Bridge Road are set aside as a streamside reserve that has benefited from active re-vegetation and natural vegetation recruitment. Inundating the riparian and in-channel vegetation at an appropriate frequency and season is likely to improve their condition and further enhance their environmental value.

Permanent or near permanent pools could be developed and maintained in Cornella Creek by partially closing the gates of the proposed regulating structure at the northern end of Cornella Creek for long periods to hold environmental water and natural flows. If the gates are fully closed, then the regulating structure could pond water in Cornella Creek as far upstream as Clarkes Bridge Road, a distance of 4.6 river kilometres. The bed of Cornella Creek upstream of Clarkes Bridge Road is higher than 105.0 m AHD and therefore water levels upstream of the road will not be affected. If water in Cornella Creek is held at the full supply level of the proposed regulators then water will back up to Clarkes Road Bridge and the depth immediately downstream of Clarkes Road Bridge will be approximately 0.1 m. It is not advisable to hold the water at this level for extended periods, because it will probably promote uncontrolled *Typha* growth that could choke the channel and reduce its environmental values. A more likely option would be to operate the regulator gates between 104.0 m and 104.5 m AHD, which would hold water in Cornella Creek for between 1.7 km and 3.5 km upstream of the regulating structure. The water level could be held at 104.0 m AHD by closing just the bottom leaves of the regulator gates. At 104.0 m AHD, water depth in Cornella Creek would vary between zero and 0.9 m.

The regulators will allow the GBCMA to inundate sections of Cornella Creek independently of Lake Cooper and if necessary without filling Gaynor Swamp. This could deliver some environmental benefits when water is scarce and could maximise environmental outcomes associated with natural streamflows that would otherwise flow into Lake Cooper where they would have little effect.

4. Proposed operating guidelines

4.1 Overview

The proposed operating procedures to deliver an Environmental Water Allocation to Gaynor Swamp are described below. At this stage the project will be evaluated on the benefits associated with delivering only the EWA, although as discussed already, the structures may also be used to deliver natural flows to Gaynor Swamp. Specific operating rules to manage natural flow events are not described in detail here.

There are a number of constraints to structure operation and EWA delivery. These include flooding private land, inundating the public road at Clarkes Bridge Road and spare capacity in the WMC. Each of these constraints are discussed at the end of this chapter.

4.2 Annual Environmental Water Planning Cycle

The GBCMA has to complete an environmental water plan for all of the waterways that are likely to receive environmental water. The planning cycle has two phases:

- Planning phase
- Delivery phase

Planning Phase

The GBCMA will recommend environmental water allocations for Gaynor Swamp in the Annual Watering Plans they submit to the Victorian Environmental Water Holder (VEWH). In some years provision may be made to fill Gaynor Swamp, in other years the allocation will be zero to allow it to dry out.

The specific objectives for the season may vary depending on the available environmental entitlement, what that environmental entitlement is likely to achieve in Gaynor Swamp compared to other assets throughout the GBMCA region, the broader environmental objectives for the season, and the time since Gaynor Swamp was last inundated. As an example the planned operations for Gaynor Swamp in any given year could be constrained by the following:

- There may be insufficient environmental water to fill the swamp from dry, therefore the recommendation may be to only deliver water to supplement a natural filling event.
- Scheduled channel maintenance may prevent environmental water delivery for a period during winter.

The GBCMA is responsible for developing Seasonal Watering Proposals for all of the waterways and wetlands it wishes to deliver environmental water to including Gaynor Swamp. It submits these proposals to the VEWH in April each year. The VEWH reviews all of the watering proposals across Victoria and then issues approved Seasonal Watering Plans that define the environmental water allocation that will go to each managed waterway. The GBCMA is likely to consult with G-MW, the VEWH and Parks Victoria to help decide how much environmental water to request for Gaynor Swamp in their Seasonal Watering Proposal.

Delivery Phase

The specific timing and application of the EWA is managed throughout the season and may vary depending on:

- The extent or absence of natural watering events
- Spare capacity in the irrigation channel to deliver and EWA
- Available water
- The commencement of a Brolga breeding event

Typical scenarios for the delivering some or all of the EWA to Gaynor Swamp in a given year may include:

- Filling the swamp on the back of a natural event that has inundated Cornella Creek so that water lost to infiltration in transit is reduced
- Filling of the swamp on the back of a natural event or events that have partially inundated Gaynor Swamp
- Topping up Gaynor Swamp in order to sustain a Brolga breeding event
- Filling, or partially filling the swamp to alleviate drought conditions

4.3 Roles and Responsibilities

The GBCMA will be responsible for managing the environmental water allocation to Gaynor Swamp. However, specific roles and the organisations responsible for operating and maintaining the regulators has not been determined.

The organisation responsible for operating the proposed structures should have adequately skilled staff and resources that are available to monitor water levels in Cornella Creek, Gaynor Swamp and Lake Cooper and adjust the structures when they are being used. Several agencies are likely to be involved in the water allocation planning phase and a subset of those organisations will most likely be responsible for the operational phase. Table 4.1 lists the organisations that are likely to be involved in the planning and operation phases.

Table 4.1 : Roles and responsibilities of organisations involved in planning environmental water delivery and operating the proposed structures. These roles and responsibilities are only indicative and will need to be agreed before the structures are built.

Agency	Comment	Planning Phase	Operation Phase
GBCMA	Agency responsible for managing the watering event	Yes	Responsible for ordering the watering event Monitor weather and stream flow conditions Monitor ecological conditions Monitor groundwater and salinity
G-MW		Yes	Advise on channel availability Operate outlet structure at Colbinabbin Monitor weather and streamflow conditions Monitor groundwater and salinity
VEWH		Yes	No
Parks Victoria		Yes	Assist with monitoring ecological conditions
Operating Agency	Agency responsible for physical operation	Yes	Operate the structure during watering events. Monitor water levels and manipulate gates Maintain the structure at other times
Advisory Group – GBMCA, Parks Victoria, G-MW, community and interest groups		Yes	No

4.4 Proposed operations to deliver an EWA to Gaynor Swamp

The operational objective when delivering an EWA to Gaynor Swamp is to fill the swamp to the target level as quickly as possible, then close the isolation bank structures to retain this water in the swamp and open the gates in the regulator at the northern end of Cornella Creek to allow Cornella Creek to drain into Lake Cooper. In some cases the regulator at the northern end of Cornella Creek may remain partially closed to meet secondary objectives of retaining water in Cornella Creek. The following task description applies to the first scenario where Cornella Creek is drained immediately after Gaynor Swamp has been filled to its target level. The tasks are separated into three phases: pre-delivery, delivery, and post-delivery.

Pre-delivery tasks

Prior to delivering an EWA, appropriately skilled staff should inspect the regulators and flow paths to ensure the flows can reach the swamp. Specific tasks may be done at any time in the weeks leading up to the release and include:

- Inspect the Colbinabbin outlet from the WMC;
- Inspect the regulator at the northern end of Cornella Creek and at Gaynor Swamp to ensure the gates are operable and the surrounding embankments and isolation banks are sound;
- Inspect and if necessary clear all culverts (especially the culverts under Clarkes Bridge Road) and other potential flow barriers in Cornella Creek;
- Install flood warning signs on Clarkes Bridge Road to warn drivers that there may be water across the road;
- Check, install, set or calibrate any water level monitoring equipment that is needed to track the EWA and to warn of any potential flood risks.

Delivery tasks

The delivery phase involves numerous sequential tasks to check the EWA can be delivered, there is a low risk of flooding and to open and close regulators at appropriate times to ensure the water reaches the target areas. These are described below.

- GBCMA to confirm with G-MW there is sufficient capacity in the WMC to deliver the EWA over the planned delivery period. The GBCMA does not have a ‘delivery share’ on the WMC and therefore environmental water delivery cannot take precedence over irrigation commitments.
- Confirm that there is a window of clear weather with a low probability of a storm event in the catchment over the delivery period that could flood private land if the regulating structures are closed.
- Order the water delivery from GMW, which will be released into Cornella Creek at Colbinabbin. The flow should ramp up from zero to peak release of 300 ML/day (see Section 4.9 for discussion of proposed release rates) over 3-4 hours. This rate of rise is consistent with the natural rate of rise in the Creek, which during events typically will rise at a rate in excess of 100 ML/day per hour, and reach a peak within 24 hours.
- Close the regulator at the northern end of Cornella Creek. The regulator will need to be fully closed to inundate Gaynor Swamp to 105.0 m AHD, but may be partially closed in years that have a lower target water level. The regulator at the northern end of Cornella Creek must be closed before the EWA release from the WMC reaches it.
- Open the gates on both Isolation bank structures at Gaynor Swamp. Normally this would be done in conjunction with closing the regulator at Cornella Creek if Gaynor Swamp is dry. If there is already some water in Gaynor Swamp, the regulators in the isolation bay will need to be opened when the water level in Cornella Creek is the same as the water level in Gaynor Swamp.
- Continue to monitor the gates in each regulating structure, water levels and weather projections over the period of the delivery. If necessary, adjust the regulator gates and/or flow delivery order to achieve the target water levels in Cornella Creek and Gaynor Swamp and to manage flood risks. Specific adjustments may need to be made in response to:
  - Faster or slower filling than predicted
  - Forecast weather conditions
  - Available channel capacity
- At the end of the filling event, releases from the WMC should be ramped down over two days to allow fish and other aquatic biota that have dispersed throughout Cornella Creek to move to refuge habitats. The low gradient of Cornella Creek means water levels will drop over more than two days as the water from the

WMC travels downstream. This is generally consistent with natural hydrograph behaviour which would typically ramp down steeply from a peak over two days to a flow of approx. 50 ML/day or less then taper off more gently.

Post delivery tasks

Once the target water level in Gaynor Swamp is reached, the normal operation will be to allow it to draw down through natural seepage and evaporation and to drain Cornella Creek. The following tasks should be completed:

- Close the gates on both structures in the isolation bank between Gaynor Swamp and Cornella Creek.
- Adjust the gates in the regulator at Willoughby Road to lower the water in Cornella Creek to an agreed level:
  - The default procedure will be to drain Cornella Creek into Lake Cooper by gradually opening the gates to their full open position.
  - If there are resources in place to continue monitoring and operating the structure then the structure may be used to retain water in Cornella Creek. Specific operating rules to retain water in Cornella Creek have not been developed and would need to be determined on a case-by-case basis.

4.5 Operation to divert natural events to Gaynor Swamp and retain water in Cornella Creek

The proposed operating structures have been designed to deliver EWA from the WMC to Gaynor Swamp. However, they could also be used to pool water from natural flow events in Cornella Creek, divert natural flow events from Cornella Creek to Gaynor Swamp or hold local run-off in Gaynor Swamp. Using natural events to fill Gaynor Swamp, or releasing environmental water to piggy back on the tail of natural events has the following benefits:

- Completely filling Gaynor Swamp with a natural flow event will save up to 3 GL of environmental water that can be used at other sites.
- Using environmental water to piggy back a natural event will also save environmental water because the natural event would have already saturated the bed of Cornella Creek and possibly wet the bed of Gaynor Swamp, thereby reducing transfer losses associated with the environmental flow releases
- Irrigation demand will be low when rainfall is high and therefore there will be plenty of capacity in the WMC to carry and deliver the EWA.
- Inundation of Gaynor Swamp would coincide with moderate to good flow and rainfall throughout the catchment and therefore important ecological cues or triggers would be present in the landscape. These cues are likely to mean that more plants and animals will respond to Gaynor Swamp filling and therefore increase the environmental outcomes associated with the watering event.

Diverting natural flow events from Cornella Creek into Gaynor Swamp will require close monitoring of flow rates in Cornella Creek at Colbinabbin (gauge 405230), hydrological models that can predict likely flow peaks, and staff who are available to open or close regulator gates to respond to changing conditions. The two main issues are the extent to which the natural flows will meet the environmental water needs of Gaynor Swamp and Cornella Creek and the risk that regulators will flood private land if they are used to hold up high flows in Cornella Creek.

The ability to use and respond to natural flow events will be improved by installing telemetering equipment at gauging station 405230 (Cornella Creek @ Colbinabbin) and installing a new telemetered water level gauge in Cornella Creek at Gaynor Swamp. A SCADA system that allows an operator to remotely control the gates in the Cornella Creek and Gaynor Swamp regulators would make it easier to take advantage of natural flow events. However, we do not recommend automating the structures because they will be used very infrequently and the cost of installation and ongoing maintenance, need for a power supply and risk of vandalism are too high.

4.6 Topping up Gaynor Swamp

It is anticipated that once filled Gaynor Swamp would draw down through evaporation and seepage. However, if the rate of evaporation or seepage is high, there may be a need to top up Gaynor Swamp to ensure the inundation event lasts long enough to meet particular environmental objectives such as successful waterbird breeding. There are likely to be substantial losses associated with draining and then re-filling Cornella Creek in the same season and therefore if top up water is likely to be needed, it will be best to either retain some water in Cornella Creek or find an alternative means of delivering environmental water to Gaynor Swamp. The GBCMA will need to include any water that it is likely to need to top up Gaynor Swamp in its Seasonal Watering Proposal and it would need to be approved in the VEWH's Seasonal Watering Plan.

The preferred method to top up Gaynor Swamp is to use the G-MW Central Goulburn No 16 channel system which runs along Darrigans Road, close to the east boundary of Gaynor Swamp. The irrigation channel is too small to fill Gaynor Swamp (G-MW, 2010), but may have enough capacity to deliver top up flows to replace water that has been lost through evaporation and seepage. The No 16 Channel already has a 300 mm diameter outlet pipe that drains directly to Gaynor Swamp. That outlet is likely to be too small to deliver enough water to top up Gaynor Swamp when needed and therefore new infrastructure may be needed to increase the outlet capacity and to measure the rate of flow. Further work is needed to determine how viable this option is and whether there is sufficient capacity in the irrigation channel to carry the required environmental allocation.

Another option may be to pump water from Cornella Creek or Lake Cooper into Gaynor Swamp. It is likely to be cheaper to pump water from Cornella Creek than from Lake Cooper. However, if pumping is likely to be needed, it will probably be best use the regulator on Cornella Creek to retain some of the original EWA in the creek near Gaynor Swamp. The benefit of this option is that it will not require a second EWA and may also provide some environmental benefit to Cornella Creek.

More detailed investigations are needed to determine how much water is likely to be lost from Gaynor Swamp after each filling event, how often and how much top up water is likely to be needed to meet the environmental water objectives, and which of the three watering options described here is likely to be most practical and effective.

4.7 Nature of Flooding Issues and its effect on operation

There is a risk of causing nuisance inundation and in some cases overtopping nearby farm levees (flooding) if the structure is closed during high natural flows in Cornella Creek. The proposed structure at the northern end of Cornella Creek is designed to pass all flow in the creek with negligible effect on upstream water levels, when the gates are fully open. The regulator will overtop when water levels in Cornella Creek exceed 105.15 m AHD. If those high flows have a low velocity then they will most likely pass straight over the structure without flooding private land upstream of Willoughby Road, even if the gates are fully closed. However, if high flows in Cornella Creek have high velocity, then the regulator may retard flow enough to flood low lying land adjacent to Cornella Creek or Gaynor Swamp.

Gaynor Swamp will spill along its natural flow path over Darrigans Road to the east when water levels exceed 105.55 m AHD and Cornella Creek will spill over farm levees and flood private properties along its western boundary when water levels exceed 106.0 m AHD. These levels are higher than the crest of the structure that is proposed for the northern end of Cornella Creek. However, the levees and Gaynor Swamp have overtopped during previous flood events, partly due to the existing hydraulic constriction in Cornella Creek at Willoughby Road.

The proposed structure at the northern end of Cornella Creek has a similar hydraulic capacity as the existing channel when its gates are open, but for economic reasons has not been oversized. The structure will not exacerbate the flood risk when its gates are fully open. There may be limited pedestrian access to the regulating structures during very high flows and therefore it is recommended that the gates be left open when they are not intentionally being used to direct water into Gaynor Swamp or hold water in Cornella Creek.

Recommended gate operations for the proposed structure at the northern end of Cornella Creek are presented in Table 4.2

Table 4.2 : Recommended operating procedures for the proposed regulator at the northern end of Cornella Creek

Lake Cooper Level	Management Objective	Gate Operation	Comment
above 105.0	Pond water in Cornella Creek at Lake Cooper level	Fully open	Gates would never be closed in this condition
<105.0	Pond water in Cornella Creek at Lake Cooper level	Fully open	It is recommend that after filling Gaynor Swamp, Cornella Creek is dropped to a lower level to improve passage of floods
<105.0	Pond water in Cornella Creek at a level higher than Lake Cooper	Set gates to match the Cornella Creek Level, but no higher than an agreed level.	The maximum level at which the gates can be set is to be determined taking into account the available operation resources. An absolute maximum of 104.5 is tentatively recommended.
Low	Dry the creek	Fully open	
Low	Divert EWA to Gaynor Swamp	Closed	See section 4.4
Low	Divert natural events to Gaynor; or Maintain a pool in Cornella Creek	Set to an agreed level and monitor intensively	Monitor the weather and be prepared to either lower the pool or open the regulator if high Cornella Creek flows are forecast

4.8 Operator access and safety considerations

The gates on both of the proposed structures need to be raised and lowered manually. Therefore field staff need access under a range of flow conditions. The regulator at the northern end of Cornella Creek has good road access via Willoughby Road which approaches from high ground to the south. The isolation structure between Gaynor Swamp and Cornella Creek has average road and forest track access via Gaynor Swamp.

The crest of the regulator at the northern end of Cornella Creek is designed to overflow on the south side and it will not be safe to access the gates from this direction when it is overflowing. The structure will still be accessible from the northern bank during high flows and a high level footbridge has been included in the design for this purpose. The northern bank can be accessed through higher ground across the isolation bar at Gaynor Swamp, or through private property north east of Darrigan Road. Depending on track conditions at the time, it may be necessary to walk part of the way to the regulating structure. The operating procedures described in this report aim to minimise the need to access either structure during natural high flow events by leaving the gates fully open most of the time.

4.9 Timing of Environmental Releases

Environmental flow releases to Gaynor Swamp can only be made when there is low irrigation demand because the GBCMA doesn't have any capacity share in the WMC and should avoid periods when heavy rainfall is forecast to reduce the risk of flooding private property.

Hydraulic modelling conducted as part of this project estimates that it will take 7-8 days to fill Gaynor Swamp to a target level of 105.0 m using environmental water from the WMC via Cornella Creek. This estimate is based on a daily release of approximately 300 ML/day from the WMC. The actual duration and rate will vary depending on antecedent conditions such as bed moisture levels, and will need to be refined by monitoring natural events or the first few managed flows. It is preferable to fill Gaynor Swamp as quickly as possible to avoid the risk of unexpected storm and high flow events. The seven day filling period is suggested because it is the maximum reliable forward estimate of weather conditions issued by the Bureau of Meteorology. Once the watering event starts, and further predictions of weather and irrigation demand become available, the daily delivery rate could be adjusted, and the duration of the EWA event extended.

4.10 Clarkes Bridge Road

Clarkes Bridge Road is the only road crossing of Cornella Creek between Colbinabbin and Lake Cooper. The crossing consists of two banks of box culverts, and a ford, which would overtop at high flows. Hydraulic modelling suggests that the capacity at this point is in the order of 1000 ML/d. The EWA flow is expected to be in the order of 300 ML/day and therefore should easily pass through the existing culverts. The culverts may become blocked with debris, particularly if Cornella Creek has not had any significant flow for a long period and therefore we recommend that they are inspected and if necessary cleared before any environmental water is released.

The environmental water release may carry additional debris down Cornella Creek, which could block one or more of the culverts. If that does happen, Cornella Creek is likely to spill across Clarkes Bridge Road. The low point on the road is designed to flood under high flow events. It should be safe to drive across the ford if environmental flows do overtop the culverts. However, it will be necessary to erect appropriate warning signs and advise council during planned environmental flow releases to alert drivers that water is over the road and therefore a potential driving hazard. This will be particularly important if there has not been heavy rain in other parts of the catchment as drivers would not expect the creek to have high flow.

5. Social and economic issues

5.1 Flooding Risks

There is likely to be some community concern that the proposed new regulating structures and delivery of environmental water will increase the frequency of nuisance flooding from Gaynor Swamp or Cornella Creek. As discussed in Section 4.7, the structures will have the same hydraulic capacity as the existing channel when the gates are fully open. Therefore as long as the gates are fully open except for the short periods when they are specifically being used to divert environmental water, they should not increase the current flood risk to private property.

5.2 Effect on Lake Cooper water levels and recreational values

Lake Cooper is used for water skiing and recreational angling. Water skiing is the activity most affected by water levels in Lake Cooper. Hydro Technology (1993) adopted a water level or 104.60 m AHD as the criterion for water skiing in Lake Cooper. They emphasised that:

> *even under existing conditions the probability of low lake levels is high. While recent experience [in 1993] has been appreciably better than this, longer term records provide many instances of sequences of drier years when lake levels would have remained low for long periods (Hydro Technology, 1993).*

Delivering environmental water to Gaynor Swamp will not reduce water levels in Lake Cooper and may raise it slightly if Cornella Creek is allowed to drain into Lake Cooper at the end of the environmental water release. Lake Cooper has a much larger surface area than Cornella Creek and so surplus water from Cornella Creek will have a relatively small effect on water levels in Lake Cooper. We anticipate that a 200 ML outfall from Cornella Creek will raise water levels in Lake Cooper by 1-2 cm.

Using the proposed structure in Cornella Creek to divert natural flows into Gaynor Swamp is more likely to reduce water levels in Lake Cooper and could be perceived to impact on water skiing activities. When the water level in Gaynor Swamp is at 105.0 m AHD, it will hold approximately 1 GL of water. If that volume was allowed to flow through to Lake Cooper instead of Gaynor Swamp, it would raise the water level in Lake Cooper by approximately 5-10 cm. An increase of that magnitude will only influence water skiing if the lake at the time is very close to the threshold of 104.60 m AHD. We note that when the water level in Lake Cooper is at the threshold of 104.60 m AHD, the deepest parts of Gaynor Swamp will be inundated by approximately 10 cm.

The GBCMA is currently planning to use the proposed structures to deliver only environmental water to Gaynor Swamp. Lake Cooper would not normally or deliberately receive environmental water and therefore delivering environmental water to Gaynor Swamp will not reduce and may slightly increase water levels in Lake Cooper. If the GBCMA decide to use the proposed structures to deliver natural flows to Gaynor Swamp then there are some circumstances when that action may affect water skiing activities in Lake Cooper. The impact will only be important in years when the water level in Lake Cooper is close to the minimum threshold required for safe water skiing. It will be up to the GBCMA to consult with affected stakeholders to determine the circumstances under which they could divert natural flows to Gaynor Swamp.

5.3 Concern that more frequent watering in Gaynor Swamp will raise salinity levels in the region

During the mid 1990's shallow saline water tables and surface expression of salt were a major concern in the region. During the Millennium Drought and in the years since the drought, water table levels across Victoria and in the vicinity of Gaynor Swamp dropped and recharge rates fell (see Section 5.3.1 for further discussion and plots of groundwater levels). As a consequence, surface expressions of salt and the risks associated with saline groundwater reduced. Local landowners are aware of the mechanisms that lead to salinity problems and may be concerned that delivering environmental water to Gaynor Swamp and Cornella Creek will raise underlying water tables, and bring saline groundwater (recorded as approximately 20,000 to 30,000 EC in nearby bores) back to the surface.

In order to understand the likely salinity risk associated with more frequent watering in Gaynor Swamp it is important to consider both the regional hydrogeological setting and the temporal variation in groundwater flow across the region and specifically within the Gaynor Swamp and Cornella Creek area.

5.3.1 Hydrogeological Setting

Gaynor Swamp (and Cornella Creek) is located within the Southern Riverine Province of the Murray Basin between the Goulburn and Campaspe deep leads. Gaynor Swamp lies within the Shepparton Formation aquifer, which is an unconfined aquifer overlying the Palaeozoic basement (Cartwright *et al.*, 2007); the Palaeozoic basement outcrops to the west (Mount Camel Ranges) and east of Gaynor Swamp (See Figure 5-1).

Groundwater generally flows away from the Palaeozoic basements outcrops towards the centre of the Murray Basin. Lateral groundwater flow in the Shepparton Formation is generally from the margins of the outcrop to the centre of the Lake Cooper embayment and then to the north or north west (see Figure 5-1).

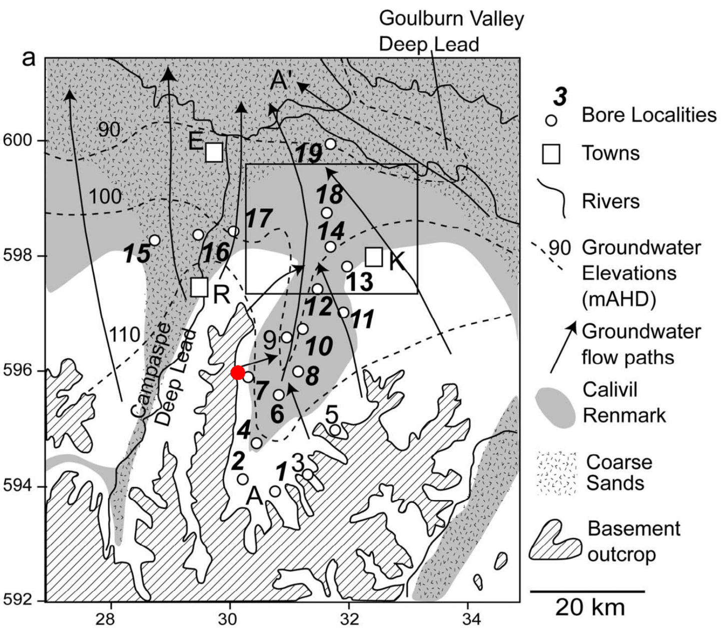

Figure 5-1: Cross section along groundwater flow path in the Lake Cooper area. The red dot shows the approximate location of Gaynor Swamp (Figure reproduced from Cartwright *et al.*, 2007)

In some areas of low topography, geological structures such as faults restrict groundwater flow and force it to discharge to the surface. The same geological structures are associated with the uplifting of the Palaeozoic basement to the west and formation of the Mount Camel Ranges. The Mount Camel Ranges is an area of significant groundwater recharge in the Lake Cooper embayment.

As in other regions of the Murray Basin, natural recharge rates are low (likely to have been <1 mm per year prior to any influence of land clearing), which accounts for the occurrence of high salinity groundwater in the area (Total Dissolved Salts TDS is between 544 and 36 700 mg/L). Groundwater recharge is a key process that affects salt mobilisation and accumulation, when natural recharge rates are low, the transpiration rate of plants often equals the rainfall which results in the build-up of salt that cannot be moved through the system (or flushed from the landscape) and is therefore maintained within the water-table. In general, the groundwater from the Lake Cooper embayment, is distinctly more saline compared to the adjacent Campaspe and Goulburn deep leads where TDS concentrations area generally less than 5,000 mg/L (Cartwright *et al.*, 2007).

The combined effect of land-use changes (e.g. land clearing) that affect recharge, long-term climate change, large-scale irrigation and groundwater abstraction have altered historical groundwater flow regimes throughout the region. In some cases (e.g. modification of drainage system and regulation of surface water for irrigation) this has drained ephemeral swamps and wetlands. In other cases (e.g. land use change that has increased recharge to approximately20 mm per year) it has raised regional water-tables by up to 30 m over the last 200 years. The regional water-table is now generally within 5 m of the surface and locally within 2 - 3m of the surface. This pattern is illustrated in the hydrographs provided in Figure 5-2 and Figure 5-3 for seven bores located in both the Shepparton Formation and the Palaeozoic basement in the vicinity of the Gaynor Swamp. The historical trends shown in the hydrographs are consistent with regional trends, in particular the more recent trends indicating a decline in groundwater level between 2005 and 2010, an increase between 2010 and 2012 and declines since 2012. The location of these bores is shown in Figure 5-4.

Prior to land clearing, transpiration rates by water efficient native vegetation would have been high. This vegetation would have assisted in keeping groundwater levels low, but would have produced groundwater with high salinities. Replacing native vegetation with shallow rooted grasses, which have lower transpiration rates, has caused the water-table to rise. In turn, the higher water tables have facilitated more direct evaporation, and incorporated saline water from the previous unsaturated zone into the saturated zone (Cartwright *et al.*, 2007).

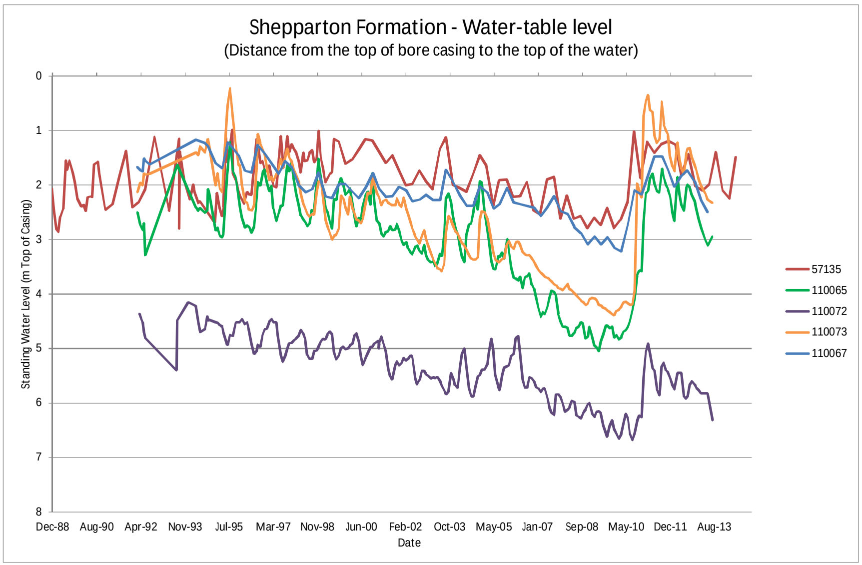

Figure 5-2: Plot of changes in groundwater level from 1988 to 2013 in five active groundwater monitoring bores for the Shepparton Formation in the vicinity of Gaynor Swamp and Cornella creek.

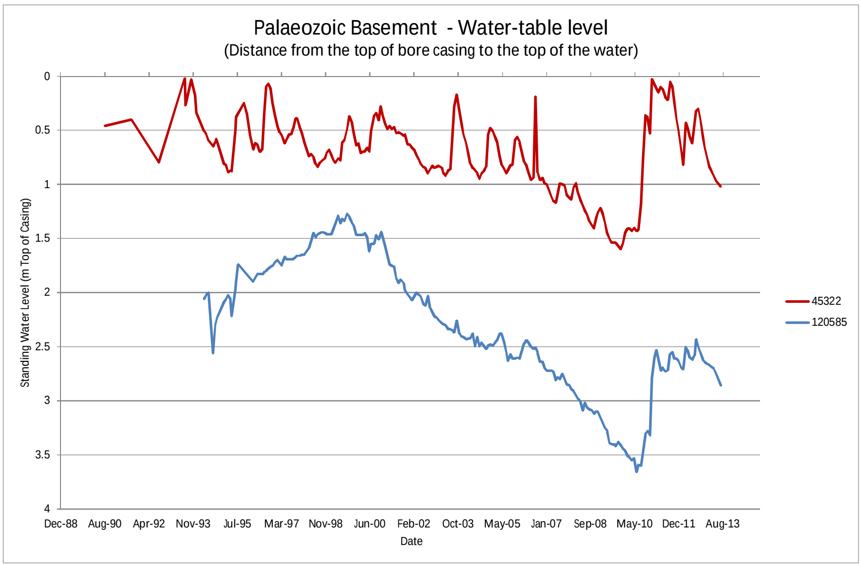

Figure 5-3: Plot of changes in groundwater level from 1988 to 2013 in two active groundwater monitoring bores for the Palaeozoic Basement in the vicinity of Gaynor Swamp and Cornella Creek.

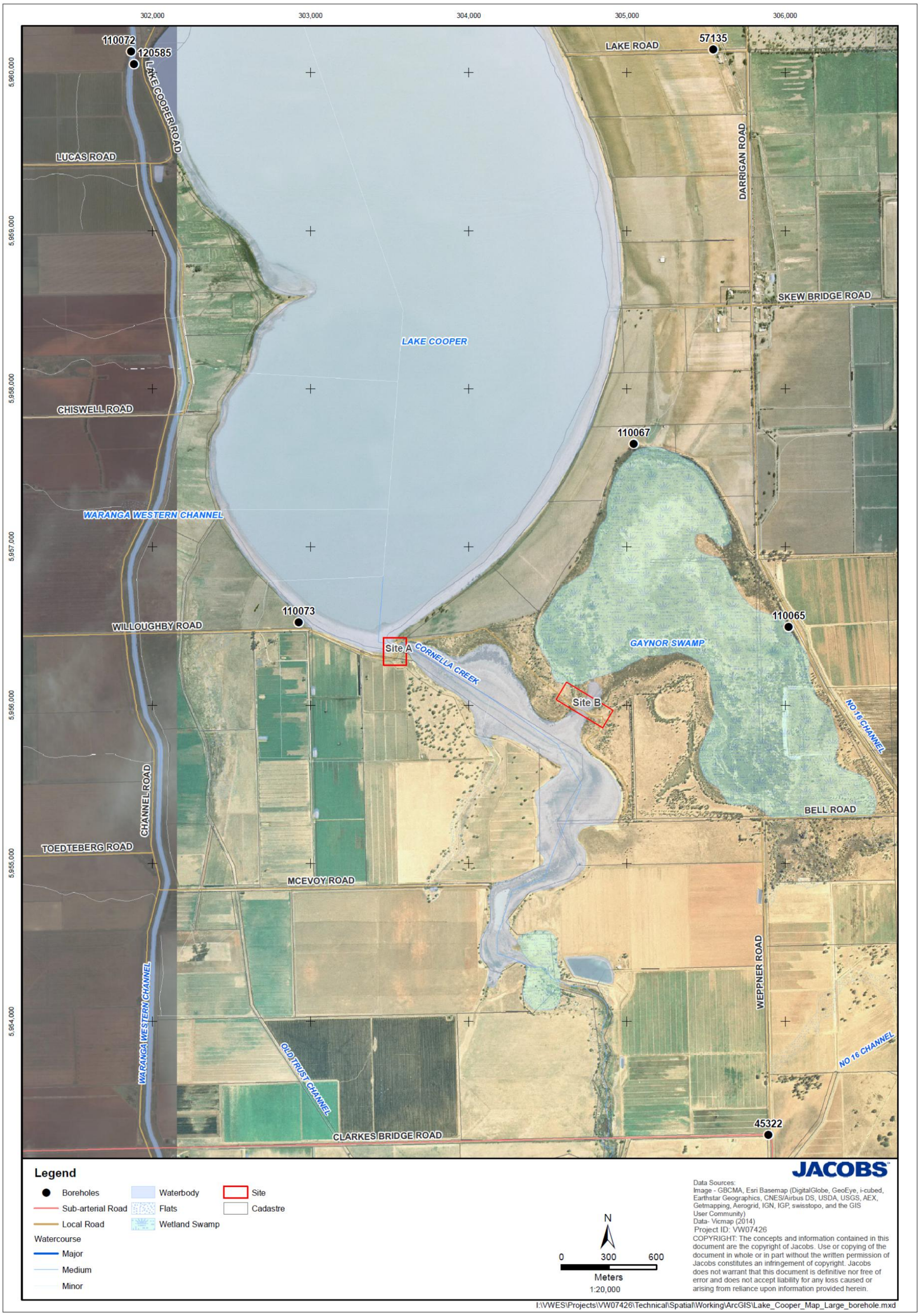

Figure 5-4: Map of the study area showing the location of groundwater monitoring bores. Bore numbers correspond to those listed in Figure 5-2 and Figure 5-3.

5.3.2 Potential salinity risk associated with environmental watering

Gaynor Swamp is located in an area of low depression in the Riverine Province and likely to experience upward pressures of groundwater (as evidenced by presence of artesian bores in the area), and therefore located within a groundwater discharge zone. During periods of high recharge (e.g. increased rainfall periods) when the water-table is close to the surface it is likely that the Swamp would be a connected system, that is, groundwater would discharge to the Swamp. During periods of low recharge (e.g. decreased rainfall periods, droughts) when the water-table is lower, it is likely that the Swamp would be a disconnected system with surface water from Gaynor Swamp, Cornella Creek or Lake Cooper leaking into the underlying aquifer.

The risk that delivering environmental water to Gaynor Swamp will raise the water table and lead to surface expression of salinity potentially differs between periods of high natural recharge and periods of low natural recharge. However, in practice the risk is likely to be low in most circumstances as explained below.

- Delivering environmental water to Gaynor Swamp during periods of high recharge (i.e. during periods of high rainfall when groundwater levels are close to the surface and groundwater discharges to Gaynor Swamp and Cornella Creek) is unlikely to increase the risk of salinity to adjacent land because there will already be surface expression of groundwater and therefore the nature of connection will not change. Any increase in groundwater levels associated with environmental watering will be confined to immediate edge of Gaynor Swamp and Cornella Creek.
- Delivering environmental water to Gaynor Swamp during periods of low recharge (i.e. during periods of low rainfall and drought when groundwater levels are well below the bed of Gaynor Swamp and Cornella Creek) is unlikely to increase surface salinity because the total volume of environmental water that will be delivered (i.e. up to 3 GL) is very small compared to the volume of the underlying aquifer and the area of the unsaturated zone. While some of the environmental water will leak into the underlying aquifer, the volume is likely to be too small to significantly influence groundwater levels.

Our assessment of the likely salinity risk associated with environmental watering of Gaynor Swamp is based on limited data. We recommend that groundwater levels and groundwater salinity should be monitored before, during and after any planned environmental water releases to Gaynor Swamp or Cornella Creek to confirm that the water releases do not significantly affect either parameter. As a minimum, data from the existing Goulburn Murray Water monitoring bores near Gaynor Swamp and Cornella Creek (see Figure 5-4) should be collected and analysed to quickly identify any significant changes to groundwater level and water quality. This surveillance monitoring will detect any emerging problems early and allow appropriate management strategies to be developed and implemented.

5.4 How will the structures affect G-MW's operation of Lake Cooper

Lake Cooper is a semi-terminal lake. It is not part of G-MW's water supply system, but where possible G-MW does manage water levels in the lake to assist with reducing potential flooding, particularly around Corop. G-MW installed a drain at the northern end of Lake Cooper to link it to Greens Lake as part of its broader surface drainage strategy. The drain provides limited capacity for water from Lake Cooper to flow to Greens Lake and is operated under strict guidelines that relate to water levels in Greens Lake and salinity levels of water transferred from Greens Lake back to the WMC. Water from Lake Cooper can only be transferred to Greens Lake if it does not impact on the primary purpose of Greens Lake or cause flooding in that area.

The proposed structures and the EWA will have no significant effect on the way Lake Cooper is operated. The Cornella Creek regulator will be transparent to flows when fully opened, and as such should be identical to the existing situation when Lake Cooper levels are high. The isolation bank culverts increase the hydraulic capacity between Lake Cooper and its natural flood outlet though Gaynor Swamp, which is unlikely to result in any change to the way G-MW manages water levels in Lake Cooper.

Cornella Creek and Gaynor Swamp are effectively part of the whole Lake Cooper system, therefore the proposed structures will have no effect on the natural inflows entering the system. At most the structures will influence where natural inflows are stored and potentially the rate at which those inflows evaporate. The application of the EWA will increase the volume of water in the system, but environmental water will most likely be delivered when the system is relatively dry and therefore the extra water should not affect G-MWs operation of Lake Cooper. If the EWA contributes excess water on some occasions, it can be removed via the link drain to Greens Lake.

6. Environmental impacts associated with construction

The proposed works are designed to improve the water regime in Gaynor Swamp to achieve specific environmental objectives such as improving the quality and quantity of native wetland vegetation including Cane Grass and improving habitat and breeding opportunities for waterbirds, especially Brolga. The environmental objectives for Gaynor Swamp are described fully by GBCMA (2012). The proposed structures may also be used to maintain pools and associated fish, macroinvertebrates and aquatic vegetation in Cornella Creek as described in Section 3. This chapter focuses on potential environmental impacts associated with construction works, which mainly relate to the potential damage of terrestrial flora and fauna.

Jacobs undertook a qualitative site inspection on 5th February 2014 and a desktop review of relevant environmental databases to assess the likely environmental impacts associated with the construction and operation of the proposed regulators at the northern end of Cornella Creek and in the isolation bank between Gaynor Swamp and Cornella Creek. This section summarises the outcome of that assessment. A more detailed assessment is provided in Appendix A.

6.1 Potential impacts at site A – Regulator at the northern end of Cornella Creek

The site of the proposed structure at the northern end of Cornella Creek is dominated by a Brackish Sedgeland vegetation community and terrestrial weeds. The only significant plants identified were a single mature River Red Gum (*Eucalyptus camaldulensis*) and a single Branching Groundsell (*Senecio cunninghamii var. cunninghamii*), which is considered rare in Victoria. Both the River Red Gum and the Branching Groundsell were on the north east bank of Cornella Creek. They are not in the direct footprint of the proposed regulator and it should be possible to conduct all works away from these plants to avoid damaging them.

The GBCMA will need to obtain a permit to remove other native vegetation from the site during construction. However, that vegetation comprises mainly common species such as Variable Flat-sedge (*Cyperus diformis*), Spiny Flat-sedge (*C. Gymnocaulis*) and Common Reed (*Phragmites australis*). Moreover, the selected site for the proposed regulator is at a natural constriction in Cornella Creek, which means the structure and its associated embankments need to span only a short distance. The total area of vegetation that will be disturbed by the works is therefore much less than it would be if the structure had to span a wider section of the channel.

6.2 Potential impacts at site B – Regulator in the isolation bank between Gaynor Swamp and Cornella Creek

The vegetation on and near the isolation bank between Gaynor Swamp and Cornella Creek is more diverse than the vegetation at site A. The floor of Gaynor Swamp and Cornella Creek immediately adjacent to the isolation bar support Cane Grass (*Eragrostis infecunda*) and the higher elevation areas support a Plains Grassy Woodland community. River Red Gum of various ages grows around the edge of Gaynor Swamp. The isolation bar has a sparse cover of predominantly non-native vegetation and some River Red Gum saplings.

The proposed works will disturb some vegetation in the area, and we recommend the works footprint, including storage and vehicle turnaround areas should be on the floor of the wetland and close to the isolation bank. Restricting the works area to the floor of the wetland will disturb some patches of Cane Grass that are currently in moderate to poor condition, but will avoid the Plains Grassy Woodland community, which are in better condition. Moreover, any areas of Cane Grass that are damaged by the works are likely to recover after it has been inundated with environmental water. The GBCMA will need to apply for a permit to remove native vegetation in the works area, but the overall impact is low and the site should recover after one or more environmental watering events.

The access track to the site will need to be graded and raised in places to cope with the construction traffic and some of the branches along the track will need to be lopped. These works are part of routine track maintenance and will not require any permits.

The site is likely to support significant fauna, particularly breeding waterbirds and frogs, when Gaynor Swamp is full. No significant fauna species were observed during the site inspection and as long as the works are completed when Gaynor Swamp and Cornella Creek are dry, they should not affect individual animals. Birds such as Brolga rely on Cane Grass habitat, but even if the Cane Grass that is disturbed by the construction works does not recover during the first watering event, the area of disturbance is so small compared to the total area of Cane Grass in Gaynor Swamp that it should have no effect on fauna.

6.3 Summary of environmental issues

Based on our preliminary site inspection and desktop review we conclude that as long as the disturbance restricted to the works footprints described in this report, the proposed works are not likely to affect any Matters of National Significance and should not trigger the Commonwealth EPBC Act of the Victorian FFG Act. The GBCMA will need to apply to the Department of Environment and Primary Industries (DEPI) for a permit to remove native vegetation at both of the proposed regulator sites. However, the total area of native vegetation cleared is likely to be less than 1.0 Ha and therefore the works will be classified as a low risk. The GBCMA will need to establish a native vegetation offset to compensate for the vegetation that is likely to be damaged. Such offsets are often established away from the proposed development site. In this case, we recommend the GBCMA ask DEPI to consider the likely improvement to native vegetation across all of Gaynor Swamp due to the proposed environmental water delivery as an equivalent offset and therefore avoid the need to create a separate offset site. The proposed works are not expected to have any lasting negative effects on native fauna.

6.4 Next steps

This environmental assessment was based on a qualitative site inspection by a trained botanist in the middle of summer. We did not identify any plants of state or national significance. We do however recommend that the GBCMA commission more quantitative vegetation assessment of the proposed works sites in spring in the year before construction is due to commence to confirm that no significant species are likely to be disturbed. If those surveys identify significant species, the GBCMA may need to modify the proposed works footprint to avoid damage or else apply for a permit under the relevant State or Commonwealth Act to remove the listed plants.

The GBCMA will need to apply to the Shire of Campaspe for a planning permit to remove native vegetation. We do not envisage any impediments to the Shire granting the permit. Permits to remove native vegetation are usually valid for two years from their issue date, therefore the GBCMA should apply for the permit once it has confirmed when works are likely to commence.

Finally, the GBCMA will need to develop an environmental management plan for the project that details the steps and procedures that will be applied to minimise impacts on environmental values. The plan should include weed management protocols and measures such as fencing off areas to be protected and appropriate training and site inductions for people working on the site to ensure the projects are limited to those identified in the planning permit application.

7. Planning and statutory approvals needed for the project

The planning approvals required for the proposed structures are determined by the *Victorian Planning and Environment Act 1987*. The Act requires every municipal council has a planning scheme to provide sound, strategic and co-ordinated planning decisions.

Gaynor Swamp and Cornella Creek are located in the Shire of Campaspe and therefore the proposed works will be subject to the provisions of the Campaspe Planning Scheme. The proposed regulators are classified as a utility installation under that scheme. Both structures will be built on land classified as 'Farming Zone', and are subject to a 'Floodway Overlay'. The structure at the northern end of Cornella Creek is also in a 'Public Conservation and Resource Zone'. The project must comply with the requirements of these zones and overlays. Under the Campaspe Planning Scheme, planning approval will be needed for 'use and building and works (including earth works) in these zones and areas affected by the Floodway Overlay. The GBCMA will also need planning approval to 'remove, destroy or lop any native vegetation throughout the project area' under Clause 52.17 'Native Vegetation' of the Campaspe Planning Scheme.

The GBCMA will need to apply to the Campaspe Shire for a Planning Permit for the proposed works. There is policy support for the type of works that are proposed here in the State Planning Policy Framework. Moreover, the GBCMA is the main authority that needs to approve works in waterways and wetlands in the project area. As such the Campaspe Shire is likely to issue the required Planning Permit, subject to conditions.

Depending on specific values identified at the site the GBCMA may need to seek approval for the project under several other types of legislation. These may include:

- The development of a Cultural Heritage Management Plan (CHMP) to comply with the *Aboriginal Heritage Act 2006*. We note the proposed works are within an Area of Aboriginal Cultural Heritage Sensitivity and understand that the GBCMA is currently assessing the potential impact of the project on cultural heritage values.
- Consent to build works within a road reserve (Willoughby Road) under the *Road Management Act 2004*.
- A permit to remove listed species under the *Flora and Fauna Guarantee Act 1988*, if subsequent surveys identify any listed species (note we did not find any listed species in our preliminary assessment; see Section 6).
- A works on waterways permit under the *Water Act 1989.*
- Approval for works within the Lake Cooper and Gaynor Swamp Wildlife Reserve under the *Land Act 1958* and/or *Crown Land (Reserves) Act 1978*.

A more detailed review of the relevant approvals needed for the project is provided in Appendix B.

8. References

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GBCMA (2012) Gaynor Swamp Environmental Water Management Plan. Goulburn Broken Catchment Management Authority, Shepparton, Victoria.

Hydro Technology (1993) Shepparton Irrigation Area Land and Water Salinity Management Plan - Corop Lakes surface drainage strategy Vol. Unpublished Report Number 1993/56. Rural Water Corporation, Tatura.

SKM (2013) Gaynor's Swamp Wetland Regulator - Design: Detailed Design Report. Sinclair Knight Merz report prepared for the Goulburn Broken Catchment Management Authority, Tatura, Victoria.

Appendix A. Preliminary environmental assessment for proposed structures

This memo outlines the potential approvals related to terrestrial ecology for the works required to upgrade the regulator at the entrance to Gaynor Swamp and to construct a new regulator in Cornella Creek immediately upstream of Lake Cooper. This project aims to provide the means by which flows into Gaynor Swamp can be controlled to maintain and enhance the ecological values of the site (GBCMA 2012). The works will include constructing a new regulator at the northern end of Cornella Creek, just upstream of the outlet to Lake Cooper (Site A) and new culverts with regulating gates to supplement the existing regulator in the isolation bank between Gaynor Swamp and Cornella Creek (Site B).

In summary, a permit to remove native vegetation will be required as it is unlikely that works to construct the required structures within Site B in particular will not affect any native vegetation. There is significant capacity, however, to minimise potential impacts by following the recommendations in this report. Further investigations will be required closer to the time of construction once the exact construction footprints have been determined, in order to inform the required planning permit application.

A.1 Method

The information in this report is based on databases and spatial layers maintained by the Victorian Department of Environment and Primary Industry (DEPI), Commonwealth Department of the Environment (DotE) and a brief field assessment conducted by Dr Drew King (Jacobs Botanist) on 5 February 2014 in the company of Andrew Sharpe (Jacobs Project Manager) Neville Paynter (Jacobs Engineer and designer of Gaynor Swamp Wetland Regulator project) and Simon Casanelia (GBCMA Project Manager). The likely footprint and the construction methods were discussed in the context of potential impacts of the native vegetation present at the site.

A.2 Results

A.2.1 Site A – Regulator at the northern end of Cornella Creek near the outlet to Lake Cooper.

The regulator to be installed at this location will be located at the northern end of Cornella Creek, just upstream of the outlet to Lake Cooper. The vegetation at and adjacent to the proposed construction area comprises a single mature River Red Gum (*Eucalyptus camaldulensis*) tree at the top of the eastern bank of Cornella Creek and Brackish Sedgeland, which formed a 1 to 5 metre wide strip along each bank of Coronella Creek. The Sedgeland flora was dominated by Variable Flat-sedge (*Cyperus diformis*), Spiny Flat-sedge (*Cyperus gymnocaulis*), and emergent Common Reed (*Phragmites australis*). A single Branching Groundsel (*Senecio cunninghamii* var. *cunninghamii*), considered rare in Victoria, was found underneath the River Red Gum tree.

The remainder of the area was dominated by non-native vegetation. Major species included Wild Aster (*Aster subulatus*) which formed a dense thicket on the western bank close to the creek, as well as Bromes (*Bromus catharticus, B. diandrus, B. hordaceous*), Hogweed (*Polygonum aviculare*) and Clustered Dock (*Rumex conglomeratus*) on the upper banks of Cornella Creek. No assessable native vegetation was observed between the top of the east river bank and the road close to the construction site and this area is proposed as a material storage site during construction.[2].

It is unlikely that threatened terrestrial flora species make significant use of the site. Other than the Branching Groundsel, no rare or threatened species were observed. The extent of suitable habitat for semi-aquatic species such as frogs is also limited.

The proposed construction includes a retaining wall and regulator that will be built across the creek close to where an old bridge was located. The timber pylons for the old bridge remain as shown in Figure A 1**Error! Reference source not found.**. Access to the site, from either the west or east banks, should follow existing roads and tracks or cross land that does not support the native vegetation outlined above. Storage of materials,

[2] Assessable native vegetation only occurs when indigenous native species constitute more than 25 % of the vegetation cover, or where mature indigenous canopy trees occur.

turning circles for trucks, and other associated construction works which involve the removal of vegetation should be placed above the banks of Cornella Creek and Lake Cooper as these areas do not support assessable native vegetation. Construction works within the creek to install the required retaining wall and regulator should be done with as minimal impact on vegetation as possible.

The construction of the regulator will involve the removal of Sedge land on the fringes of Cornella Creek and therefore a permit to remove native vegetation will be needed. There is little capacity to avoid native vegetation as it follows the creek to the north and south of the proposed location. Any movement of the site would likely increase the impacts on native vegetation as additional works (construction of retaining wall) would be required to achieve the project aims.

Figure A 1: Photos of proposed regulator site at northern end of Cornella Creek (site A) showing native vegetation on the left bank.

Relevant information for a planning permit to remove native vegetation in Site A is listed below in Table A 1.

Table A 1: Information relevant to native vegetation at Site A

Vegetation type	Strategic Biodiversity Score[3]	Condition Score (modelled)	Risk Pathway
Brackish Sedgeland and single Scattered Tree	0.439	0.590	Low (Location A and less than 1.0 ha of native vegetation to be cleared)

A.2.2 Site B – Cornella Creek – Gaynor Swamp Regulator.

The assessed area for the Gaynor Swamp regulator included the existing retaining wall, which currently houses a regulator, and the low-lying sections of Cornella Creek and Gaynor Swamp that are within 50 m either side of the retaining wall. The retaining wall is made of earth and crushed rock and has a vehicle track along the top (see Figure A 2). The area is listed as a Nationally Important Wetland – *Wallenjoe Swamp*, as is the entire Gaynor Swamp (actual swamp areas only, not the entire reserve).

The retaining wall currently has a sparse cover of predominantly non-native vegetation, including Toowoomba Canary-Grass (*Phalaris aquatica*), Oats (*Avena sp.*) and Barley Grass (*Hordeum sp.*). A number of young River

[3] Values are based on estimated impact areas and may be subject to change following determination of final footprint.

Red Gum saplings are also growing on the retaining wall, but none are sufficiently mature to require further assessment or offsets for their removal.

The low lying sections of Cornella Creek (south of the retaining wall) and Gaynor Swamp (north of the retaining wall) contain some patches of Cane Grass Swamp dominated by Southern Cane Grass (*Eragrostis infecunda*). The Cane Grass patches close to the retaining wall are small (<0.5 ha) and surrounded by non-native grasses and herbs. It is suggested that the ancillary construction areas including access to the regulator be located on low-lying areas near the retaining wall as the surrounding areas outside the inundation zone support Plains Grassy Woodland in better condition than the Cane Grass Swamp. The Cane Grass Swamp is also more likely to regenerate following construction activities and the start of active water management in Gaynor Swamp. Regardless, some native vegetation will need be removed for the proposed construction works. Given the construction will necessarily occur during a dry period to allow for access to the regulator, works can be undertaken in such a manner as to avoid impacts on the ecological values of the site that make it worthy of listing as a Nationally Important Wetland.

The likely construction footprint will involve the removal of some Cane Grass in order to access the regulator being replaced. No threatened species or communities were observed at the time of assessment. There is potential habitat for threatened bird species that are likely to use the wetlands; however, those species are not likely to be affected if construction works occur when the wetland is dry.

Access to the site will be along existing tracks from Site A and/or from the corner of Bell and Weppner Roads to the east. It is likely that the roads will require some works to improve access for trucks and other construction equipment. This will involve at a minimum re-grading the road and lopping some overhanging trees. We do not expect such works will involve the removal of any assessable native vegetation, and are unlikely to require a permit to remove vegetation as they will be considered normal road maintenance works. There is capacity for any turnout points to be located in areas of non-native vegetation, and every effort should be made to do so to avoid unnecessary damage to native vegetation. .

Figure A 2: Photo of the existing regulator and access track along the isolation bank between Gaynor Swamp and Cornella Creek (Site B).

Relevant information for a planning permit to remove native vegetation in Site A is listed in Table A 2.

Table A 2: Information relevant to native vegetation at Site B.

Vegetation type	Strategic Biodiversity Score[4]	Condition Score (modelled)	Risk Pathway
Cane Grass Wetland	0.637	0.650	Low (Location A and less than 1.0 ha of native vegetation to be cleared)

A.3 Summary of potential impacts on terrestrial ecological values

- Removal of Brackish Sedgeland on both banks of Cornella Creek at Site A to allow construction of the regulator;
- Removal of Cane Grass Wetland at Site B to allow for replacement of regulator;
- Based on the extent of native vegetation observed and the likely construction footprint, the project will remove less than 1 ha of native vegetation from each site. This means that the project will be classified as Low risk under the Native Vegetation Permitted Clearing Regulations (less than 1 ha of vegetation removal in Location A);
- No threatened flora species or communities[5] are likely to be impacted by the construction of either regulator, provided the Branching Groundsel in Site A is avoided. This can be achieved by avoiding impacts on the single River Red Gum on the right bank.
- The wetland communities with the potential to be impacted are habitat for a range of bird species that are unlikely to be impacted so long as the construction works are undertaken when the wetlands are dry.
- The ongoing operation of the regulators is unlikely to negatively impact on the extent or condition of native vegetation or threatened species habitat so long as the management aims outlined in the Gaynor Swamp Environmental Water Management Plan 2012 (GBCMA 2012) are maintained. There is the potential for some changes to the extent and location of some ecological values (e.g. gradual change of some wetlands from Cane Grass Wetland to Red Gum Swamp) but such changes are compatible with the project objectives to increase the overall extent of native vegetation and habitat for threatened species.

A.4 Implication of Legislation and Policy

The legislation and policy relating to terrestrial ecology that have the potential to be triggered by the project are listed in Table A 3 below.

Table A 3: Commonwealth and State legislation that may relate to terrestrial ecology values at the project site.

Policy / legislation	Description	Project relevance/ actions required
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act has significant implications for natural resource and environmental management in Australia. This Act provides for the listing of threatened species, threatened ecological communities and key threatening processes. It also relates to actions likely to have a significant impact on matters of National Environmental Significance (NES). There are nine matters of NES: • World heritage properties • National heritage places • Wetlands of international importance (Ramsar Wetlands) • Nationally threatened species and ecological	The project (construction and operation) will not have a significant impact on any Matters of National Environmental Significance so long as construction impacts are limited to the areas specified in this report. The aims of the project are to improve the values of Gaynor Swamp which will improve the habitat for a number of EPBC listed bird species in the area.

[4] Values are based on estimated impact areas and may be subject to change following determination of final footprint.
[5] Listed under the EPBC Act and/or FFG Act

Policy / legislation	Description	Project relevance/ actions required
	communities • Migratory species protected under international agreements • Commonwealth marine areas • Nuclear actions • the Great Barrier Reef Marine Park • A water resource, in relation to coal seam gas development and large coal mining development	
State		
Flora and Fauna Guarantee Act 1988 (FFG Act)	The FFG Act provides a framework for biodiversity conservation in Victoria. Threatened species and communities of flora and fauna, as well as threatening processes, are listed under this Act. A number of non-threatened flora species are also listed as protected under the FFG Act. A Permit to Take is required to remove these species from public land.	No threatened species or communities are likely to be removed as part of the construction or operation of this project. The only protected species noted in the proposed construction area was Branching Groundsel, which should be avoided during construction. A more detailed field assessment is recommended closer to the proposed time of construction to confirm that no FFG listed species will be affected.
Planning and Environment Act 1987	Applications to remove, destroy, or lop native vegetation in Victoria invoke relevant municipal planning schemes and the *Planning and Environment* Act, which are given authority through the Victorian Planning Provisions (VPP). A range of exemptions apply under this Act. Depending on the scale of the native vegetation clearance, statutory referral to the DEPI may be required. Offset requirements for the clearances of native vegetation are determined by the Permitted Clearing Regulations.	The GBCMA will need to apply to the Shire of Campaspe for a planning permit to remove native vegetation to satisfy the requirements of this Act. Permits to remove native vegetation generally expire within 2 years of the issue data and therefore should be requested closer to the commencement of any construction works.
Native Vegetation Permitted Clearing Regulations (DEPI 2013)	The NVPCR regulates the management of native vegetation in Victoria. The NVPCR requires that impacts on native vegetation be avoided and/or minimised wherever possible and offset when unavoidable. The primary goal of the NVMF is to achieve no net loss of native vegetation, where unavoidable losses are offset through the protection and ongoing management of an area proportional to their importance to Victoria's biodiversity. A risk based approach has been developed which defines the assessment required to inform permit applications to remove native vegetation. For projects assessed as being of **Low** risk, the information requirements are minimal and can be based on existing data. Threatened species habitat does not need to be considered. For projects assessed as being of **Moderate** and **High** risk, the information requirements to inform a planning	The project should be classified as **low** risk so long as the extent of vegetation removal is less than 1.0 ha. General Biodiversity Offsets will be required to offset the removal of native vegetation. These may take the form of off-site offsets and need to be in place prior to the removal of native vegetation. There is potential that the improvements in vegetation extent and quality that the project is aiming to institute may constitute a sufficient offset and this should be discussed with DEPI

Policy / legislation	Description	Project relevance/ actions required
	permit are increased and it is necessary to consider the potential impacts on rare and threatened species.	
Catchment and Land Protection Act 1994 (CaLP Act)	The CaLP Act defines requirements to: ▪ Avoid land degradation; ▪ Conserve soil: ▪ Protect water resources; and ▪ Eradicate and prevent the spread and establishment of noxious weed and pest animal species. The Act defines four categories of noxious weeds: State Prohibited Weeds, Regionally Prohibited Weeds, Regionally Controlled Weeds and Restricted Weeds. Noxious weeds species and the category they are placed in is specific to individual CMA regions.	Noxious weeds (Spear Thistle) are present at both sites. Appropriate management to prevent the spread of weeds will be required during construction phase of this project.
Wildlife Act 1975	The Wildlife Act establishes procedures for the protection and conservation of wildlife; the prevention of wildlife becoming extinct; and the sustainable use of and access to wildlife and to prohibit and regulate the conduct of persons engaged in activities concerning wildlife.	As no trees or active fauna habitat is proposed to be removed, no handling of fauna is likely to be required and no permits required under the Wildlife Act.

A.5 Next Steps

- Refine the likely footprint for construction of the two regulators including site access requirements, laydown areas and material storage areas. Access should be along existing tracks to each site and the footprint for construction should be kept as small as possible to avoid impacts on native vegetation. The River Red Gum on the right bank of Cornella Creek within Site A should be avoided.
- Apply for a planning permit to remove native vegetation. This can be based on existing modelled data or a field assessment. A field assessment is recommended as the extent and quality of vegetation is overestimated in the modelled data.
- If necessary, apply for a permit to remove protected flora under the FFG Act. The presence of any FFG Act protected flora species should be determined through field assessment closer to the time of construction and can be undertaken in conjunction with the above requirements.
- Develop an environmental management plan for the project which details steps and procedures to be applied which will minimise the impact of the project on environmental values. This should include the following items:
  - Weed management protocols to limit the spread of noxious and environmental weeds present at the site.
  - Measures to ensure that the project impacts are limited to those identified in the planning permit application. This should include temporary fencing of native vegetation and relevant environmental training for construction personnelas part of routine site inductions.

Appendix B. Desktop review of relevant planning approval requirements

B.1 Introduction

Goulburn Broken Catchment Management Authority (GBCMA) engaged Jacobs to undertake a desktop planning assessment of the Gaynor Swamp Structures project (the project).

The project will involve constructing two regulating structures to deliver environmental water to Gaynor Swamp. The regulating structures are:

- Site A - a regulator at the northern end of Cornella Creek near the outlet to Lake Cooper; and
- Site B - a structure through the existing isolating embankment between Cornella Creek and Gaynor Swamp.

This preliminary planning assessment considers local planning controls contained within the Campaspe Planning Scheme.

The planning assessment includes the following components:

- Review of zones, overlays and other provisions of the Campapse Planning Scheme for the two sites;
- Determination of the statutory approval requirements under the Campaspe Planning Scheme; and
- Other legislation relevant to the project.

B.2 Planning Approvals Context

This section summarises the planning policy framework and planning controls relevant to the project. The documents that provide the planning context for the project are:

- *Planning and Environment Act 1987*
- *Campapse Planning Scheme*

B.2.1 Planning and Environment Act 1987

The *Planning and Environment Act 1987* governs the use and development of land in Victoria and provides the statutory framework to ensure planning decisions are fair, orderly, economic and sustainable. The Act requires that every municipal council has a planning scheme to implement the objectives of planning in Victoria and provide sound, strategic and coordinated planning decisions.

B.2.2 Planning Schemes

The project area and all relevant reticulation areas are located within the Shire of Campaspe and is subject to the provisions of the Campaspe Planning Scheme.

Pursuant to Clause 74 of the Campaspe Planning Scheme, the project can be defined as a ‘utility installation’, being

> *“Land used:*
>
> *a) for telecommunications;*
>
> *b) to transmit or distribute gas, oil, or power;*
>
> ***c) to collect, treat, transmit, store, or distribute water;*** *or*

d) to collect, treat, or dispose of storm or flood water, sewage, or sullage.

It includes any associated flow measurement device or a structure to gauge waterway."

B.2.2.1 State and Local Planning Policy Frameworks

The State and Local Planning Policy Framework provides the strategic contact for the proposal. The State Planning Policy Framework (SPPF) contains the overarching state level policies that apply across Victoria. At a local level, each Planning Scheme contains a Local Planning Policy Framework (LPPF), which contains content specific to each municipality. It includes a Municipal Strategic Statement (MSS) which establishes the strategic planning directions for a municipality and Local Planning Policies which guide decision making processes.

State Planning Policy Framework

The following clauses are applicable to the Project:

Clause 12.01 'Biodiversity' seeks to "*to assist the protection and conservation of Victoria's biodiversity, including important habitat for Victoria's flora and fauna and other strategically valuable biodiversity sites."*

Clause 14.02-1 'Catchment planning and management' is particularly relevant to this project. The objective of this Clause is "*to assist the protection and, where possible, restoration of catchments, waterways, water bodies, groundwater, and the marine environment."*

Local Planning Policy Framework

The following local planning policy is applicable to the Project:

- Clause 21.02- Key Influences
- Clause 21.03 – Vision Statement
- Clause 21.04-2 – Environment

B.2.2.2 Zones, Overlays and Particular Provisions

The Campapse Planning Scheme sets out the relevant planning controls which determine whether planning approval is required for the use and/or development of land which forms part of this project. These controls include zones, overlays and particular and general provisions.

Table B 1 outlines the zones, overlays and particular and general provisions which apply within the Campaspe Planning Scheme and identifies whether approval is required. Figure B 1 and Figure B 2 show the location of the zones and overlays within this area.

Table B 1: Planning provisions and approval requirements within the Campaspe Planning Scheme

Zone, Overlay or Provision	Planning Approval Requirements	
	Site A – proposed new structure at Willoughby Road	*Site B – Proposed modification to existing structure at inlet to Gaynor Swamp*
Zones		
Farming Zone (FZ)	✓ Planning approval is required for use and buildings and works (including earthworks).	✓ Planning approval not required for use as the project will not change the use, as the site is currently used as a 'utility installation'. Planning approval is required for buildings and works (including earthworks).
Public Conservation and Resource Zone (PCRZ)	✓ Planning approval is required for use and development.	NA
Overlays		
Floodway Overlay (FO)	✓ Planning approval is required for buildings and works.	✓ Planning approval is required for buildings and works.
Particular and General Provisions		
Clause 52.17 Native Vegetation	Planning approval will be required to remove, destroy or lop any native vegetation throughout the project area. [6]	

In summary, planning approval from the Shire of Campaspe will be required for:

- Use, buildings and works, and to remove, destroy, or lop native vegetation at Site A.
- Use, buildings and works (including earthworks), and to remove, destroy, or lop native vegetation at Site B.

[6] Some exemptions apply. The size, location and type of any vegetation proposed to be impacted is required to confirm whether approval is required.

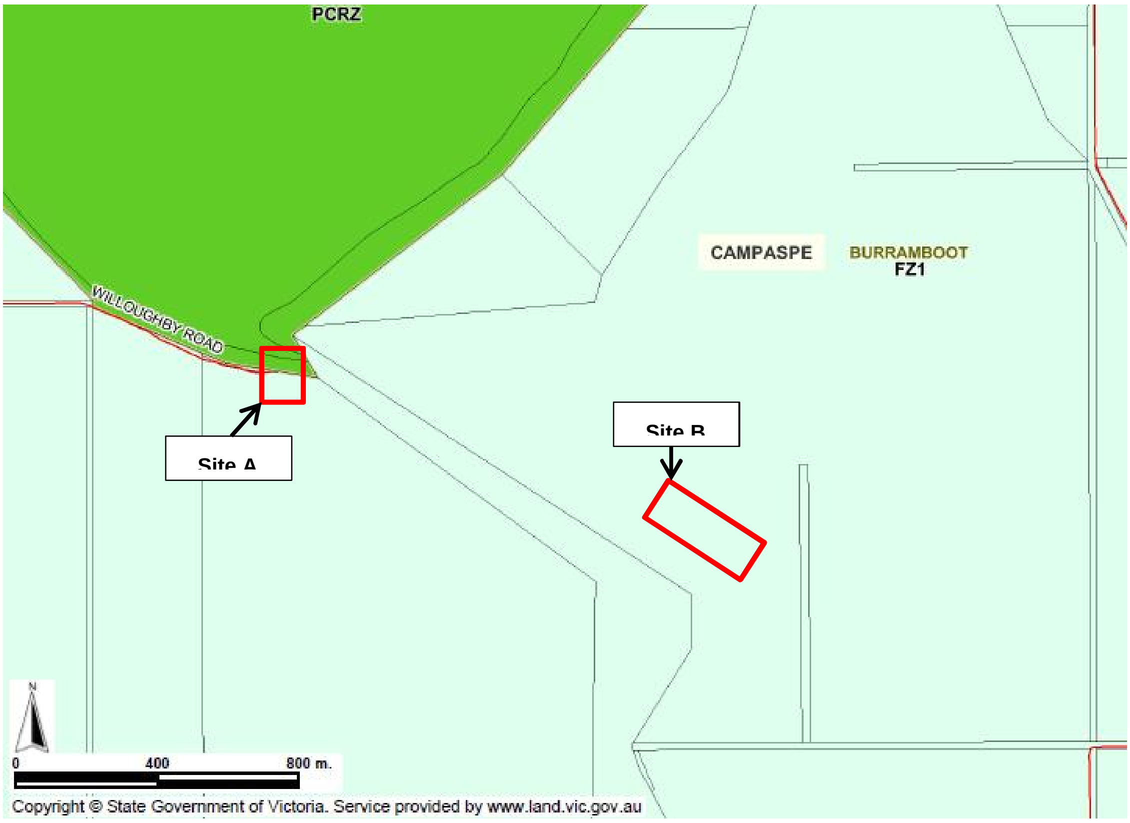

Figure B 1: Map of the proposed works areas showing distribution of Farming Zone (FZ – shaded in light green) and Public Conservation and Resource Zone (PCRZ – shaded in dark green).

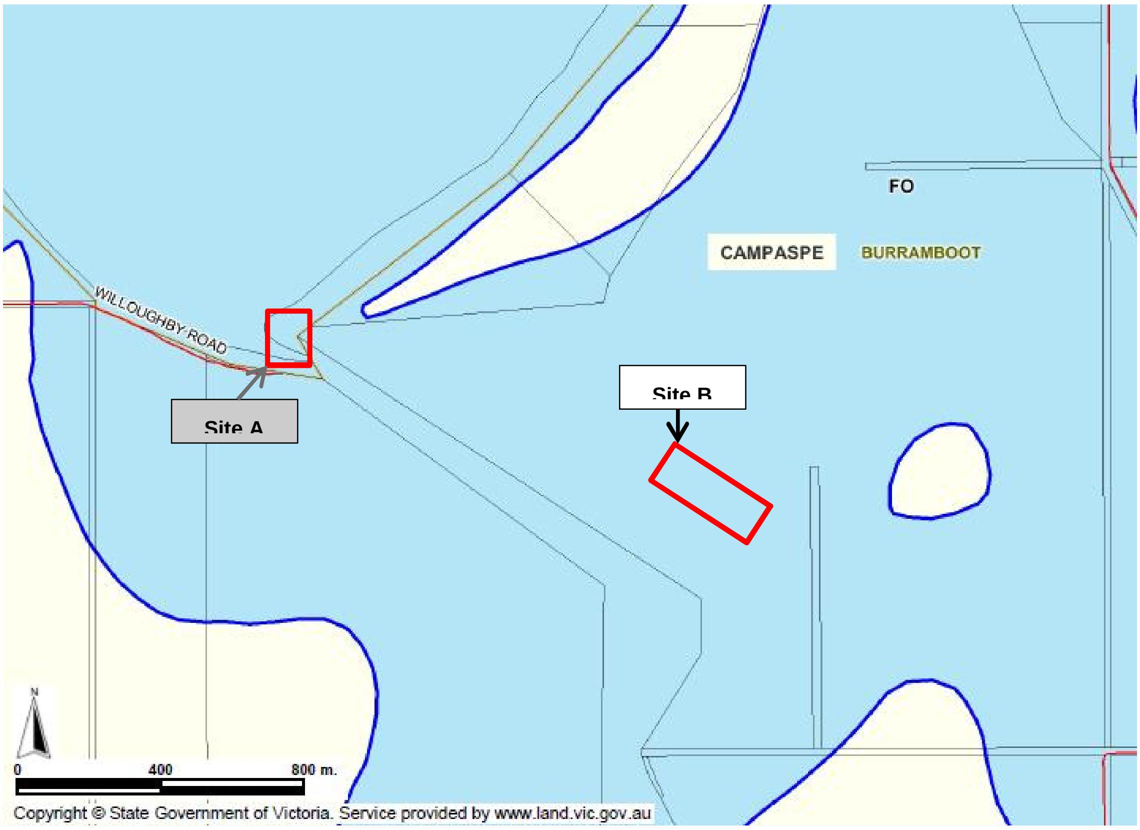

Figure B 2: Map of the proposed works areas showing distribution of designated Floodway Overlays (shaded in blue).

B.2.3 Planning Approval Process

It is recommended that planning approval is sought from the Shire of Campaspe via a planning permit. A planning permit application will require the following supporting documents:

- Application Form
- Application Fee (based on a cost of works)
- Full, current copy of title information
- A plan of the existing conditions
- Plans showing the layout and details of the proposal (including any proposed native vegetation removal)
- A description of the likely effect of the proposal on traffic, any waterways and environmental impacts (where relevant)

Additionally, the planning application will involve the following:

- A planning application must be signed by the owner of the land or include a declaration by the applicant that the owner / public land manager has been notified about the application.
- There is a statutory 60 day period within which decisions on applications should be made. However, the 60 day period can be stopped and started at a number of times throughout the process by requests for further information, statutory referrals (e.g. DEPI for native vegetation removal and / or GBCMA within the FO) and 3rd party notification.
- Notification of the application and receipt of any objections may delay the decision making process, while any escalation of the planning application to the Victorian Civil and Administrative Tribunal (VCAT) may affect delivery of the project. Council may notify any person or party who they consider may potentially suffer from material detriment as a result of the planning application. If objections are received, a Notice of Decision to Grant a Permit (NOD) must first be issued before a planning permit can be granted. A NOD allows objectors 21 days to appeal to VCAT regarding the intended decision.[7] Pursuant to section 149 of the *Planning and Environment Act 1987*, the proponent may apply to the VCAT for the review of any conditions included on the approved planning permit within 28 days of the issue of the permit.
- The use of the site for a Utility Installation is not prohibited in the FZ and PCRZ and there is policy support of this type of development in the SPPF. As such, there is opportunity for the Shire of Campaspe to issue a planning permit for the project, subject to conditions.
- However, it must be understood that approval is subject to the satisfaction of the Shire of Campaspe that the application and project meets the requirements set out in the Campaspe Planning Scheme. This will include demonstrating that the project is consistent with the purpose and objectives of the planning provisions, as well as relevant State and local planning policy. Additionally, comments from the statutory referral authorities (e.g. DEPI or GBCMA) may influence the decision.
- It is recommended that the Shire of Campaspe and referral authorities be consulted early in the projects development to ensure that the approval requirements are met and that any conditions imposed on a planning permit are implementable by GBCMA.

B.3 Other Legislation

In addition to the planning approval requirements, the following legislation may apply to the development works or occupation of land associated with the project.

Approvals may be required under more than one piece of legislation and approval granted under one Act, may not exempt approval requirements under another.

[7] Consideration of a matter referred to VCAT could take a further 4 – 6 months. There is no guarantee that a permit will be approved.

- Confirmation should be sought if a Cultural Heritage Management Plan (CHMP) is required under the *Aboriginal Heritage Act 2006* as the works are within an Area of Aboriginal Cultural Heritage Sensitivity. A planning permit cannot be issued until a CHMP is approved.
- Buildings and works within a road reserve (Willoughbry Road) will necessitate consent from the Shire of Campaspe pursuant to the *Road Management Act 2004*.
- A permit under the *Flora and Fauna Guarantee Act 1988* may be required to remove listed species on public land.
- A works on waterways permit under the *Water Act 1989* is likely to be required for works on, or near, Lake Cooper (Site A) and Cornella Creek (Site B).
- Confirmation should be sought on the process for approval for works within the Lake Cooper (Site A) and Gaynor Swamp Wildlife Reserve (Site B) under the *Land Act 1958* and/or *Crown Land (Reserves) Act 1978* from Department of Environment and Primary Industries (DEPI), and the public land managers (Goulburn-Murray Water and Parks Victoria).

B.4 Conclusion and Recommendations

The project triggers the requirement for planning approval pursuant to the Farming Zone, Public Conservation and Resource Zone, Floodway Overlay and Clause 52.17 Native Vegetation. A planning permit should be sought from the Shire of Campaspe.

In addition to the requirements of the *Planning and Environment Act 1987*, confirmation should be sought as to the requirements under the *Aboriginal Heritage Act 2006, Road Management Act 2004, Water Act 1989, Land Act 1958 / Crown Land (Reserves) Act 1978*, and the *Flora and Fauna Guarantee Act 1988.*

Appendix C. Estimated costs for constructing the proposed structures

The following construction costs were estimated by SKM (2013) when they developed detailed designs for the proposed structures. The costs have been reproduced here for completeness.

It is likely that unit rates will vary considerably between this estimate and when the project is implemented. There have been some price escalations since the cost estimate was produced, which have not been incorporated in the estimates. It is recommended that the cost estimate is updated when the works closer to implementation.

C.1 Cost summary

The construction costs for the two structures are estimated as follows:

- Willoughby Road Regulator - $749,000
- Isolation bank Culvert - $245,000

The unit rates used to formulate the cost estimates were obtained from a range of sources including:

- Previous NVIRP projects for reinforced concrete works
- AWMA – for gate estimate
- Various quarries
- J Steel – for sheet piles
- Rawlinsons 2011

All estimates are exclusive of GST. A detailed breakdown of the costs is provided below.

C.2 Contingencies

A contingency of 15% has been allowed on top of the direct construction cost.

C.3 Cost Exclusions

The following items are not included in the cost estimate:

- Further design or document preparation
- Cultural Heritage management
- Environmental management
- Survey
- Investigations into salinity effects
- Public consultation

GAYNORS SWAMP WETLAND REGULATOR - DETAILED DESIGN COST ESTIMATE

Willoughby Road Regulator

Engineers Estimate

Date: 11-Jul-13

Item	Description of work	Quantity	Unit	Rate	Amount ($)	Subtotal ($)
1	SITE ESTABLISHMENT / MOBILISATION TO SITE					
	Permits, Insurances, OH&S Plans, EMS Plan etc	1	Item	5,000.00	5,000.00	
	Site Mobilisation, Temporary Facilities	1	Item	7,500.00	7,500.00	
	Demobilisation	1	Item	2,500.00	2,500.00	
						$15,000
2	DEMOLITION					
	Remove old bridge structure	1	Item	3,000.00	3,000.00	$3,000
3	EARTHWORKS					
	Clearing of site and stockpile unsuitable material on site	1	Item	2,000	2,000.00	
	Foundation Earthworks and set out	1	Item	4,800	4,800.00	
	Upstream Approach Earthworks - Cut and store nearby	1	Item	12,500	12,500.00	
	Downstream departure Bed Earthworks - Cut and store nearby	1	Item	5,000.00	5,000.00	
	Lower banks	1	Item	2,000.00	2,000.00	
	Structure Backfill	200	cum	20.00	4,000.00	
	Access Track and hard stand	1500	sqm	10.00	15,000.00	
						$45,300
4	SHEET PILING					
	upstream sheet pile cut off	90	sqm	280.00	25,200.00	
	downstream sheet pile weir	61	sqm	280.00	17,080.00	
						$42,280
5	STRUCTURE					
	Blinding concrete	5	cum	300.00	1,500.00	
	Reinforced Concrete Floor and Foundations	47	cum	2,500.00	117,500.00	
	Reinforced Concrete Walls and Piers	24	cum	4,500.00	108,000.00	
	Reinforced concrete cap to sheet pile	10	cum	1,000.00	9,720.00	
	Reinforced concrete paving crest to weir	2	cum	1,000.00	2,025.00	
	Reinforced concrete bridge abutment	1	Item	4,500.00	2,250.00	
	Reinforced concrete Cast in place peirs	7	m	115.50	808.50	
						$241,804
6	BEACHING AND FILTERS					
	Geotextile	1075	sqm	10.00	10,750.00	
	Zone 2A Sand Filter - Supply	39	cum	100.00	3,900.00	
	Zone 2A Sand Filter - Place	39	cum	25.00	975.00	
	Zone 2B Gravel Filter - Supply	3	cum	80.00	240.00	
	Zone 2B Gravel Filter -Place	3	cum	25.00	75.00	
	Drain Pipes - supply and place	25	m	60.00	1,500.00	
	Beaching supply	908	tonne	23	20,893.20	
	Beaching place	908	tonne	10	9,084.00	
						$47,417
7	FRAMES/GATES					
	2100 wide x 2000 high split leaf	7	No	21,600.00	151,200.00	
	Gate Installation	1	Item	4,000.00	4,000.00	
	Portable Actuator	1	No	4,000.00	4,000.00	
						$159,200
8	METALWORK					
	Operationing Platform walkway - Supply	1	Item	13,500	13,500.00	
	Operationing Platform walkway - Install	1	Item	1,000	1,000.00	
	Handrails	26	m	85.00	2,210.00	
	Precast concrete bridge beam supply	10	sqm	191	1,914.00	
	Precast concrete bridge beam install	1	Item	1,500	1,500.00	
	Walkways install	1	Item	1,000	1,000.00	
	Supplyand Install steps	1	m	3,537	3,536.50	
						$24,661
9	POWER AND ELECTRICAL					
	Nil		NA			
	It is assumed gates ar manually operated, there is not lighting, power or monitoring		NA			
10	SITE CLEAN UP					
	Site Clean Up	1	Item	7,500.00	7,500.00	$7,500
1	ADDITIONAL COSTS					
	nil					
	DIRECT COST (DC)					$586,161
	Contingencies			15% of DC		$87,924
	Total Construction Cost					$674,085
	Aurthority Overheads			10% of CC		$67,409
	Environmental Management					$7,000
	TOTAL COST					$748,494

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GAYNORS SWAMP WETLAND REGULATOR - DETAILED DESIGN COST ESTIMATE

Willoughby Road Regulator

Engineers Estimate

Date: 11-Jul-13

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