REFERRAL OF A PROJECT FOR A DECISION ON THE NEED FOR ASSESSMENT UNDER THE *ENVIRONMENT EFFECTS ACT 1978*

REFERRAL FORM

The *Environment Effects Act 1978* provides that where proposed works may have a significant effect on the environment, either a proponent or a decision-maker may refer these works (or project) to the Minister for Planning for advice as to whether an Environment Effects Statement (EES) is required.

This Referral Form is designed to assist in the provision of relevant information in accordance with the *Ministerial Guidelines for assessment of environmental effects under the Environment Effects Act 1978* (Seventh Edition, 2006). Where a decision-maker is referring a project, they should complete a Referral Form to the best of their ability, recognising that further information may need to be obtained from the proponent.

It will generally be useful for a proponent to discuss the preparation of a Referral with the Impact Assessment Unit (IAU) at the Department of Environment, Land, Water and Planning (DELWP) before submitting the Referral.

If a proponent believes that effective measures to address environmental risks are available, sufficient information could be provided in the Referral to substantiate this view. In contrast, if a proponent considers that further detailed environmental studies will be needed as part of project investigations, a more general description of potential effects and possible mitigation measures in the Referral may suffice.

In completing a Referral Form, the following should occur:

- Mark relevant boxes by changing the font colour of the 'cross' to black and provide additional information and explanation where requested.
- As a minimum, a brief response should be provided for each item in the Referral Form, with a more detailed response provided where the item is of particular relevance. Cross-references to sections or pages in supporting documents should also be provided. Information need only be provided once in the Referral Form, although relevant cross-referencing should be included.
- Responses should honestly reflect the potential for adverse environmental effects. A Referral will only be accepted for processing once IAU is satisfied that it has been completed appropriately.
- Potentially significant effects should be described in sufficient detail for a reasonable conclusion to be drawn on whether the project could pose a significant risk to environmental assets. Responses should include:
    - a brief description of potential changes or risks to environmental assets resulting from the project;
    - available information on the likelihood and significance of such changes;
    - the sources and accuracy of this information, and associated uncertainties.
- Any attachments, maps and supporting reports should be provided in a secure folder with the Referral Form.
- A CD or DVD copy of all documents will be needed, especially if the size of electronic documents may cause email difficulties. **Individual documents should not exceed 2MB as they will be published on the Department's website.**

- A completed form would normally be between 15 and 30 pages in length. Responses should not be constrained by the size of the text boxes provided. Text boxes should be extended to allow for an appropriate level of detail.
- The form should be completed in MS Word and not handwritten.

The party referring a project should submit a covering letter to the Minister for Planning together with a completed Referral Form, attaching supporting reports and other information that may be relevant. This should be sent to:

Postal address

Minister for Planning
GPO Box 2392
MELBOURNE VIC 3001

Couriers

Minister for Planning
Level 20, 1 Spring Street
MELBOURNE VIC 3001

In addition to the submission of the hardcopy to the Minister, separate submission of an electronic copy of the Referral via email to ees.referrals@delwp.vic.gov.au is required. This will assist the timely processing of a referral.

PART 1 PROPONENT DETAILS, PROJECT DESCRIPTION & LOCATION

1. Information on proponent and person making Referral

Name of Proponent:	
Authorised person for proponent: **Position:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Frank Fisseler Project Director, GMW Connections Project PO Box 165, Tatura, VIC 3616 Connections.reception@gmwater.com.au 0358 263 800 **-**
Person who prepared Referral: **Position:** **Organisation:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Pat Feehan Director Feehan Consulting 84 Balaclava Rd, Shepparton VIC 3630 pfeehan@mcmedia.com.au 0437 354 088 **-**
Available industry & environmental expertise: (areas of 'in-house' expertise & consultancy firms engaged for project)	In house skills and expertise: • Project Management • Environmental Management • System Operation • Civil Engineering Organisations that contributed to information used in the preparation of this application: • North Central Catchment Management Authority (NC CMA) for Environment Management • Department of Environment, Land, Water and Planning (DELWP) for Planning advice • URS Corporation for Groundwater Modelling, hydrogeology • GHD for Acid Sulphate Soils assessment • Jacobs for civil engineering, cultural heritage and environmental Management • Rakali Consulting Pty Ltd for Flora Management • Biosis for Fauna Management • RMCG for economics and social assessment and business case preparation • CPS Environmental Research for fish management • Fluvial Systems Pty Ltd for hydraulic modelling

2. Project – brief outline

Project title: **Third Reedy Lake Bypass Project**
Project location: (describe location with AMG coordinates and attach A4/A3 map(s) showing project site or investigation area, as well as its regional and local context) The project proposes to undertake works around Third Reedy Lake, which is a 230 ha freshwater lake, approximately 10 km north west of Kerang, in the Shire of Gannawarra. The site is located at E239706, N2649842. **Attachment A** shows the location of the Lake within its regional and local context.
Short project description (few sentences)**:** The project proposes to manage Third Reedy Lake's water regime by undertaking works and measures to disconnect the lake from the Torrumbarry Irrigation System. The objective is to provide a more natural watering regime to Third Reedy Lake, generating environmental benefits, and reduce current water losses. The water savings will contribute to the overall Goulburn Murray Water Connections (GMW CP) Project Stage 2 water savings target, which will be owned by the Commonwealth Environmental Water Holder and used to improve the health of priority wetlands and waterways.

3. Project description

Aim/objectives of the project (what is its purpose / intended to achieve?):

The Third Reedy Lake Bypass Project is one of the "Special Projects" identified in the Stage Two Business Case for the GMW CP.
The Third Reedy Lake Bypass project aims to

- Enhance the environment of Third Reedy Lake and the associated Ramsar site
- Provide for water savings.

It will achieve this by constructing a bypass channel, disconnecting Third Reedy Lake from the irrigation system, and installing structures to allow environmental watering that more closely resembles its former, natural watering regime. Complementary environmental management actions will be implemented.

The project will result in the wetland periodically drying out and being progressively revegetated with native vegetation, which will provide habitat for native animals and migratory birds.

Water savings will be generated after the environmental water needs of the lake are taken into account.

GMW customers who currently extract water directly from the lakes will be reconnected to the adjacent irrigation system.

Background/rationale of project (describe the context / basis for the proposal, eg. for siting):

The KLBP
The Kerang Lakes Bypass Project (KLBP) is a proposal under Stage 2 of GMW CP, a $1 billion water saving project in northern Victoria's Goulburn Murray Irrigation District (GMID). The GMW CP has sought to identify cost effective and value for money investments to generate water savings and environmental benefits. Several 'special environmental' projects including the KLBP, were included in Stage 2 and these projects provided opportunities for specific environmental and social benefits whilst generally improving the overall efficiency of the irrigation system.

The Stage 2 Business Case listed the benefits of the KLBP as:

- water savings of approximately 3,860 ML LTCE (long term cap equivalent).
- significant environmental benefits to the Kerang Lakes Ramsar Site. If the Kerang Lakes (First Reedy, Middle Reedy and Third Reedy Lake, Little Lake Charm and Racecourse Lake (which includes Bertrams Lake)) are removed from the Torrumbarry Irrigation Area supply system and provided a preferred water regime linked to the historical unregulated flows in the Loddon River, existing high environmental values will be maintained and enhanced.
- Middle Lake which supports a large Ibis colony will be connected to the bypass channel to enable top up water to be provided as needed to support nesting habits and the general well-being of these birds.

Accordingly, GMW CP commissioned a review of the alternative investment options for generating water savings from bypassing lakes in the Kerang Lakes complex.

A comprehensive analysis was completed of a range of options including works at individual lakes and combinations of lakes. This assessed:

- The technical feasibility of constructing bypass infrastructure
- The cost of the infrastructure and other works required
- The water savings that would be generated
- The social and environmental benefits and costs
- Risks and issues associated with the initiative

- Governance and project delivery requirements.

The project business case has been submitted to DELWP and the Commonwealth Department of the Environment. In May 2015 ,GMW CP was advised that:

- The KLBP satisfies the due diligence criteria for State Priority projects. The draft due diligence report recommends the project proceed to seek approvals under Commonwealth and State Government environmental legislation.
- It is expected that identified knowledge gaps and risks associated with the proposed changes will be addressed as part of the environmental approval process (these relate mainly to the potential for emergence of acid sulfate soils and saline groundwater intrusion).
- If the outcomes of the approvals process do not have a material impact on the scope of the project, DELWP and DoE have agreed that the project will proceed.

Kerang Lakes
Third Reedy Lake is part of the Kerang Lakes complex in northern Victoria, which includes over 100 permanent freshwater and saline lagoons, lakes and marshes. The lakes represent an important environmental asset and some are listed under the Ramsar Convention on Wetlands of International Importance, including Third Reedy Lake.

Prior to European settlement, the inundation level of the wetlands varied within and between seasons. After European settlement some of the lakes were gradually developed for water supply and they converted into permanent freshwater lakes in 1925 when they were incorporated into the Torrumbarry Irrigation System.

Third Reedy Lake is at the northern extent of the Reedy Lakes complex (see Attachment 1). The lake is 230 ha in area and has a high density and abundance of dead river red gums across its shallow open water zone. The total area of the site (lake and surrounding land) is about 250 ha. The lake provides some habitat for a range of fauna species due to its extensive fringing aquatic vegetation, abundant snags and permanent open water for fish (North Central CMA 2014). However, the lake is not representative of its former wetland type, and is believed to be in poor health overall.

The lake is part of the Torrumbarry Irrigation Area (TIA) System and is used to supply water to irrigation channels to the west (No 7 Channel) and north (1/7 Channel). It is also a direct source of irrigation supply for five GMW customers and is used for boating and fishing by the local community.

Main components of the project (nature, siting & approx. dimensions; attach A4/A3 plan(s) of site layout if available):
Overview map – See attachment 1, figure 4.

The two main components of the project are

- Construction of infrastructure construction to enable management of the lake's water regime
- Operations – long term management of the lake's water regime to achieve environmental objectives and channel and pipeline operation to deliver irrigation water to GMW customers.

Infrastructure has been designed to preliminary standard appropriate to allow estimation of costs for input into the Business Case. Detailed design will be required before the project can be implemented.
The main components of the Third Reedy Lake bypass project are:

- Infrastructure (to be constructed by mid 2017) (for further detail see Attachment 4 Section 6.7
- Infrastructure will be constructed, or modified on the west side of the lake. No activities will occur on the east side of the lake or on the lunette located on the eastern margins of the lake.
- Third Reedy Lake Isolation Regulator will control flows being diverted into Third Reedy Lake and allow isolation of the lake from the current regime that results in a permanent

'full' lake and by controlling flows allow the preferred watering regime to be established. This existing structure will be upgraded. Construction footprint approximately 50m x 30m

- Third Reedy Lake Bypass Offtake is the regulator that diverts flows from Middle Reedy Lake into the new bypass channel. Construction footprint approximately 50m x 30m.
- Third Reedy Lake Bypass Fishway (vertical slot fishway) will allow fish passage to and from Middle Reedy Lake into the bypass channel and will have a construction footprint of approximately 15m x 20m.
- Third Reedy Lake Bypass Channel will be used to transfer flows of up to 750Ml/day around Third Reedy Lake and back to the No 7 channel and will have a construction footprint of approximately 1400m x 50m
- Occupational Bridge to allow access across the channel
- TO 1/7 Channel Pump Station will pump water out of the new diversion channel into the new pipeline to supply landowners previously supplied from the 1/7 channel. The pump station will have a construction footprint of approx. 40m x 40m and a permanent footprint of approximately 10m x 10m.
- TO 1/7 Pipeline will be a pressurised pipeline of approximately 1100m in length used to supply customers previously supplied from the 1C/7 channel. The pipeline will have a construction footprint of approximately 10 metre either side of the existing channel which to be decommissioned
- Third Lake Inflow Measurement.
- Removal of existing 1/7 channel pump station at the north end of Third Reedy Lake and rehabilitation of the site
- A small area (~7 ha) of adjacent private used (farmland) will be acquired for construction of the bypass channel.

Operations

- Management of the infrastructure to achieve the desired environmental water regime
- Management of channel, pump station and pipeline to supply water to GMW customers
- Monitoring to inform adaptive management of the lake system
- Adaptive management involving regular review of monitoring, assessment against objectives and application of appropriate management actions.

Ancillary components of the project (eg. upgraded access roads, new high-pressure gas pipeline; off-site resource processing):

There are no ancillary components of the project.
Flood Lane will not require upgrade.
Mains power is available at TRL6 (pump station) site

Key construction activities:

Drawings (attachment) provide typical set-out of channel, control regulators, isolation regulator, pump station and fishway. Note that these drawings are conceptual only and detailed design (and possible amendment of set out) is required before construction can proceed.

Table 1 Work components

Stage	Description of works	
Preliminary site/works preparation	Site establishment, survey, site setout, floating (transport of machinery by floats), mobilisation	
	Environmental offsets - secure	
	Preparation; Clearing and grubbing	
	Land acquisition, legalities (crown land and landholder land)	

Construct channel - Bulk earthworks	Topsoil stripping	
	Channel excavation	
	Compacted Bank Construction	
	Class 3 crushed rock	
	Topsoiling	
Construct Associated Infrastructure	Inline regulators - TRL3	
	New vertical gates (between Middle and Third)	
	Flow measurement	
	Bridge (@ 3rd Reedy - regulator access)	
	Fish ladders	
	Pump Station and Pipeline	
	Coffer dams	
Demobilisation	Site clean up, including decommissioning of existing pump station.	
	Fencing	
Landholder connections	Connect existing GMW customers to pipeline	

Key operational activities:
The key operational activities are:
Management of the water regime of Third Reedy Lake:
The bypassing of Third Reedy Lake will remove the lake from being a permanent component of the TIA with very minimal fluctuation in water level (fluctuations of water level between 74.2 – 74.56 mAHD). The new watering regime (see below) will result in the lake being filled, then allowed to completely dry out in accordance with the Environmental Watering Plan (EWP) (to be developed). This regime will reflect the more natural flow requirements typically required for river red gums (*Eucalyptus camaldulensis*).

Operation of the bypass channel:
The bypass channel will be utilised to pass irrigation supplies for TIA customers around Third Reedy Lake further downstream to Lake Charm and Lake Kangaroo and beyond. The channel can be operated by remotely controlling the various regulators/ offtakes to allow water to enter Third Reedy in accordance with the requirements of the EWP.
Operation of pump and pipeline:
The new pump station and pipeline will divert water out of the bypass channel into the 1/7 pipeline for irrigation supply during the irrigation season from mid-August to mid-May each year. This facility will have the capability of being remotely operated. This will supply irrigation water to not only customers directly off the 1/7 pipeline but also further downstream on the 1/7 channel as it heads in a northerly direction away from Third Reedy Lake.
Environmental management:

Environmental management will include monitoring, evaluation and management.

Proposed environmental water regime:

Table 2 Third Reedy Lake – current and proposed environmental watering regime

KLBIP lake	Current Water Regime	Proposed Environmental Watering Regime
Third Reedy Lake	Irrigation regulation (FSL 74.56 mAHD). Permanently freshwater lake minimal fluctuations of water level between 74.2 – 74.56 mAHD)	3 × 4 year cycles, with the first year of the first two cycles rising to 74.0 with the first year of the third cycle rising to 74.56 and being held for 31 days to allow a flushing flow for salt management. It includes an option for an intermediate rise to about 73.2 m with a duration of 31 days which could be included in the third year of each cycle for ecological (frogs and turtles) purposes (if necessary) for adaptive management purposes. An establishment phase to provide opportunities for establishment of River Red Gums across the wetland floor is proposed.

Key decommissioning activities (if applicable):
The key decommissioning activity is removal and relocation of existing pump station supplying the 1/7 channel.

The Decommissioning of any GMW assets as part of the GMW CP is an activity that has been formally articulated and hence approved as part of the project approvals for the broader GMW CP.

Is the project an element or stage in a larger project?

☐ No ☒ Yes If yes, please describe: the overall project strategy for delivery of all stages and components; the concept design for the overall project; and the intended scheduling of the design and development of project stages).

Whilst the KLBP is being funded under Stage 2 of the GMW CP, it is listed as one of several 'special environmental projects' that in many cases have been assessed via the preparation of their own Business Case and were not part of the original referral under *Environmental Effects Act*. These 'Special Projects' were intended to achieve benefits such as water savings, environmental enhancement and/or improved customer level of service.

Therefore, the viability of the KLBP and its preferred outcome being the Third Reedy Lake Bypass project is not dependent on the implementation of the GMW CP.

Is the project related to any other past, current or mooted proposals in the region?

☐ No ☒ Yes If yes, please identify related proposals.

The concept of disconnecting the lakes from the irrigation system has been periodically explored since immediately after World War II. The various studies undertaken since 1946 up until the investigation phase of the current project are summarized in Attachment 4 Section 2

4. Project alternatives

Brief description of key alternatives considered to date (eg. locational, scale or design alternatives. If relevant, attach A4/A3 plans):

As part of the investigation, GMW CP commissioned a review of the alternative investment options for generating water savings from bypassing different lakes in the Kerang Lakes complex, which currently form part of the TIA System.

In addition, a "do nothing" scenario was considered.

Do nothing
The do nothing scenario is not an acceptable outcome.

Total average annual system water losses from all five lakes are estimated at a total of 11,413 ML ((Gippel 2012) p2). This represents a substantial economic loss to the region.

There are two views about the ecological state of Third Reedy Lake (and adjacent, permanently full lakes), if there is no intervention in its current management (Attachment 4 Sec 6.5).

One view is that the condition of the lakes is on a long, slow, steady decline which will continue into the future. This is the view expressed by Rakali Consulting (2013) who surveyed vegetation of the Kerang Lakes in 2013.

An alternative view, expressed in discussion with the Expert Review Panel (ERP), is that the lakes have already suffered an ecological decline and are now in a reasonably stable state that is different to their state before the early 1970s (or even the 1990s). The latter view is accepted by the ERP as being more likely.

Either way, the productivity of the lakes is significantly reduced and the lake's contribution to Ramsar values is diminished.

Maintaining a permanent water regime will eventually reduce habitat, potentially leading to less habitat diversity in the longer term.

Bypass options (Attachment 4, Sec 4,5,6))

Outcomes of the investigation considered options from two perspectives:

- Which lakes, or combinations of lakes, could be bypassed? Selection of a site for bypass required consideration of the combination of water regime, environmental enhancement, potential impacts, benefits and costs to give a desirable outcome.
- At an individual lake what combination of water regime, water savings, ecological outcomes and impacts would give an acceptable outcome?

The bypass option investigation was undertaken in two phases. Phase 1a of that review involved a series of investigations using four generic watering scenarios to test the feasibility of the proposed bypass options (see Attachment 4 Section 5). Phase 1b involved more targeted studies to understand the implications of the recommended scenario for each lake (See Attachment 4 Section 6).

The outcome of the investigations was that bypassing Third Reedy Lake was the only option that satisfied project success criteria (water savings, environmental benefits andcost per megalitre of water saved).

The rationale for excluding other options is a follows:

Option	**Rationale for excluding option**
First Reedy Lake	Minimal water savings and very high cost of bypass.
Middle Reedy Lake	High environmental risk; minimal water savings
Little Lake Charm	High salinity risk; minimal water savings
Racecourse Lake	High cost of water savings and high cost of bypass
Racecourse/Bertram Lake	High cost of water savings
Lowering lake operating levels	Insufficient water savings; minimal environmental benefits (See Attachment 4 Section7.4)

Development of the Third Reedy Lake bypass option involved several iterations that considered:

- Cost of by-pass
- Selection of a suitable environmental water regime
- Water savings.
- Salinity risk associated with the water regime
- Economic benefits.

As a result of these considerations the water regime previously described below was adopted.

Brief description of key alternatives to be further investigated (if known)**:**

No further alternatives are to be investigated.

5. Proposed exclusions

Statement of reasons for the proposed exclusion of any ancillary activities or further project stages from the scope of the project for assessment:

This assessment does not include activities associated with implementing irrigation connections to the new pipeline. These activities will be undertaken using the existing process for the GMW CP.

The decommissioning of the existing 1/7 channel pump station is also excluded from the assessment as this is covered under existing GMW CP approvals processes.

6. Project implementation

Implementing organisation (ultimately responsible for project, ie. not contractor)**:**

The project will be implemented by GMW CP.

Implementation timeframe:
It is planned to construct the bypass works commencing in 2016 and completing them by mid-2017. Scheduling of most construction activities can occur within the irrigation season.
Proposed staging (if applicable):
It is not intended to stage the project.

7. Description of proposed site or area of investigation

Has a preferred site for the project been selected?

☐ No ☒ Yes If no, please describe area for investigation.

If yes, please describe the preferred site in the next items (if practicable).

At a concept level the project's preferred sites have been determined

General description of preferred site, (including aspects such as topography/landform, soil types/degradation, drainage/ waterways, native/exotic vegetation cover, physical features, built structures, road frontages; attach ground-level photographs of site, as well as A4/A3 aerial/satellite image(s) and/or map(s) of site & surrounds, showing project footprint):

Regional Setting

Refer to Attachment 4 Section 1 for more information. (And attachments 1 and 2 for maps, photos).

The Kerang Lakes irrigation water storage and distribution system is a complex of lakes and channels located on the northern Loddon Plain, approximately 5 km northwest of the township of Kerang and near the western margin of the Riverine Plain in northern Victoria

The lakes are located in and around the townships of Kerang and Lake Charm, and form part of a larger wetland system encompassing over one hundred wetlands in the Loddon-Murray Region. The lakes region is located within the Gannawarra Shire.

The Kerang Lakes

Twenty-three of the Kerang Lakes are protected under the Ramsar Convention (the Kerang Lakes Ramsar site). Middle Lake, in particular, contains an ibis rookery of National significance. Other lakes in this complex regularly support significant number of important groups of waterbirds such as ducks, cormorants, spoonbill and large populations of prevalent Australian species.

All wetlands lie on the floodplains of the Loddon River, near where it meets the Murray River floodplain.

The wetlands sit in a regional setting of cleared agricultural land. Intensity of agricultural use varies from annual surface and sub-surface irrigation, perennial irrigation and dryland cropping and grazing.

Seven lakes within the Kerang Lakes complex are components of the TIA system which are artificially filled for water storage and distribution. (First Reedy, Middle Reedy, Third Reedy Little Lake Charm, Lake Charm, Racecourse Lake and Kangaroo). Five of these seven were investigated in Phase 1 of the project. Only the proposal for Third Reedy Lake met project success criteria.

Third Reedy Lake lies immediately to the north of Middle Reedy Lake, at the northern extent of

the Reedy Lakes Complex. It is currently classified as a Permanent Open Water wetland, but under natural conditions it would have been classified as a Deep Freshwater Marsh.

Topography

The land around Third Reedy Lake sits on a very gently sloping alluvial plain with scattered permanent and intermittent lakes. It is part of a much larger unit known as the Riverine Plain, comprising the fluvial plains of the Murray, Murrumbidgee, Goulburn and Lachlan Rivers and their tributaries. Lacustrine (lake) elements are generally ephemeral or intermittent shallow lakes and are typically saline or brackish. The most distinctive aeolian (wind-blown) feature of these plains is the lunette, up to 4 or 5 m high a crescent-shaped ridge of fine sand, silt, clay often containing pellets of salts including gypsum and occurring on the eastern side of lakes (Rosengren 1992).

Bathymetry (underwater contours) (Attachment 4 Sec 8.3)

The bathymetry of Third Reedy Lake shows a maximum depth of 1.66 metres (bed elevation 72.92mAHD and full supply level at 74.56 mAHD (Australian Height Datum)) with a slight gradient of 0.4 metres to the littoral zone[1] (at 73.6mAHD). The wetland bed is relatively flat, with only minor variations in depth and it has relatively steep sides (refer to Attachment 4 Appendix C for the wetland bathymetry map and the rating table). 50% of the area of the lake bed has a depth of 73.3 -73.4 mAHD.

Climate

Mean annual rainfall is approximately 375 mm at Kerang. The average annual pan evaporation rate is around 1,600 mm. This varies seasonally from up to 250 mm/month during the summer months to less than 50 mm/month in the winter, when rainfall can exceed evaporation.

Hydrology (Attachment 4 Section 8.5)

The wetland currently receives inflow from Middle Reedy Lake to the south and provides water to Little Lake Charm via the Torrumbarry No. 7 channel. The wetland supplies irrigation areas to the north via the Torrumbarry 1/7 channel. Scotts Creek to the west can also be hydrologically linked during flood events.

Under natural conditions, Third Reedy Lake would have been an intermittent wetland receiving water irregularly during flood events in the cooler winter months of wet years.

Up until 1996 the average recurrence interval for floods in the Loddon River that would have resulted in unregulated flows into the Reedy Lakes was 1 in 2 years with the maximum interval between events being 4 years (SKM 2010).

Third Reedy Lake's inclusion in the TIA system resulted in the lake remaining inundated since the 1920s through good quality fresh water inflows from the River Murray via First and Middle Reedy Lakes. Its water level is maintained at a maximum depth of 74.56m AHD and a minimum of 74.2m AHD. It operates above 74.47 m AHD for 95% of the time, with a level of 74.56m AHD for 50% of the time. (NC CMA 2012);

In the mid-1960s the lake's water levels were lowered by approximately 300 mm to the current FSL of 74.56 mAHD.

Lake ecology

Third Reedy Lake (and many other Kerang Wetlands) is an example of an ephemeral deflation basin lake (EDBL) (Scholz and Gawne 2004) that are widespread throughout the arid and semi-arid regions of the Murray-Darling Basin. EDBLs are important both as wetlands and as components of the larger floodplain ecosystem. They support diverse and productive plant and animal communities. A growing body of evidence suggests that the impacts of water resource and agricultural development on arid-zone EDBL have generally been detrimental in terms of net ecosystem productivity and diversity (Kingsford 2000a,b).

Both wet and dry periods are important in maintaining ecosystem integrity in ephemeral wetlands. Disturbances, such as flooding and drying, drive aquatic and terrestrial successional processes and facilitate biotic and abiotic exchanges between elements of the floodplain and the riverine environment. Because of this EDBL are potentially sites of high productivity and diversity within arid zone floodplain ecosystems. As a consequence, the management of these systems has implications for the productivity and diversity at a landscape scale.

[1] Littoral zone- the shore of a wetland which usually includes the zone of shallow waters at the edge.

Geomorphically, EDBL are floodplain depressions formed by wind and wave action moving material from their beds eastwards with the prevailing winds. Sand dunes or lunettes formed by the deposition of these eroded materials commonly occur on the eastern margin of lake basins. Lakebeds generally consist of fertile clay soils deposited by successive flooding events, and differ markedly from the soils on surrounding higher ground (Bowler 1990, Pressey 1990). These lakes receive water only intermittently through connection to their riverine supply during periods of high flow or from local rainfall. They are thus subject to episodes of rapid flooding followed by more protracted periods of evaporative drying. The periodicity of these wet/dry phases varies considerably between lakes.

Stratigraphy (Attachment 4 Sec 8.7)

Pre-Tertiary bedrock underlies the Loddon Plain and comprises Ordovician mudstone, fine-grained sandstone and shale, and Devonian granite. Overlying the bedrock is up to 600 m of unconsolidated Cainozoic sediments, within which there are at least four major aquifer systems (Bartley J. 1992). Three of these, the Renmark Group, Parilla Sand and the Shepparton Formation occur within the study area, where these fluvial and marine sediments are around 150 m combined thickness.

Local Groundwater and Surface Water Flow (extracted from URS) Attachment 4 Section 8.2 and 8.7

The net upward hydraulic gradient between the Parilla Sand and the surficial Shepparton Formation aquifers in the area allows no deep vertical drainage of recharge waters – whether from lake, channel, rain or irrigation. Groundwater flow is directed to the near-surface aquifer, which significantly contributes to:

- the maintenance of a high watertable
- the evaporative concentration of salts and
- discharge of saline water into low-lying areas nearby, such as the Sheepwash Creek depression.

The regional flow system is a major controlling factor on lake/groundwater interactions, with a strong upward gradient and, at times, pressure heads above ground surface.

The Parilla Sand aquifer situated below the Shepparton Formation aquifer is an important aquifer at a regional scale but in the context of this assessment it plays little part in the salinity or acid sulfate risk assessment due to:

- The lower (by several orders on magnitude) hydraulic conductivity of the overlying Shepparton Formation sediments, and
- The relatively small vertical hydraulic gradient between the two formations (in the study area).
- Climate (regional rainfall recharge) is the more dominant driver for groundwater levels (Shepparton Formation & Parilla Sand aquifers) than localised lake levels.

Water Quality (Attachment 4 Section 8.8)

There is no regular water quality monitoring program at Third Reedy Lake. The nearest monitoring station in on the Loddon River at Kerang. Water quality in Third Reedy Lake is assumed to approximate the quality of the Loddon River site because both are influenced by flows of water from the River Murray via deliveries for the TIA. In 2013, data extracted from the Victorian Water Management System (VWMS) indicates high turbidity, occasionally high salinity (EC), high Total Nitrogen (TN) levels dominated by organic nitrogen (TKN) and very low levels of nitrates (NOX), high level of Total Phosphorus (TP), but relatively low levels of bioavailable phosphorus. Values for TP, TN and turbidity trigger Victorian State Environment Planning Policies (Waters Of Victoria) objectives.

Site area (if known): 250 ha (hectares)

The total area of the Third Reedy Lake site is approximately 250 ha. Of this, 230 ha is occupied by the lake. In addition, approximately 7 ha of private land will be acquired for the channel alignment.

Route length (for linear infrastructure) 1.4 (km) **and width** 50 (m)

The By-pass Channel is expected to be 1.4Km in length

Current land use and development:

The wetlands sit in a regional setting of cleared agricultural land. The intensity of agricultural use varies from annual surface and sub-surface irrigation, perennial irrigation, and dryland cropping and grazing.

Third Reedy Lake is currently used as part of the TIA delivery system. Apart from some encroachments on the eastern side, the site is not used for any agricultural purpose. It also has values for recreation and nature conservation. Recreation usage information was estimated by RMCG (Attachment 4 Section 10.1). There are no visitor or interpretation facilities.

Description of local setting (eg. adjoining land uses, road access, infrastructure, proximity to residences & urban centres):

For further information See (Attachment 4 Section 1 and 8)

Third Reedy Lake sits in a regional setting of cleared agricultural land. Intensity of agricultural use varies from annual surface and sub-surface irrigation, perennial irrigation and dryland cropping and grazing. The Lake is approximately 10 km north west of Kerang and 1.5 km from the Murray Valley Highway (via Flood Lane).

Access to Third Reedy Lake is via Flood Lane which runs along the western side. Access to other parts of the lake is via private or GMW tracks.

The main uses of the lake by locals and visitors is fishing.

The five lakes, including Third Reedy Lake, are less developed and less commonly used for recreation than the larger nearby lakes in the Kerang wetlands system, Lake Charm and Lake Kangaroo. Their value as tourism assets is largely as adjuncts to those larger lakes, providing another activity for visitors, rather than being drawcards in themselves.

There are three residences along the western edge of Third Reedy Lake, one residence on the northern edge and one on the south-eastern edge, close to the inlet to the lake. Road access is via Flood Lane, which runs along the western edge of the lake.

The Shire of Gannawarra advised that the lakes are of importance to the local and visiting community (letter dated 11 June 2013).

Planning context (eg. strategic planning, zoning & overlays, management plans):

Ramsar (See Attachment 4 Section 13)

The Kerang Wetlands Ramsar Site was listed by Australia as a wetland of international importance in 1982. The site occupies 9,419 ha and is made up of 23 named permanent and temporary wetlands, including permanent freshwater lakes, permanent saline/ brackish/ alkaline lakes, permanent freshwater marshes and seasonal/ intermittent freshwater marshes (Clunie 2010).

The Ramsar criteria for which the site is listed, the ecological character of the site and threats to the ecological character of the Ramsar site are described in the ecological character description (ECD) for the site (KBR 2011).

Loddon Mallee Regional Strategic Plan

The Loddon Mallee Regional Strategic Plan 2015-18 identifies the opportunities and needs of the Loddon Mallee region.

It lists the GMW CP ($2 billion) and the Sunraysia Modernisation Project ($200 million) as priority areas, providing a once-in-a-century improvement to the water delivery infrastructure within our irrigation districts.

Within the Strategic Direction 3, “Protect and enhance the liveability and appeal of our Region”, three relevant priority areas are listed:

- 4-7 Efficiently use our water resources to achieve economic, environmental, and lifestyle

improvements

- 4-8 Support thriving arts, culture, sports, recreation and major events
- 4-9 Improve our pride in, and protection of, our Aboriginal and historic cultural heritage

Kerang Swan Hill Future Land Use Study

This study (Rendell McGuckian, Sinclair Knight Merz et al. 2003) included a "regenerating the lakes" component. This aimed to prevent further decline in those ecosystems and maintain them at their current (undesirable) level (the minimum standard) or we can choose to take a path of regeneration and attempt to return ecosystems to their former, more desirable levels.

The changed regime for the lakes were to be designed to create improved biodiversity for high value lakes and wetlands, as well as reduce existing water supply losses (i.e. create water savings in the Murray).

Torrumbarry Reconfiguration and Asset Modernisation Strategy (TRAMS)

TRAMS (G-MW 2007) identified the KLBP as a water savings strategy. This involved bypassing lakes with a channel and then providing an environmental flow for affected Lakes. The strategy covered Racecourse Lake and Little Lake Charm and possibly First Reedy, Middle Reedy and Third Reedy Lakes, but recognised the environmental risks for these three lakes may be prohibitive.

Gannawarra Planning Scheme

The Gannawarra Planning Scheme Municipal Strategic Statement includes as an objective for Natural Resource Management (Section 21.04-2*) Management of public land (State Forests and Parks, river and stream reserves, wetlands and lakes) that provide for a range of opportunities including nature conservation, recreation, and tourism.*

Gannawarra Planning Scheme Zones and Overlays relevant to Third Reedy Lake are shown below. (Attachment 4, Sec 11.1) See attachment 1 for Planning Scheme maps.

Table 3: Zones and Overlays relevant to Third Reedy Lake

Zone	Applicable to
PCRZ (Public conservation and resource zone)	The lakes and adjacent public land.
FZ (Farming Zone)	Private land surrounding the lakes (but not the lakes)
Overlays	
ESO3 (Environmental Significance Overlay) (Lake Environs)	The lakes
LSIO (Land subject to inundation)	Areas surrounding the lakes (but not the lakes)
Rural floodway	The lakes

Local government area(s):

The project area lies entirely within the Shire of Gannawarra.

8. Existing environment

Overview of key environmental assets/sensitivities in project area and vicinity
(cf. general description of project site/study area under section 7)**:**

Some 67 flora species, 73 bird species, two native turtles, three native frogs and 11 native fish species have been recorded at Third Reedy Lake. Listed species are further considered in Section 12.

Both Biosis (2013) and Rakali Consulting (2013) considered the likelihood of occurrence of species that were not recorded (due to presence of suitable habitat) and also the potential impact on those species.

EPBC Protected Matters

A Protected Matters Search Tool (PMST) search on 27 October 2015 based on a 2.5 km radius of the centre of Third Reedy Lake returned the following results (in summary):

*denotes that additional species (not in PMST but known from site) were added

Table 4 Results of PMST search

World Heritage Properties:	None	
National Heritage Places:	None	
Wetlands of International Importance:	5	Banrock station wetland complex Hattah-Kulkyne lakes Kerang wetlands Riverland The Coorong, and lakes Alexandrina and Albert wetland
Great Barrier Reef Marine Park:	None	
Commonwealth Marine Area:	None	
Listed Threatened Ecological Communities:	3*	Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia Natural Grasslands of the Murray Valley Plains White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (White Box Woodland) community*
Listed Threatened Species:	17*	**Flora species** *Austrostipa wakoolica* Winged Pepper-cress (*Lepidium monoplocoides*) Chariot Wheels (*Maireana cheelii*) Slender Darling-pea (*Swainsona murrayana*) **Birds** *Botaurus poiciloptilus* Australian Bittern *Grantiella picta* Painted Honeyeater *Lathamus discolor* Swift Parrot *Leipoa ocellata* Malleefowl *Pedionomus torquatus* Plains-wanderer *Pezoporus occidentalis* Night Parrot *Rostratula australis* Australian Painted Snipe **Frogs** *Litoria raniformis* Growling Grass Frog **Mammals** *Nyctophilus corbeni* South-eastern Long-eared Bat reptiles *Delma impar* Striped Legless Lizard **Fish** *Bidyanus* Silver Perch *Craterocephalus fluviatilis* Murray Hardyhead *Maccullochella peelii* Murray Cod *Macquaria australasica* Macquarie Perch
Listed Migratory Species:	7*	*Apus pacificus* Fork-tailed Swift] Migratory Terrestrial Species *Haliaeetus leucogaster* White-bellied Sea-Eagle *Merops ornatus* Rainbow Bee-eater *Motacilla flava* Yellow Wagtail *Myiagra cyanoleuca* Satin Flycatcher Ardea alba Great Egret, White Egret *Ardea ibis* Cattle Egret *Gallinago hardwickii* Latham's Snipe, Japanese Snipe *Rostratula benghalensis (sensu lato)* Painted Snipe

Ramsar site

Third Reedy Lake forms part of the Kerang Lakes Ramsar Site.

Overall, Third Reedy Lake is not a significant contributor to the ecological character of the Kerang Lakes Ramsar site. (Attachment 4, Section13.1.1).

Table 5: Current EVCs within Third Reed Lake and their bioregional conservation status (Rakali, 2013)

Bioregion	EVC No.	EVC	Bioregional Conservation Status in the Victorian Riverina[1]
Victorian Riverina	98	Semi-arid Chenopod Woodland	Endangered
	103	Riverine Chenopod Woodland	Vulnerable
	104	Lignum Swamp	Vulnerable
	653	Aquatic Herbland	Not listed for Victorian Riverina (Vulnerable in Murray Fans bioregion)
	813	Intermittent Swampy Woodland	Depleted
	821	Tall Marsh	Depleted
	823	Lignum Swampy Woodland	Vulnerable

Flora

Table 6: Significant flora species recorded at Third Reedy Lake (extracted from (North Central CMA 2014). Location of these species is shown in (Rakali Consulting 2013) Map 14

Common Name	Scientific Name	Water dependency[1]	Last record	IUCN Red List	EPBC status	FFG status	Victorian Conservation status
Branching Groundsel	*Senecio cunninghamii var. cunninghamii*	W	2013				r
Brown Beetle-grass	*Leptochloa fusca* subsp. *fusca*	T	U				r
Dark Roly-poly	*Sclerolaena muricata* var. *semiglabra*	T	2013				k
Flat-top Saltbush	*Atriplex lindleyi* subsp. *lindleyi*	T	2013				k
Short Water-starwort	*Callitriche brachycarpa*	A	2013			L	v
Spiny Lignum	*Muehlenbeckia horrida* subsp. *horrida*	W	2013				r
Twin-leaf Bedstraw	*Asperula gemella*	T / W	1996				r

Conservation Status:

Water dependency: T- River terrestrial, A- River aquatic, W- wetland dependent

IUCN: EX- Extinct, EW- extinct in the wild, CR- critically endangered, EN- endangered, VU- vulnerable, NT- near threatened, LC- least concern, DD- data deficient

EPBC: VU – Vulnerable, EN- Endangered

FFG status: L – Listed as threatened

Victorian Conservation status: e - Endangered, v- Vulnerable, r - Rare, n- Near Threatened, k- Poorly Known, d- Data Deficient

U- unknown year of record

[1]Water Dependency advised by Significant wetland-dependent flora species spreadsheet supplied by DEPI (compiled by D. Frood) and VEAC, 2008.

Table 7: Significant fauna species recorded at Third Reedy Lake

Common Name	Scientific Name	Water depend-ency[1]	Last record	Inter-national treaty	IUCN Red List	EPBC status	FFG status	Victorian Conservation Status
Birds								
Brown Treecreeper	*Climacteris picumnus*	Y	2013		LC			NT
Caspian Tern	*Sterna caspia*	Y	1998	J/C	LC	M	L	NT
Eastern Great Egret	*Ardea modesta*	Y	2013	J/C		M	L	VU
Hardhead	*Aythya australis*	Y	2006		LC			VU
Musk Duck	*Biziura lobata*	Y	2006					V
Nankeen Night Heron	*Nycticorax caledonicus*	Y	2013					NT
Pied Cormorant	*Phalacrocorax varius*	Y	2013		LC			NT
Royal Spoonbill	*Platalea regia*	Y	2013		LC			NT
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Y	2013	C	LC	M	L	VU
Fish								
Freshwater Catfish	*Tandanus tandanus*	Y	1981				L	EN
Silver Perch	*Bidyanus bidyanus*	Y	2013		VU		L	VU
Unspecked Hardyhead[2]	*Craterocephalus stercusmuscarum fulvus*	Y	2013				L	
Golden Perch	*Macquaria ambigua*	Y	2013					NT
Murray Cod	*Maccullochella peelii*	Y	2006		CE	VU	L	VU
Reptiles								
Murray River Turtle	*Emydura macquarii*	Y	2006					VU
Common Long-necked Turtle	*Chelodina longicollis*	Y	2013					DD

Significant fauna key:

Water dependency: Y- water dependent, N- not water dependent

International Treaty: J-JAMBA, C- CAMBA, R-ROKAMBA, B-BONN

IUCN: EX- Extinct, EW- extinct in the wild, CE- critically endangered, EN- endangered, VU- vulnerable, NT- near threatened, LC- least concern, DD- data deficient

EPBC status: VU – Vulnerable, M- Migratory

FFG status: L – Listed as threatened

DSE status: EN- Endangered, CR- Critically Endangered, VU- Vulnerable, NT– Near Threatened, K- Poorly known, DD- da deficient

U- unknown record

[1]Water Dependency advised by Significant Wetland Dependent Fauna Species spreadsheet supplied by DEPI (compiled by R. Loyn (birds), N. Clements (Reptiles), M. Scrogie (Frogs), P. Papas (Invertebrates), L. Lumsden (Mammals) and J. Kohen and T. Raadik (Fish)).

[2]Unspecked Hardyhead was not included in the April 2013 release of the Advisory List of Threatened Vertebrate Fauna Victoria (DSE, 2013). The species has been reassessed as abundant across many locations within Victoria, however it is currently gazetted under FFG (October 2012) and management options that impact this species may trigger the *Environmental Effects Act 1978*.

9. Land availability and control

Is the proposal on, or partly on, Crown land?

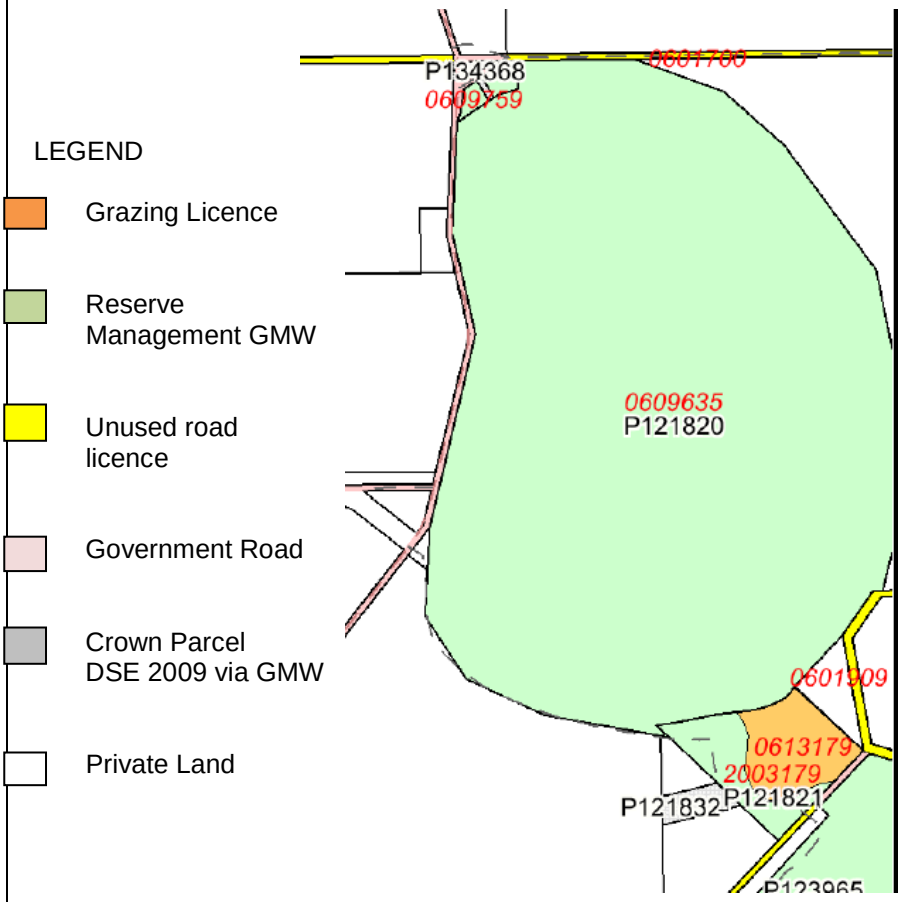
☐ No ☒ Yes If yes, please provide details.

The bypass channel will be constructed on public and private land. Third Reedy Lake is public land currently managed by GMW.

Table 8: Relevant public land classification (VEAC 2008)

Wetland	VEAC River Red Gum Investigation Recommendation	Land Manager
Third Reedy Lake	H2 water distribution and drainage area	GMW

Current land tenure (provide plan, if practicable):



Intended land tenure (tenure over or access to project land):

Discussions with DELWP and Parks Victoria indicate Third Reedy Lake public could be classified Nature Conservation Reserve post project implementation with management coordinated by them with similar nearby public land areas.

Other interests in affected land (eg. easements, native title claims):

Information provided by Gavin Parkes (DELWP) on 6 May 2014 notes

Native Title Extinguishment Assessments have previously been completed for Third Reedy Lake. P121820: Native title rights and interests have been fully extinguished over the body of the lake, the channels, regulators and pumps on the basis of the 'state works of water supply' having been vested in the State Rivers and Water Supply Commission under section 36 of the *Water Act 1905*. There are no further *Native Title Act 1993* (NTA) requirements for works within that area. P121821: No extinguishment of native title. The future act of the construction of an earthen

water supply channel and a regulator is valid under section 24JA of the NTA. To comply with the NTA, the native title claimants need to be notified of the proposed works and provided with a

Your search returned **4** matches.

Name	NNTT file no	Federal Court file no	Date filed	Application status
Wamba Wamba, Barapa Barapa and Wadi Wadi Peoples.	VC2000/005	VID6005/2000	19/07/2000	Struck-out
North West Nations	VC1997/017	VID6019/1998	06/11/1997	Discontinued
Yorta Yorta Clans	VC1994/001	VID6001/1995	21/02/1994	Determined
Yorta Yorta Clans	VP1994/001	VID6001/1998	21/02/1994	Discontinued

period of 28 days to respond. A search of the National Native Title Tribunal records indicates there are no current native title claimants.

10. Required approvals

State and Commonwealth approvals required for project components (if known):

EPBC Act approval is expected to be required for the project which triggers some EPBC requirements.

Planning Permit (Planning and Environment Act 1987) is required for the project on the basis that buildings and works may be covered by the Land Subject to Inundation and Environmental Significance Overlays, PCRZ, removal of native vegetation and creation or removal of easements and land acquisition.

Cultural Heritage Management Plan will be prepared covering the relevant works components – Aboriginal Heritage Act 2006.

Consents under a range of Acts may be required including Water Act 1989 (works on waterways), Land Act 1958 and Crown Land (Reserves) Act 1978 (changes in land status and management).

GMW CP holds permits under the Fisheries Act, Wildlife Act, Flora and Fauna Guarantee Act. These apply to an “approved EMP”. An EMP will be required for project construction.

Have any applications for approval been lodged?

☒ No ☐ Yes If yes, please provide details.

Approval agency consultation (agencies with whom the proposal has been discussed):

The proposal has been discussed with DELWP, DEDJTR, GMW and the Commonwealth Department of the Environment. The Shire of Gannawarra has also been engaged with during the course of the investigation.

A Project Technical Reference Group was established to provide technical guidance to investigations being undertaken and included representatives from DELWP, Shire of Gannawarra, NC CMA, and GMW. This Group met every two months during the investigation and development of the Business Case in 2013/14.

Other agencies consulted:

The proposal has been discussed with NC CMA, Parks Victoria and OAAV.

PART 2 POTENTIAL ENVIRONMENTAL EFFECTS

11. Potentially significant environmental effects

Overview of potentially significant environmental effects (identify key potential effects and comment on their significance and likelihood, as well as key uncertainties):

The KLBP Investigation commenced in 2011 with the aim of saving water lost to seepage and evaporation, and improving the ecological values of the lakes, by disconnecting the lakes from the irrigation system.

To support the project, a range of investigations, summarised in Attachment 4, Appendix 1, were undertaken to better understand the lakes and risks associated with their bypass. Information from the investigations was used to reduce the scope of the project and to support business case development.

In addition, these investigations were supported by a rigorous peer review process (Attachment 4 Section 15) including:

- Expert Review Panel
- Scientific Review Panel
- Project Reference Group
- Project Specific reviews.

Project progress and outcomes were also review by the Community Reference Group.

Table 9 Key potential environmental effects are:

Changes to Ramsar Limits of Acceptable Change:				
Impact	Likelihood	Consequence	Certainty	Mitigation
Hydrology	Almost certain	Insignificant (positive)	High	Environmental water plan
Water quality (salinity)	Moderate	Minor		Operational plan
Acid sulfate soils	Moderate	Major	Very low	Investigation
threatened ecological communities	Unlikely	Insignificant	High	
listed flora and fauna	Unlikely	Insignificant	High	
Clearing of native vegetation	Almost certain	Minor	Moderate	Biodiversity assessment report- off-sets and wetland vegetation
Dust from lake	Unlikely	Minor	Moderate	Revegetation
Fish management	Almost certain	Minor	Moderate	Fish management plan
Blackwater (low or no oxygen in the water column)	Unlikely	Minor	high	Environmental lwater management
Carp management	Almost certain	Minor	Moderate	Fish management plan; carp screens
Flooding	Almost certain	Minor	Moderate	No change to flood flows.
Fish passage	Almost certain	Moderate	Moderate	Provide for fish passage

Other issues of interest to local community

- Fish management – as the lake dries fish will die and present odour problems. It may be possible to translocate native species. GMW has prepared and implemented fish contingency plan at nearby Lake Boga. A similar plan will be prepared for Third Reedy Lake and implemented if required.
- Blackwater (low or no oxygen in the water column) Blackwater assessment was undertaken. See Attachment 4, Sec 18.1
- Carp management – Carp screens
- Flood impacts and management – no impact on flood flows; planning permit required; some small flood mitigation benefit occurs in drying or dry lake phase.
- Fish passage – fish passage along the bypass channel is provided for. Fish passage to and from Third Reedy Lake is not provided for; this is essentially a binary operation – either the regulator will be open or it won't be.

Further discussion below on major environmental risks:

Construction / Works Impacts

Native vegetation clearing

The project will result in some removal of native vegetation. Impacts of native vegetation clearing are discussed in Section 12. These locations are likely to be in areas highly disturbed by agricultural operations.

Impact on significant flora and fauna

The impact of the project on significant flora and fauna is discussed in Section 12.

12. Native vegetation, flora and fauna

Native vegetation

Is any native vegetation likely to be cleared or otherwise affected by the project?

☐ NYD ☐ No ☒ Yes If yes, answer the following questions and attach details.

What investigation of native vegetation in the project area has been done? (briefly describe)

A number of investigations of flora and fauna were undertaken during the investigation:

- Rakali Consulting (2013) undertook EVC mapping, Index of Wetland Condition assessments and collection of flora and fauna data.
- Biosis (2013) undertook fauna investigations.
- (SKM 2013) also undertook some flora and fauna assessment and groundtruthing of previous investigations.

SKM (2013) undertook a net gain assessment as part of the investigation. This involved a field and net gain assessment. This was updated by (Jacobs 2016) who undertook an assessment of off-set requirements for works at Third Reedy Lake using the Permitted Clearing of Native Vegetation Biodiversity Assessment Guidelines.

The impact area in this assessment assumes a 20 m wide construction footprint at the proposed pipeline (10 m either side of the existing channel) and a 50 m wide construction footprint for the new channel. This is considered to be worst case scenario and total vegetation loss is likely to be less.

The Native Vegetation Information Management (NVIM) system was used to generate a Biodiversity Assessment Report (BAR) for vegetation removals (Jacobs 2016). The total extent of vegetation loss associated with this project is 6.8 ha of remnant vegetation and five scattered trees. The total vegetation loss calculated is based on the impact area provided and is summarised in Table 10.

The vegetation removal is entirely within Location risk A and combined with greater than 1 ha of native vegetation removal means the proposed works are considered to be Moderate risk under the risk-assessment pathway detailed in the Biodiversity Assessment Guidelines[2]. A shapefile has been submitted to DELWP and offset requirements have been provided in the Biodiversity Impact and Offset Requirements Report (BIOR).

Based on the details of the BIOR report, the project will require removal of 6.727 ha of native vegetation. An offset of 2.536 General Biodiversity Equivalence Units of a minimum Strategic Biodiversity Score of 0.454 within NC CMA or Gannawarra Shire Council areas must be sought. Consideration of threatened species under the Victorian Advisory Lists, the Flora and Fauna Guarantee Act and the Environment Protection and Biodiversity Conservation Act is determined by DELWP and provided as specific offsets. No specific offsets are required for this project based on the BIOR after being determined by DELWP.

Permanent inundation of Third Reedy Lake has resulted in an outward shift in the zone once occupied by River Red Gums (i.e. historically the wetland body but now the boundary zone). This has allowed Intermittent Swampy Woodland to occupy a zone that was once supporting Black Box dominated communities (fringing zone) (Rakali, 2013).

Application of the proposed water regime will result in (North Central CMA 2014) Section 8.1):

- The outer margins of the wetland would be similar to what is currently present (predominately Black Box and some River Red Gums and shrubby understory) however the quality of vegetation will be improved and regeneration encouraged through fluctuations in water level.
- The Intermittent Swampy Woodland zone would extend throughout the wetland, with the dominant species being River Red Gums.
- The deeper zones would be more characteristic of a shrubby Intermittent Swampy Woodland with lignum, sedges and cane grass present. During wet phases, Aquatic Herbland (EVC 653) may be present on outer margins. When the wetland dries this EVC may shift to a corresponding dry EVC such as Floodway Pond Herbland (EVC 810).

The regime should positively impact on the diversity and abundance of understory species in the wetland body. It is likely that Tall Marsh will be lost from the system however this EVC is the result of a modified water regime (would not have occurred under the natural water regime for Third Reedy) and its habitat function will be replaced by other species.

The loss of native vegetation by construction activities is expected to be offset, in part at least, by the improvement in quality of native vegetation achieved through re-instatement of the lake's natural watering regime (or a more natural watering regime). Any offset requirements that cannot be met by reinstating the watering regime will be achieved through the standard GMW CP off-set management process (by which appropriate off-sets are provided.

What is the maximum area of native vegetation that may need to be cleared?

☒ NYD Estimated area ……6.8 ha……(hectares)

How much of this clearing would be authorised under a Forest Management Plan or Fire Protection Plan?

☒ N/A …… approx. percent (if applicable)

Which Ecological Vegetation Classes may be affected? (if not authorised as above)

☒ NYD ☒ Preliminary/detailed assessment completed. If assessed, please list.

The total vegetation loss calculated and affected EVCs is based on the impact area provided and are summarised in Table 10.

[2]DEPI (2013). *Permitted clearing of native vegetation: Biodiversity assessment guidelines*. Department of Environment and Primary Industries. East Melbourne.

Table 10 Remnant Vegetation identified within the impact area

Ecological Vegetation Class	Loss (ha)
Riverine Chenopod Woodland (EVC 103)	5.4
Intermittent Swampy Woodland (EVC 813)	1.4
Total	**6.8**

Have potential vegetation offsets been identified as yet?

☒ NYD ☐ Yes If yes, please briefly describe.

The loss of native vegetation by construction activities is expected to be offset, in part at least, by the improvement in quality of native vegetation achieved through re-instatement of the lake's natural watering regime (or a more natural watering regime). Any offset requirements that cannot be met by reinstating the watering regime will be achieved through GMW CP normal off set processes.

Any additional off-sets required will be provided by the GMW CP as part of its normal native vegetation clearing assessment and approvals process.

Other information/comments? (eg. accuracy of information)

N/A

NYD = not yet determined

Flora and fauna

What investigations of flora and fauna in the project area have been done?
(provide overview here and attach details of method and results of any surveys for the project & describe their accuracy)

A number of field investigations of flora and fauna were undertaken during the investigation:

- Rakali Consulting (2013) undertook EVC mapping, Index of Wetland Condition assessments and collection of flora and fauna data.
- Biosis (2013) undertook fauna investigations.
- Sharpe (2014) undertook investigation into the presence of Murray Hardyhead and its habitat.
- SKM (2013) also undertook some flora and fauna assessment and ground-truthing of previous investigations.

Survey methods are described in detail in each of these reports.

In addition, NC CMA developed extensive flora and fauna species lists based on the first 3 surveys above, plus information from

- Ho et al. (2006). Development and application of an ecological monitoring and mapping program for targeted Kerang lakes.
- SKM (2001). Reedy Lakes environmental status report.
- SKM (2010). Environmental water regime requirements of the Kerang Lakes. Review of system losses, identification of environmental water regimes and potential water savings.
- Birdlife Australia.

These full lists are attached to North Central CMA (2014).

Have any threatened or migratory species or listed communities been recorded from the local area?

☐ NYD ☐ No ☒ Yes If yes, please:List species/communities recorded in recent surveys and/or past observations.

Indicate which of these have been recorded from the project site or nearby.

Some 67 flora species, 73 bird species, two native turtles, three native frogs and 11 native fish species have been recorded at Third Reedy Lake.

Both Biosis and Rakali reports considered the likelihood of occurrence of species that were not recorded (due to presence of suitable habitat) and also the potential impact on those species.

EVCs (see attachment sec 9.2)

In the Reedy Lakes area, the vegetation has been predominantly mapped as two EVCs: EVC 103 Riverine Chenopod Woodland and EVC 813 Intermittent Swampy Woodland. Three additional EVCs were mapped within the investigation area: EVC 813 Intermittent Swampy Woodland, EVC 823 Lignum Swampy Woodland and EVC 98 Semi-arid Chenopod Woodland. Areas that supported no overstorey and supported less than 25% cover of indigenous species were classified as degraded treeless vegetation in accordance with the NVMF (SKM 2013).

Aquatic and Emergent EVCs will be disturbed by application of the change in water regime.

The Ecological Vegetation Class (EVC) Tall Marsh (EVC 821) (various combinations i.e. Tall Marsh/Cumbungi (*Typha* spp.), Tall Marsh/ Giant Rush (*Juncus* spp.) etc) extends for approximately 50 metres from the edge of the wetland to depths of around 0.3-0.7 metres. The boundary of the wetland is characterised by Intermittent Swampy Woodland (EVC 813), comprising of a Red Gum and Black Box (*Eucalyptus largiflorens*) overstory, with a shrubby understory (predominately Tangled Lignum (*Duma florulenta*)). Small 10m^2 patches of Aquatic Herbland (EVC 653) (which is characterised by rushes and aquatic herbs) is also present particularly in a small depression on the south-east boundary of the wetland (Rakali, 2013).

If known, what threatening processes affecting these species or communities may be exacerbated by the project? (eg. loss or fragmentation of habitats) Please describe briefly.

Table 11 Assessment of FFG Threatening processes

FFG Threatening process	Impact of proposal
Alteration to the natural flow regimes of rivers and streams.	Proposal will generate water savings to be used to restore environmental flows to rivers, streams and wetlands. Minimal impact at Third Reedy Lake because water regime will move towards more natural. Overall, positive impact.
Infection of amphibians with Chytrid Fungus, resulting in chytridiomycosis	Proposal is unlikely to change the risk of Chytrid Fungus occurring in Third Reedy Lake, although breaking the hydraulic connection between Third Reedy Lake and other local waterrbodies may provide some small degree of protection.
Degradation of native riparian vegetation along Victorian rivers and streams.	Changed water regime will positively affect habitat availability in the 230 ha currently permanently inundated. Positive impact.
Habitat fragmentation as a threatening process for fauna in Victoria.	Neutral
Prevention of passage of aquatic biota as a result of the presence of instream structures.	Provision of a fish ladder in the bypass channel will provide for passage of aquatic fauna.
Wetland loss and degradation as a result of change in Water regime, dredging, draining, filling and grazing.	Proposal will restore a more natural water regime to the wetland. Wetland classification will change from permanent open water to deep freshwater marsh. Permanent Open Water is considered over represented and deep freshwater marsh underrepresented within the North Central CMA region (Positive impact.
Alteration to the natural temperature regimes of rivers and streams.	Proposal is unlikely to alter the current temperature regime of rivers and streams
Increase in sediment input into Victorian rivers and streams due to human activities.	Proposal is unlikely to increase the sediment input to rivers and streams. Construction activities will be managed to minimised sediment movement.
Input of toxic substances into Victorian rivers and streams.	Proposal is unlikely to change the input of toxic substances to Third Reedy Lake (subject to ASS assessment).
Removal of wood debris from Victorian streams.	Proposal will ultimately enhance volume of woody debris in Third Reedy Lake by encouraging regeneration of river red

	gum which over time will provide woody debris.

Are any threatened or migratory species, other species of conservation significance or listed communities potentially affected by the project?

☒ NYD ☒ No ☒ Yes If yes, please:

List these species/communities:

Indicate which species or communities could be subject to a major or extensive impact (including the loss of a genetically important population of a species listed or nominated for listing) Comment on likelihood of effects and associated uncertainties, if practicable.

Further info Attachment 4 Sections 9

A number of investigations of flora and fauna were undertaken during the investigation. These are summarised in NC CMA (2014) and below.

- Rakali Consulting (2013) undertook EVC mapping.
- Biosis (2013) undertook fauna investigations,
- Sharpe (2014) investigated the presence of Murray hardyhead and its habitat.
- SKM (2013) also undertook some flora and fauna assessment and groundtruthing of previous investigations.

Survey methods are described in the reports.

EVCs Attachment 4 (Section 9)

Table 12: Current EVCs within Third Reedy Lake and their bioregional conservation status (after Rakali Consulting 2013)

Bioregion	EVC No.	EVC	Bioregional Conservation Status in the Victorian Riverina[1]	Impact assessment
Victorian Riverina	98	Semi-arid Chenopod Woodland	Endangered	Not present in works area. No impact
	103	Riverine Chenopod Woodland	Vulnerable	Up to 5.4 ha impacted.
	104	Lignum Swamp	Vulnerable	Not present in works area. Likely to be positively affected by restoration of dynamic water regime.
	653	Aquatic Herbland	Not listed for Victorian Riverina (Vulnerable in Murray Fans bioregion)	Not present in works area. Likely to be positively affected by restoration of dynamic water regime.
	813	Intermittent Swampy Woodland	Depleted	Up to 1.4 ha impacted.
	821	Tall Marsh	Depleted	Not present in works area. Likely to be positively affected by restoration of dynamic water regime
	823	Lignum Swampy Woodland	Vulnerable	Not present in works area. Likely to be positively affected by restoration of dynamic water regime
[1]EVC Bioregional Conservation Status updated using revised wetland BCS spreadsheet supplied by DEPI (compiled by D. Frood)				

DSE pre-1750s mapping predicts that the wetland would have historically been a deep freshwater marsh made up of Lignum Swampy Woodland (EVC 823) with fringing zones of Riverine Chenopod Woodland (EVC 103) and Semi-arid Chenopod Woodland (EVC 98). Lignum, the dominant understorey species in Lignum Swampy Woodland, can tolerate a flooding duration of three to seven months at a depth less than 1 m. With the maximum depth of the wetland being 1.36 m at full supply level (FSL), it is likely that in reality the wetland may have flooded too frequently and for too long to support Lignum Swampy Woodland. A recent survey identified the EVC Intermittent Swampy Woodland (EVC 813) to be the most likely historical EVC. This is supported by the presence of a large number of dead River Red Gum trees throughout the base

of the wetland, at a density uncharacteristic of Lignum Swampy Woodland (Rakali Consulting 2013).

North Central CMA (2014) (Section 6.3) notes submerged aquatic vegetation is severely depleted and negligible in the open water zones of Third Reedy Lake. Small, localised areas of Aquatic Herbland occurred at Reedy Lake in association with Tall Marsh. While relatively common, no single patch of Aquatic Herbland was larger than 10 square metres and therefore none were mapped (Rakali Consulting 2013)

Sharpe (2014) (Section 4.1.1) also commented on the absence of submerged aquatic macrophytes in Middle and Third Reedy Lakes.

Table 13:Likelihood of impact for listed flora species

Significant impact criteria	*Austrostipa wakoolica*	Winged Pepper-cress (*Lepidium monoplocoides*)	Chariot Wheels (*Maireana cheelii*)	Slender Darling-pea (*Swainsona murrayana*)	*Callitriche brachycarpa* Short Water-starwort
1. lead to a long-term decrease in the size of an important population of a species	No	No	No	No	No
2. reduce the area of occupancy of an important population	No	No	No	No	No
3. fragment an existing important population into two or more populations	No	No	No	No	No
4. adversely affect habitat critical to the survival of a species	No	No	No	No	No
5. disrupt the breeding cycle of an important population	No	No	No	No	No
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	No	No	No	No
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No	No	No	No	No
8. introduce disease that may cause the species to decline	No	No	No	No	No
9. interfere substantially with the recovery of the species	No	No	No	No	No
Impact significance **NS= Not Significant, S = Significant**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 14Likelihood of impact for Endangered and Critically Endangered ecological communities

Significant impact criteria	Buloke Woodlands of the Riverina and Murray-Darling Depression	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Natural Grasslands of the Murray Valley Plains	Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
1. reduce the extent of an ecological community	No	No	No	No
2. fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	No	No	No	No
3. adversely affect habitat critical to the survival of an ecological community	No	No	No	No
4. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	No	No	No	No
5. cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	No	No	No	No
6. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established; or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	No	No	No	No
7. interfere with the recovery of an ecological community	No	No	No	No
Impact significance **NS= Not Significant, S= Significant**	**NS**	**NS**		

Fish

Biosis (2013) note that the fish community within Third Reedy Lake was dominated by exotic species with 70 individual Carp accounting for 37% of all individuals collected and representing 99% of the total biomass. The overall native biomass for Third Reedy was 0.1%.

Some elements of the FFG listed Lowland Riverine Fish Community of the Southern Murray Darling Basin (DELWP 2013) exist at Third Reedy Lakes and adjacent lakes.

Table 15 Impact assessment - fish

Fish	Status	PMST assessment	Assessment
Silver Perch *Bidyanus*	Critically endangered	Species or species habitat likely to occur within area.	Two Silver Perch (Bidyanus bidyanus) specimens were located by Biosis (2013) in the connecting channel between Middle and Third Reedy Lake, but none were located within Third Reedy Lake. Ho, Roberts et al. (2006) surveyed the fish of the Kerang Lakes (including Third Reedy Lake) in 2006 and failed to detect any Silver Perch. Unlikely to be significantly impacted (see discussion below)
Freshwater Catfish *Tandanus*	FFG Endangered	Abundant habitat.	The most recent record is from 1981. This species was not recorded in 2006 or during the current investigation. While they may

			persist in small numbers they are difficult to detect. Unlikely to be significantly impacted.
Murray Hardyhead [56791] *Craterocephalus fluviatilis*	Endangered	Species or species habitat may occur within area	Impact highly unlikely. Species not recorded at Third Reedy Lake and no suitable habitat is present ((Sharpe 2014) (see discussion below)
Murray Cod [66633] *Maccullochella peelii*	Vulnerable	Species or species habitat may occur within area	The population of Murray Cod *(Maccullochella peelii) is* potentially the result of recreational fish stocking at First Reedy Lake (North Central CMA 2014) Section 5.3). Unlikely to be impacted -
Unspecked hardyhead *Craterocephalus stercusmuscarum fulvus*	FFG Threatened	Species recorded in Third Reedy Lake. (Biosis and CPS)	Recorded in large numbers in the adjacent Middle Reedy Lake and also in Little Lake Charm.. Has similar habitat requirements to that of Murray Hardyhead; key MHH habitat not encountered. Unlikely to be impacted.
Macquarie Perch [66632] *Macquaria australasica*	Endangered	Species or species habitat may occur within area	No suitable habitat occurs within study area, with most recent record indicative of unsuccessful stocking.(Biosis 2013). Impact highly unlikely

Murray Hardyhead

Murray Hardyhead (*Craterocephalus fluviatilis*), has not been recorded in Third Reedy Lake, but a single specimen was identified in the adjacent, and hydraulically connected Middle Reedy Lake (Biosis 2013).

A reconnaissance survey undertaken by Mick Dedini (DEPI) in Middle Reedy Lake in May 2013 failed to locate any Murray Hardyhead. This may have been due to the timing of this survey and potentially the extremely low abundance of Murray Hardyhead within this system.

Detailed survey (Sharpe 2014) was undertaken in March 2014, with the specific aim of targeting the collection of Murray Hardyhead. Survey gear types used were tailored to maximise encounter with small bodied fish species, including Murray Hardyhead; not to describe the entire fish community (as this was done in 2013). Survey equipment used was identical to that used in the efficient capture of Murray Hardyhead at other locations, including Cardross Lakes and Lake Hawthorn near Mildura.

This project conducted more than 2,800 hours of netting effort with small meshed fyke nets and seine hauls over eight survey nights during March 2014. Despite this effort, Murray Hardyhead were not detected in Middle Lake or Third Lake. Based upon the extensive survey effort applied in this project, the absence of Murray Hardyhead in these surveys indicates that the species is not present as a detectible population in either Middle Reedy Lake or Third Reedy Lake.

The absence of submerged aquatic plants and the relatively low salinity levels for each lake (recorded as electrical conductivity) are two habitat features considered likely to influence the status of Murray Hardyhead in Middle Reedy and Third Reedy Lake. In other locations where the species occurs, a close association between the occurrence Murray Hardyhead and the presence of submerged aquatic plants has been identified (Wedderburn SD, Walker KF et al. 2007); (Hammer and Wedderburn 2008)). In particular, it has been noted that dense beds of aquatic plants are required for the species to proliferate, with plants offering critical spawning substrate and shelter from predation.

Combined with the absence of submerged aquatic plants, it appears that Middle Reedy and Third Reedy Lake do not offer the key habitat conditions conductive to the proliferation of Murray Hardyhead as has been suggested for populations at other locations (Ebner, Raadik et al. 2003), (Wedderburn SD, Walker KF et al. 2007); (Stoessel 2008)). Based upon the extensive survey effort applied in this project, the absence of Murray Hardyhead in these surveys indicates that the species is not present as a detectible population in either Middle Reedy Lake or Third Reedy Lake.

The presence of Golden Perch are assumed to be mostly the result of fish stocking.

Biosis (2013) comment that most of the native species collected during the surveys prefer flowing riverine (lotic) habitats to still (lentic) water bodies. Many of these species, including Silver Perch, Bony Bream, Flatheaded Gudgeon, Golden Perch and Murray Cod, are known to be highly

mobile and have been recorded to move large distances from 10 to 1000 kilometres; (Humphries et al, 1999, and Cadwallader and Lawrence, 1990). The detection of four of these five species within the lakes surveyed, Silver Perch being the exception, indicates that movement between these lakes (lentic) and channels (lotic) by these species is necessary for them to complete their lifecycles. Silver Perch were detected within the channel between Middle and Third First Reedy only, and it is therefore difficult to make assumptions in regards to this species movement throughout the system

Table 16: Likelihood of impact on listed fish species at Third Reedy Lake

EPBC Act Significant Criteria	Freshwater catfish	Silver perch	Un-specked hardyhead	Murray Cod	Golden perch	Murray Hardyhead	LRFCSMDB
Lead to a long-term decrease in the size of an important population of a species	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Highly unlikely	Highly unlikely
Reduce the area of occupancy of an important population	Highly unlikely	Unlikely	Unlikely	Highly unlikely	Unlikely	Highly unlikely	Highly unlikely
Fragment an existing important population into two or more populations	Unlikely	Unlikely	Unlikely	Highly unlikely	Unlikely	Highly unlikely	Highly unlikely
Adversely affect habitat critical to the survival of a species	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Disrupt the breeding cycle of an important population	Unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Highly unlikely	Highly unlikely	Highly unlikely	Very highly unlikely	Highly unlikely	Very highly unlikely	Highly unlikely
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Introduce disease that may cause the species to decline	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Interfere substantially with the recovery of the species.	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely	Highly unlikely
Impact significance	**Not significant**	**Not significant**	**Not significant**	**Not significant**	**Not significant**	**Not Significant**	**Not significant**

Australasian Bittern *Botaurus poiciloptilus* (Endangered; FFG Threatened)

The Australasian Bittern is restricted to wetland habitats where it prefers dense reed-beds. This species is unlikely to occur throughout most areas of the proposed bypass, however it is possible that some wetland areas may be occasionally be utilised by the species including along drainage channels west of the Reedy Lakes and along the drainage system between Little Lake Charm and Racecourse Lake. These areas do not represent important habitat.

Swift Parrot *Lathamus discolor* (Endangered, FFG Threatened)

The Swift Parrot is a highly nomadic species that migrates to the Australian mainland from Tasmania every year. It mainly feeds on a diet of nectar from a range of Eucalypts and other nectar-producing trees and shrubs. The species is only occasionally recorded for the region and is more common in the box-ironbark region to the south. Although the possibility of this species occasionally foraging within the proposed bypass area cannot be ruled out, the area supports no critical habitat.

Malleefowl *Leipoa ocellata* (Vulnerable; FFG Threatened)

The Mallee Fowl is highly dependent on the presence of suitable mallee habitats. No such habitat was observed within or near the proposed bypass area and so this species is unlikely to occur.

Plains-wanderer *Pedionomus torquatus* (Vulnerable, FFG Threatened)

The Plains Wanderer prefers grassland habitat with a sparse, low cover of tussocks. No suitable habitat was observed within or near the proposed bypass area and so this species is unlikely to occur.

Australian Painted Snipe *Rostratula australis* (Vulnerable, FFG Threatened)

The Australian Painted Snipe is one of Australia's rarest wetland bird species, preferring a range of wetland habitats including low grassy meadows and open Lignum swamps. This species is unlikely to occur throughout most areas of the proposed bypass, however it is possible that some wetland areas may occasionally be utilised by the species including along drainage channels west of the Reedy Lakes and along the drainage system between Little Lake Charm and Racecourse Lake. However these areas do not represent core habitat.

Caspian Tern (*Hydroprogne caspia*) (Migratory, FFG Threatened)

The **Caspian Tern** (*Hydroprogne caspia*) is found in most coastal habitats throughout the world (Higgins and Davies 1996). In Australia populations are widespread on the coast and inland in the east. The species usually forages in open wetlands, including lakes and rivers, though it prefers sheltered shallow waters near margins. Caspian Tern occasionally breeds inland, though this is quite rare. In Victoria, the species is present in most coastal regions, with scattered records in the Murray Valley. Populations in the GMID are concentrated around Kerang Wetlands and Corop Lakes.

This species was recorded at several of the lakes during the survey period. Although the species may occasionally forage over the proposed bypass area, it is unlikely to be impacted by the proposed works. ((Rakali Consulting 2013).

Fork-tailed Swift (Pacific Swift), *Apus pacificus* (Migratory)

The Fork-tailed Swift is a non-breeding migrant to Australia. Habitat: is almost exclusively aerial from <1 m to 1000m. Most observed over inland plains in Australia, but sometimes recorded over coastal cliffs and beaches as well as urban areas. In Victoria it is widespread but scattered in all regions, mainly in the west and north and along coasts (DOE 2015). It has not been recorded at Third Reedy Lake (North Central CMA 2014)

Great Egret *Ardea alba* (or *modesta*) (Migratory, FFG Threatened)

The Great Egret occurs throughout a range of wetland habitats and was observed during the current survey period at several of the Kerang Lakes. This species is unlikely to regularly utilise the majority of the proposed bypass area due to the absence of suitable habitat. However the species may occasionally forage along the drainage system between Little Lake Charm and Racecourse Lake.(Rakali Consulting 2013)

Cattle Egret *Ardea ibis* (Migratory)

The Cattle Egret occurs throughout a range of wetland types and often forages in surrounding habitats, including in cleared paddocks. Land within the proposed bypass area is not considered important foraging or roosting habitat for this species. The species may occasionally forage along the drainage system between Little Lake Charm and Racecourse Lake.(Rakali Consulting 2013)
Latham's Snipe, Japanese Snipe *Gallinago hardwickii* (Migratory, FFG near threatened)

The **Latham's Snipe** (*Gallinago hardwickii*) is a migratory shorebird breeding primarily in Japan. The species is widespread from the Hunter Valley to south eastern South Australia and Tasmania and pass through eastern Queensland during migration. It is found in south eastern Australia in spring and summer in shallow freshwater wetlands with soft substrates and dense vegetation nearby. Inundation of shallow freshwater vegetated wetlands is important to its survival in this part of its non-breeding range. Its population in Victoria, Tasmania and South Australia is estimated at 15,000 (Higgins and Davies 1996), but the proportion occupying the GMID is not known. It has not been recorded at Third Reedy Lake (North Central CMA 2014) Appendix C

Australian Painted Snipe *Rostratula australis* (Vulnerable, Migratory, FFG Threatened))The Australian Painted Snipe is one of Australia's rarest wetland bird species, preferring a range of wetland habitats including low grassy meadows and open Lignum swamps. This species is unlikely to occur throughout most areas of the proposed bypass, however it is possible that some wetland areas may occasionally be utilised by the species including along drainage channels west of the Reedy Lakes and along the drainage system between Little Lake Charm and Racecourse Lake. However these areas do not represent core habitat.

Limited habitat within study area, individuals are likely to occur occasionally.
White-bellied Sea-Eagle *Haliaeetus leucogaster* (Migratory, FFG Threatened))

The **White-bellied Sea-eagle** (*Haliaeetus leucogaster*) is found along the coasts of south east Asia, India and Australasia (Marchant and Higgins 1993). It is a bird of maritime habitats, and large inland wetlands and waterways in tropical and temperate Australia and offshore islands. It ranges inland only along large rivers and water bodies. This eagle hunts over extensive, open areas of water. In inland habitats, it usually breeds in tall trees in or near water, or on cliffs, rock pinnacles and escarpments.

The White-bellied Sea-eagle feeds on birds, reptiles, fish, mammals, crustaceans and carrion, usually hunting from an exposed perch, followed by a plunge-dive, sometimes almost completely submerging for surface swimming fish (Marchant and Higgins 1993). There are records of the eagle breeding in the Murray Valley and its tributaries. In GMID, records of this species come from larger waterways and permanent open freshwater wetlands, including water storages. GMID is likely to support a small number of the limited number of pairs present in inland Victoria. At a national level, numbers in the region are unlikely to be significant.

While the White-bellied Sea-eagle has been recorded from the bypass area west of the Reedy Lakes, this is likely from fly-over record, and this species is unlikely to be impacted by the proposed bypass works. (Rakali Consulting 2013). In recent years breeding has occurred at the nearby Middle Reedy Lake (pers comm Mick Dedini, DELWP)
Rainbow Bee-eater *Merops ornatus* (Migratory)

The Rainbow Bee-eater is distributed across much of mainland Australia, and occurs on several near-shore islands. It occurs in open woodlands and shrub-lands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (and, especially in arid or semi-arid areas), in riparian, floodplain or wetland vegetation assemblages) (The only actual, identified threat to the Rainbow Bee-eater is the introduced Cane Toad (*Bufo marinus*).

Is not recorded at Third Reedy Lake ((North Central CMA 2014) Appendix C)
Yellow Wagtail *Motacilla flava* (Migratory)

The species is considered a vagrant to Victoria, South Australia and southern Western Australia. In Victoria it is considered vagrant to coastal areas. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves. It has not been recorded at Third Reedy Lake (DOE 2015)
Satin Flycatcher, *Myiagra cyanoleuca* (Migratory)

Satin Flycatchers are found extensively along the Great Dividing Range along the eastern and south-east seaboard of Australia – from Cape York to eastern South Australia. In Victoria they are

widespread in south and east south of a line running through Numurkah, Maldon, north Grampians, Balmoral and Nelson. Scattered records from Little Desert. (DOE 2015). They have not been recorded at Third Reedy Lake ((North Central CMA 2014), Appendix C
Biosis 2013 notes:

The EPBC Protected Matters Report included an additional nine species, including the Sharp-tailed *Calidris acuminata,* Curlew Sandpiper (*Calidris ferruginea*), Red-necked Stint (*Calidris ruficollis*), Double-banded (*Charadrius bicinctus*), Latham's Snipe (*Gallinago hardwickii*), Bar-tailed Godwit (*Limosa lapponica*), Black-tailed Godwit (*Limosa limosa*), Little Curlew (*Numenius minutus*) and Marsh Sandpiper (*Tringa stagnatilis*). The majority of the study area does not support suitable habitat for these species, however they may occasionally utilise habitats along the drainage channels west of the Reedy Lakes and along the drainage system between Little Lake Charm and Racecourse Lake.

Table 17: Likelihood of impact on vulnerable bird species

EPBC Act Significant Criteria	**Malleefowl *Leipoa ocellata***	**Plains-wanderer *Pedionomus torquatus***	**Australian Painted Snipe (*Rostratula australis*)**
Adverse long-term impact to population size	Highly unlikely	Highly unlikely	Highly unlikely
Reduction in habitat quality and availability	Highly unlikely	Highly unlikely	Highly unlikely
Fragmentation of existing populations	Highly unlikely	Highly unlikely	Highly unlikely
Disruption to breeding cycles	Highly unlikely	Highly unlikely	Highly unlikely
Introduction of non-indigenous species and diseases	Highly unlikely	Highly unlikely	Highly unlikely
Interfering substantially with the recovery of a species	Highly unlikely	Highly unlikely	Highly unlikely
Impact Significance	**Not significant**	**Not significant**	**Not significant**

Table 18:Likelihood of impact on critically endangered and endangered bird species

EPBC Act significant criteria	**Australasian Bittern *Botaurus poiciloptilus***	**Swift Parrot (*Lathamus discolour*)**
Adverse long-term impact to population size	Highly unlikely	Highly unlikely
Reduction in habitat quality and availability	Highly unlikely	Highly unlikely
Fragmentation of existing populations	Highly unlikely	Highly unlikely
Disruption to breeding cycles	Highly unlikely	Highly unlikely
Introduction of non-indigenous species and diseases	Highly unlikely	Highly unlikely
Interfering with the recovery of a species	Highly unlikely	Highly unlikely
Impact Significance	**Not significant**	**Not significant**

Table 19 Likelihood of impact on migratory bird species (No = highly unlikely; NS = not significant)

EPBC Act significant criteria	**Caspian Tern (*Hydroprogne caspia*)**	**Fork-tailed Swift (Pacific Swift), *Apus pacificus***	**Swift Parrot (*Lathamus discolour*)**	**Great Egret *Ardea alba* (or *modesta*)**	**Cattle Egret *Ardea ibis***	**Latham's Snipe, Japanese Snipe *Gallinago hardwickii***	**White-bellied Sea-Eagle *Haliaeetus leucogaster***	**Rainbow Bee-eater *Merops ornatus***	**Yellow Wagtail *Motacilla flava***	**Satin Flycatcher, *Myiagra cyanoleuca***
Adverse long-term impact to population size	No	No	No	No	No	No	No	No	No	No
Reduction in habitat quality and availability	No	No	No	No	No	No	Unlikely	No	No	No
Fragmentation of existing populations	No	No	No	No	No	No	No	No	No	No
Disruption to breeding cycles	No	No	No	No	No	No	No	No	No	No
Introduction of non-indigenous species and diseases	No	No	No	No	No	No	No	No	No	No
Interfering with the	No	No	No	No	No	No	No	No	No	No

recovery of a species										
Impact Significance	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Conclusion
Based on the assessment above, apart from the removal of 6.8 ha of native vegetation, significant impact on other flora and fauna species is expected to be unlikely to very highly unlikely.

Is mitigation of potential effects on indigenous flora and fauna proposed?
☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Construction – works will be sited, where possible to avoid effects to flora and fauna. A Site Environmental Management Plan will be developed to ensure that works are carried out in accordance with relevant legislation and that detail regarding siting and location of works, water management, dust and noise are managed.

Environmental Water management – provision of the environmental water regime will alter the ecology of the wetland to be more productive, providing habitat and foraging opportunities for a broader range of flora and fauna currently found there. Environmental water management will be guided by an Environmental Watering Plan (EWP).

Fish passage along the bypass channel – provides for linking of water bodies south of Third Reedy Lake (Middle and First Reedy Lakes) with water bodies further to the north - Lake Charm, Little Lake Charm, Racecourse Lake and Kangaroo Lake. It is not intended to provide fish passage between Third Reedy Lake and the connecting channel as this connection will only operate during filling or flushing of the lake every 4 years and during its operation it is not expected to provide a barrier to fish movement.

Offsets will be provided for native vegetation removal.

Operations

Operational Plan – to guide management of salinity in Third Reedy Lake

Fish management plan - to guide management of fish (and dead fish) in drying phase (noting that fish biomass is 99% carp) and provide appropriate cues for native fish to exit lake.

Other information/comments? (eg. accuracy of information)

13. Water environments

Will the project require significant volumes of fresh water (eg. > 1 Gl/yr)?

☐ NYD ☒ No ☐ Yes If yes, indicate approximate volume and likely source.

The project does not require significant volumes of "new" freshwater. It will provide water savings contributing to the overall GMW CP Stage 2 water savings target, which will be owned by the Commonwealth Environmental Water Holder and used to improve the health of priority wetlands and waterways

Will the project discharge waste water or runoff to water environments?

☐ NYD ☒ No ☐ Yes If yes, specify types of discharges and which environments.

Are any waterways, wetlands, estuaries or marine environments likely to be affected?

☐ NYD ☐ No ☒ Yes If yes, specify which water environments, answer the following questions and attach any relevant details.

Third Reedy Lake will be directly affected by the project.

Other downstream lakes, Little Lake Charm, Racecourse Lake, Kangaroo Lake and Lake Boga have potential to be affected.

Work including refurbishment of a regulator and linking of the by-pass channel will be required in the waterway linking Middle Reedy and Third Reedy Lakes.

Are any of these water environments likely to support threatened or migratory species?

☐ NYD ☐ No ☒ Yes If yes, specify which water environments.

As described in Section 12 above

These water environments are likely to support threatened or migratory species.
The only water environment to be significantly impacted is Third Reedy Lake. The likely impacts of the change on threatened or migratory species at Third Reedy Lake has been assessed above in Section 12 (pages 25-33).
Given that the likely magnitude of potential changes at other, downstream, water environments, will be very small (ie no changes in water levels, small increases in salinity (up to 100 EC) the impact on threatened or migratory species will be negligible.

Are any potentially affected wetlands listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'?

☐ NYD ☐ No ☒ Yes If yes, please specify.

Third Reedy Lake is part of the Kerang Lakes Ramsar Complex and is also listed in the Directory of Important Wetlands in Australia.

It is implausible that upstream sites could be affected.

Table 20Downstream lakes wetlands that could potentially be affected by the project include;

Lake/wetland	Ramsar	DoIW	Potential impact from project
Third Reedy Lake	✓	✓	Change in water regime
Little Lake Charm,	✓	✓	Occasional increase in salinity
Lake Charm,	✓	✓	No change; managed hydraulic connections.
Racecourse Lake,	✓	✓	Occasional increase in salinity (up to 100 EC increase)
Kangaroo Lake	✓	✓	Occasional increase in salinity (up to 100 EC increase)
Lake Boga	N	N	Possible small increases in salinity
Cullens Lake -	✓	✓	No change. Managed hydraulic connection.
Stevensons Swamp	✓	✓	No change; no hydraulic connection.
Murray River and downstream Ramsar sites.	✓	✓	No plausible impact; most sites are hundreds of kilometres downstream and are subject to a

Banrock station wetland complex 300 - 400km downstream Hattah-Kulkyne lakes 150 - 200km downstream Kerang wetlands Within Ramsar site Riverland 300 - 400km downstream The Coorong, and Lakes Alexandrina and Albert wetland 300 - 400km downstream			variety of water management regimes. Potential impacts on downstream components of the Kerang Ramsar site are assessed above.	

Could the project affect streamflows?

☐ NYD ☒ No ☐ Yes If yes, briefly describe implications for streamflows.

The project may have a very minor to negligible effect on flows in Box Creek/Pyramid Creek. These creeks are used to deliver water to irrigators via Kerang Weir and the Kerang Wetlands. During the irrigation season flow in Box Creek is around 750 ML/day. The volume of water saved (~1600 ML/ year) compared to the volume delivered (up to 750 ML/day x 6-8 months) overall is negligible and will have a negligible impact on Box/Pyramid Creek flows.

There will be no change to running water levels of other lakes in the Kerang Lakes system.

There will be no impact on the Loddon River.

Could regional groundwater resources be affected by the project?

☐ NYD ☐ No ☒ Yes If yes, describe in what way.

The Parilla Sand aquifer situated below the Shepparton Formation aquifer is an important aquifer at a regional scale but in the context of this project it is unlikely to be affected due to:

- The lower (by several orders on magnitude) hydraulic conductivity of the overlying Shepparton Formation sediments,
- The relatively small vertical hydraulic gradient between the two formations (in the study area).
- Climate (regional rainfall recharge) being the more dominant driver for groundwater levels (Shepparton Formation & Parilla Sand aquifers) than localised lake levels.

Furthermore, high groundwater tables create a substantial salinity threat to ecological values, and any reduction in regional water-table levels would be beneficial and in alignment with regional catchment strategies.

Could environmental values (beneficial uses) of water environments be affected?

☐ NYD ☐ No ☒ Yes If yes, identify waterways/water bodies and beneficial uses (as recognised by State Environment Protection Policies)

Table 21Beneficial use impact assessment (Y= potential to affect beneficial use; N = beneficial use unlikely to be affected/impacted)

Beneficial use (from SEPP(WOV)	Waterbody/lake						**Potential impact**
	Scotts Creek (No 7 Channel)	Little Lake Charm	Lake Charm	Racecourse Lake	Kangaroo Lake	Lake Boga.	
Aquatic ecosystems	Y	Y	Y	Y	Y	Y	Salinity and ASS could affect this beneficial use. Small increases in salinity are possible at infrequent intervals. Likelihood can be managed (see Attachment 4 section 20)
Primary contact recreation	Y	Y	Y	Y	Y	Y	Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence – very low number of users.
Secondary contact recreation	Y	Y	Y	Y	Y	Y	Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence. Low number of users
Aesthetic enjoyment	Y	Y	Y	Y	Y	Y	Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence. Small number of users
Indigenous cultural and spiritual values	N	Y	Y	Y	Y	Y	Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence.
Non-indigenous cultural and spiritual values	N	Y	Y	Y	Y	Y	Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence.
Agriculture and irrigation	Y	Y	Y	Y	Y	Y	Salinity increases and ASS could affect this beneficial use. Likelihood can be managed (see Attachment 4 section 20)
Industrial and commercial use	N	N	N	N	N	N	No use is made of lake water for this purpose. Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence
Human consumption after appropriate treatment	N	N	N	N	N	N	No use is made of lake water for treatment for human consumption (ie urban water supply). Ability to use lake for beneficial use highly unlikely to be affected. Insignificant consequence
Fish, crustacean and mollusks for human consumption.	Y	Y	Y	Y	Y	Y	Use made of lakes for recreation fishing with some fish used for human consumption. Ability to use lake for beneficial use unlikely to be affected. Insignificant consequence.

Could aquatic, estuarine or marine ecosystems be affected by the project?
☒ NYD ☒ No ☒ Yes If yes, describe in what way.

The project could affect aquatic ecosystems by potential changes in:

- Hydrology
- Water quality (salinity)
- Acid soil formation.

Limits of Acceptable Change (LAC)

The Kerang Lakes Ramsar Ecological Character Description (ECD) defines limits of acceptable change (Variation that is considered acceptable in a particular component or process of the ecological character of the wetland without indicating change in ecological character that may lead to a reduction or loss of the criteria for which the site was Ramsar listed). The hydrology and physiochemical Limits of Acceptable Change (LAC), relevant to Third Reedy Lake and which will be affected by the project are tabulated below:

Table 22: Limits of acceptable change (LAC) applicable to Third Reedy Lake (KBR 2011)

Water bodies	Baseline condition and range of natural variation where known	LAC	Basis of LAC	Confidence level
Lake Charm Little Lake Charm Third Lake	These lakes are influenced by the Torrumbarry Irrigation System established in 1923. The lakes are maintained at or near full supply level to maintain ecological condition of littoral zone, with annual fluctuations of up to 1000 mm. These lakes were flooded in the extreme flood event of 2011. The water regimes of these wetlands are artificially managed. There is uncertainty about whether a more natural water regime, such as that which existed prior to 1923, would represent an unacceptable change. As such, the LAC is set around conditions prevailing at the time of listing (1982).	Permanently inundated. Not to exceed the 1000 mm range of fluctuation in water levels two years in a row.	Based on knowledge of the prevailing operating conditions at and since the time of listing.	Low
Third Lake	Mean salinity level is 360 EC; maximum is 1200 EC (KLAWG 1992).	Salinity levels to be less than 4000 EC when lake is more than 75% full.	Based on expert opinion of project steering committee and tolerance levels of biota to salinity cited in PPK Environment and Infrastructure (2000).	Low

No other LAC specifically apply at Third Reedy Lake.

Table 23: Assessment of impact of proposed change at Third Reedy Lake against LAC

LAC	Assessment
Hydrology	The wetland will be substantially modified by the proposed change in water regime. This change will affect volume, timing, duration and frequency of surface water flows and potentially affect ground water flow into the wetland. This will be

	a significant impact. There are substantial benefits from the proposed change and it is likely to beneficial to the LAC.
Water quality/salinity	The salinity LAC is unlikely to be triggered **providing** salinity water quality objectives are adopted and management is implemented to ensure target achievement.

Hydrology LAC

The proposed Third Reedy Lake water regime is described in the table below.

Table 24: Third Reedy Lake - current and proposed water regime

KLBI lake	Current Water Regime	Proposed Environmental Watering Regime
Third Reedy Lake	Irrigation regulation (FSL 74.56 mAHD). Permanently freshwater lake minimal fluctuations of water level between 74.2 – 74.56 mAHD)	3 × 4 year cycles, with the first year of the first two cycles rising to 74.0 with the first year of the third cycle rising to 74.56 and being held for 31 days to allow a flushing flow for salt management. It includes an option for an intermediate rise to about 73.2 m with a duration of 31 days which could be included in the third year of each cycle for ecological (frogs and turtles) purposes **if necessary** for adaptive management purposes. An establishment phase to provide opportunities for establishment of River Red Gums across the wetland floor is proposed.

The rationale for 4 year cycles is based around considerations of moving the lake from a permanent wetland to something more closely resembling its natural wetting and drying cycle. Being the furthest downstream in the Reedy Lakes series, Third Reedy Lake would have been the driest of the three, and is thought to have been an intermittent wetland before the 1920s. The proposal does not seek to reinstate the supposed pre-European water regime of Deep Freshwater Marsh but to provide a water regime that is episodic and is considerably drier than it has been over the last 90 years. This is expected to reverse at least two of the current symptoms of a stable permanent water regime: the development of a live River Red Gum woodland, and conditions favourable to building up numbers of Common carp.

The selection of the 4 year cycle water regime was determined in close collaboration with the GMW CP Expert Review Panel and the NC CMA (see letter Attachment 4, appendices 4 and 5).

The option of an intermediate rise to about 73.2mAHD is included, although the ecological benefit of this is questionable due to the small area inundated and the likely short duration of inundation.

The two figures below are modelled representations of the application of the water regime over the period 1980 to 2010 (modelling covers the period 1892 to 2010). Figure 1 shows lake water level and Figure 2 shows proportion (%) of lake bed exposed (1= totally dry lake). The period 1980 to about 1998 was a wet period, while the period post 1998 was characterised by severe drought. The figures highlight the influence of climate (eg rainfall, wet/dry periods) on the hydrology of the lake. While the water regime outlined above is the management objective, it is highly likely that it will be influenced by climate and weather over time and an adaptive management regime, guided by environmental water plans, will be in place to guide management and achievement of management objectives. Figure show that the difference in water level using 1980 onwards vs the full data set (1891 onwards) is relatively small.

Figure 5 in attachment 1 shows area of lake inundated at 74.56, 74.0 and 73.3 m.

Figure 1 Third Reedy Lake modelled water level with new water regime

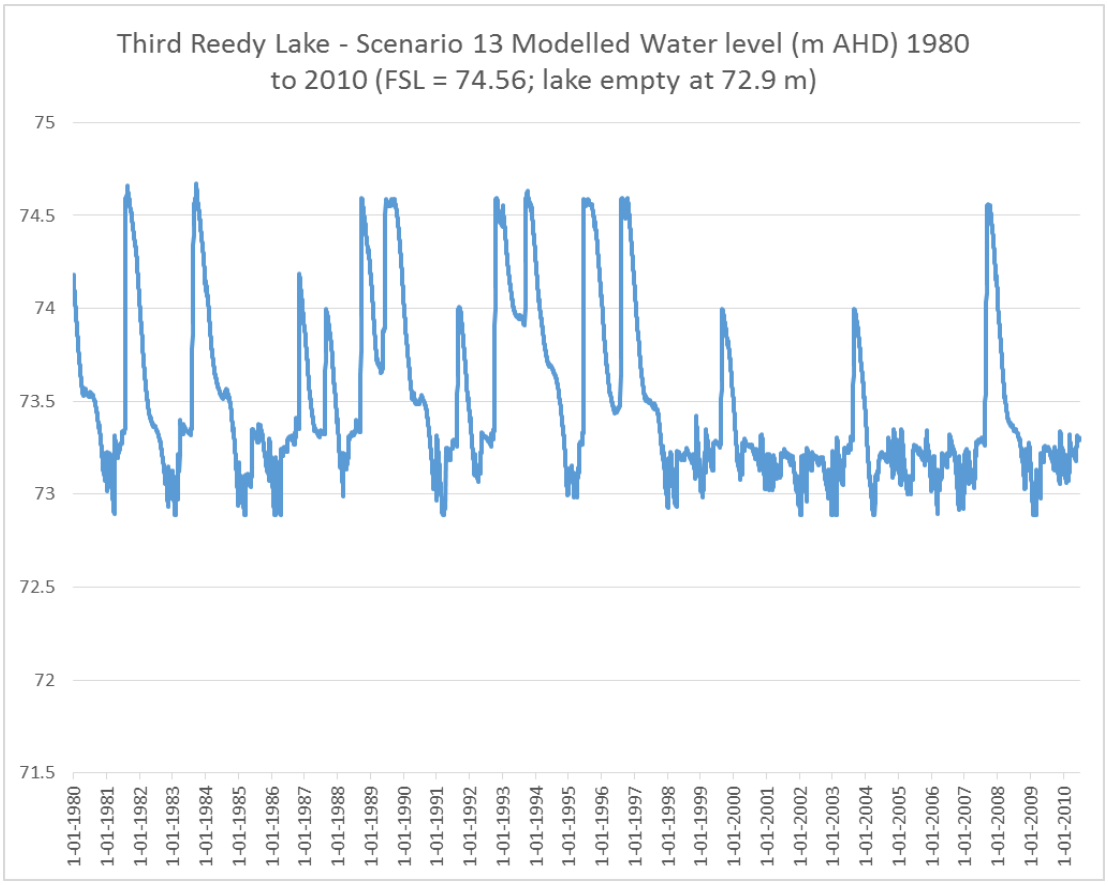


Figure 2 Third Reedy Lake modelled proportion of lake bed exposed with new water regime

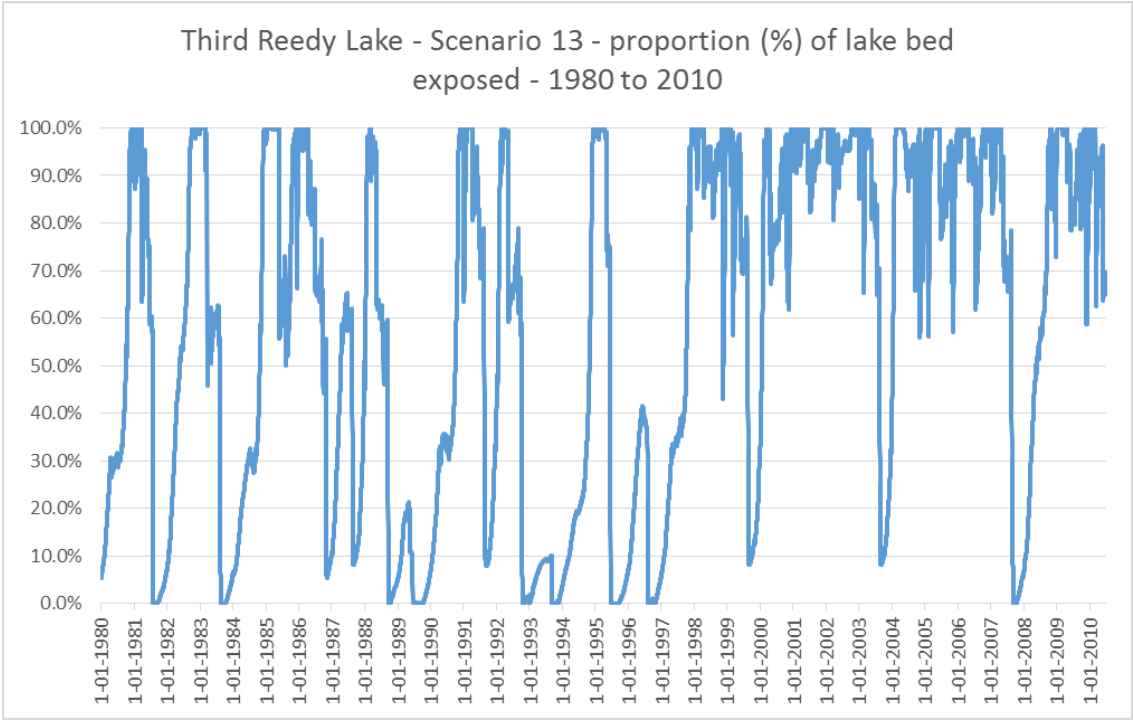
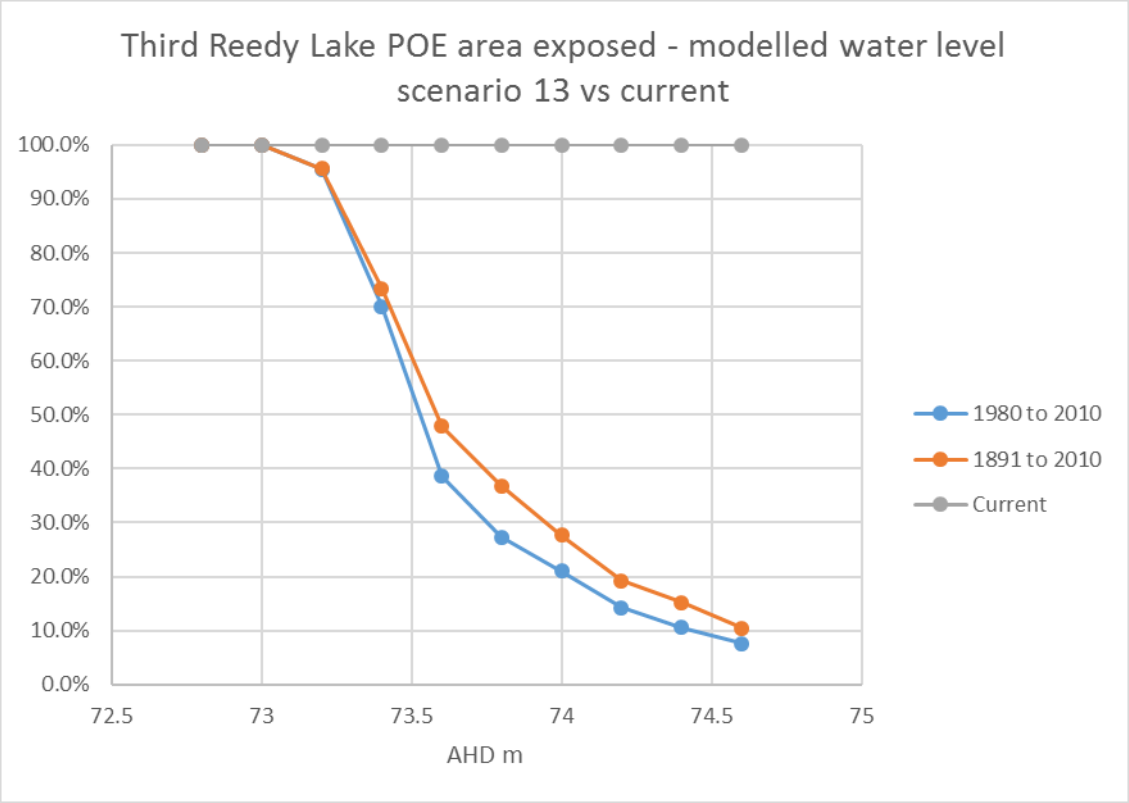


Figure 3 Third Reedy Lake Probability of Exceedance – modelled water level 1980 to 2010 vs 1891 to 2010



Implementing the Third Reedy Lake bypass will substantially modify the wetland's hydrological regime. It will change from permanent open water to a deep freshwater marsh. This change will affect volume, timing, duration and frequency of surface water flows and potentially affect ground water flow into the wetland. This will be a significant, but not necessarily negative, impact.

(North Central CMA 2014)reviewed potential changes and concluded there would be no change in ecological character. Detailed benefit / risk assessment was undertaken indicating improvements in River Red Gum and understorey species extent and increases bird breeding and feeding opportunities during wetting phase ((North Central CMA 2014). They noted:

- Drying allows establishment of Red Gum seedlings (under assumption that there is appropriate seed source available). Health of trees is maintained through an appropriate cycle of wetting and drying (Roberts and Marston 2011)
- Drying will allow understory vegetation to establish in wetland body (expansion of Intermittent Swampy Woodland). Variability in water level promotes diversity of vegetation ((Rogers and Ralph 2011) (Roberts and Marston 2011)).
- Flooding acts as a stimulus for breeding in most waterbirds. Depth and duration of flood water as well as drawdown impact on the success (Rogers and Ralph 2011).
- Wetlands are highly productive during the re-wetting and drawdown phase (i.e. organic matter, insects, shoots, seeds etc) ((Rogers and Ralph 2011)Rogers and Ralph, 2011).

There are substantial benefits from the proposed change and it is likely to be beneficial to the LAC. There is an extensive literature (reviewed in Feehan (2016)) about the importance of wetting and drying phases for the ecology of wetlands such as Third Reedy Lake. The loss of a drying phase can affect physical and geomorphic processes, habitat availability at both local and landscape scales, biological and ecological processes for riverine and floodplain flora and fauna (e.g. breeding, migration, recruitment, metabolism, and competition), water quality and the cycling of nutrients and energy and resilience to invasive flora and fauna species.

None of the literature reviewed suggests that maintaining the current water regime at Third Reedy Lake will result in the occurrence of natural processes. The reinstatement of wetting and drying to Third Reedy Lake will clearly have a beneficial effect. The review of relevant literature clearly

indicates that lakes such as Third Reedy Lake, which was originally an ephemeral wetland, would benefit from provision of a water regime that included both wet and dry phases.

Case studies of reinstatement of the drying phases in lakes in the Murray Darling Basin (Feehan 2016) suggest a general overall improvement in the condition of the subject lakes. There is no indication that drying phase reinstatement has resulted in adverse ecological outcomes. In some cases, beneficial outcomes have been achieved quite quickly.

This indicates that a more natural water regime, such as that which existed prior to 1923, would represent a positive (and therefore, acceptable) change.

Benefits of implementing the proposed option

In their current condition, the Kerang Lakes in the project area support opportunistic feeding and breeding opportunities for water-birds, although productivity under the current water regime is significantly reduced and the value the wetlands could provide to significant colonial nesting water-birds breeding in the Ramsar site is somewhat diminished.

The proposed water regime changes will enhance the habitat value for water-birds across the KLBI wetlands. For example, Third Reedy Lake will provide breeding water-birds with habitat to forage (B. Lane [Brett Lane & Associates] pers. comm. 18 Sept 2013).

Post change

After the implementation of the water regime changes proposed at Third Reedy Lake, the lake will continue to provide:

- a range of habitat types suitable for water-bird nesting, resting and breeding
- a range of terrestrial and aquatic food sources including insects, macro-invertebrates, fish, algae and plant matter.

The ERP considers that changing the water regime to include drawdowns as at Third Reedy Lake is an unparalleled ecological opportunity for this wetland complex, for two reasons. First, there is the chance to have a wetland where the negative effects of Common Carp dominance can be ameliorated and serve as a public and high profile demonstration site, possibly becoming a special feature of the Kerang Lakes. Second, this should add considerably to the diversity of the wetland complex, by providing conditions favourable for certain migratory birds, frogs and a range of plants that currently are under-represented.

Third Reedy Lake is currently classified as permanent open water (Lugg 1989) using the Victorian wetland classification system (Corrick and Norman 1980). In the NC CMA region, the area of this wetland type has almost doubled in size since European occupation and this wetland type is now considered over-represented in the landscape (NCCMA 2014). In the Kerang Wetlands Ramsar site, eight wetlands are currently classified as permanent open water.

After implementation of the project, the wetland classification of Third Reedy Lake will change to deep freshwater marsh. Of the six wetland types present within the Ramsar site, shallow freshwater marshes and deep freshwater marshes are amongst the most depleted wetland categories in Victoria, with only 40% of the original area of shallow freshwater marshes and 30% of deep freshwater marshes remaining. The deep freshwater marshes within the Kerang Lakes Ramsar site represent 3.8% of the area of this wetland type remaining in Victoria, while the shallow freshwater marshes represent 0.5% of this wetland type in the State (DSE 2010). Alteration of their wetland classifications will therefore contribute to increasing the area of depleted wetland categories.

Table 25: Proposed ecological objectives and benefits for the wetlands (NC CMA 2014).

Third Reedy Lake
Maintain health of existing Black Box fringing wetland vegetation (within Intermittent Swampy Woodland)
Restore opportunities for recruitment of River Red Gum trees through body of wetland
Restore diverse understorey Intermittent Swampy Woodland vegetation (i.e. lignum and sedge communities) in the body of the wetland able to withstand fluctuating water levels
Restore water-bird breeding opportunities
Restore water-bird feeding opportunities
Provide opportunistic turtle and frog feeding and breeding

Maintain connectivity between Reedy Lakes
Restore ecological process associated with intermittent drying

Conclusion

The KLBP Investigation wetlands currently contribute to the Ramsar listing, and the changes proposed will enhance breeding, roosting and feeding for waterbirds. It is concluded that the proposed hydrological change at Third Reedy Lake would represent an acceptable ecological change.

Salinity LAC (Attachment 4, Section 20)

For the preferred option (Scenario 13 in the table below) URS (2014) estimated salt inflow to the lakes at P50 (50th percentile)and P80 (80th percentile) return intervals. (The P20 figure represents the lowest 20% of values and will be exceeded 80% of the time. It can be considered the best case scenario. It will occur when groundwater levels are below the level of the lake bed. The P50 figure represents the median and will be exceeded 50% of the time. The P80 figure represents the highest 20% of values and will be exceeded 20% of the time. It can be considered the worst case scenario. It will occur when groundwater levels are near, or above, the level of the lake bed. Webb in Attachment 4, Sec 17.4.2 considered the results as a worst case scenario.

Table 26 – Summary of Monte Carlo Simulations – Third Reedy Lake Salt Inflow (tonnes) (URS 2014)

Scenario	Percentile		
	P20	P50	P80
Current	0	0	100
Scenario 13	0	800	5,370

The Scenario 13 salt loads have been used to assess salt impacts (see below).

Salinity LAC assessment

The LAC reads “Salinity levels to be less than 4000 EC when lake is more than 75% full”. Volume and equivalent level is given in rating tables prepared as part of bathymetry mapping.

Table 27Table: Volume and level of Third Reedy Lake at 75% full (by volume)

	Volume at FSL ML	75% volume ML	Level of the lake at 75% full
Scenario 1 FSL 74.56 m AHD	2459	1872	74.3 m AHD
Scenario 2 FSL 74.0 m AHD	1221	809	73.8 m AHD

Management of the lake is intended to have EC levels at acceptable levels when the lake is full (regardless of the starting EC).

Salinity impact assessment method

EC on filling

Salinity has been assessed as Third Reedy Lake fills and dries, using a simple spread sheet model. The salinity at lake full can be assessed against the target. If the target is achieved, no further action is required. If the target is not achieved, management action can be implemented to ensure the target is reached.

Table 28: Summary of spreadsheet model results for salinity at Third Reedy Lake – scenario 13 – filling from empty. Salt loads from (URS 2014)

		Scenario1 fill from empty to 74.56		Scenario 2 fill from empty to 74.0	
75% by volume		EC at 75% volume level (74.3 m)	EC at 100% volume	EC at 75% volume level (73.8 m)	EC at 100% volume
	EC @ P50 salt load	934	770	1831	1298
	EC @ P80 salt load	4840	3744	10863	7282

P50 salt loads do not cause exceedance of LACs. P80 salt loads do cause LAC exceedance. The number and quantum of exceedance results will increase as salt load levels increase from P50. There should be no LAC exceedance results at below P50 levels.

A management objective is to have EC levels at acceptable levels when filling has been completed. This will be achieved by salt flushing with irrigation water until desired levels are reached (see below).

EC on drying

As the lake dries by evaporation EC will naturally rise as salt is concentrated. In the drying from full scenario and assuming the starting EC is the same as Torrumbarry system water (ie 250 EC), EC at 75% full will be 327 and 375 in the 74.56 and 74.0 starting level scenarios. These EC present no risk to LAC exceedance.

Conclusion

The salinity LAC could be exceeded at some times in the filling phase. It will not be triggered in the drying from full phase.

Acid Sulfate Soils (ASS)

The potential for ASS formation has been considered and is further discussed in Section 14 (Soils).
Overall, the project is likely to have a beneficial effect on aquatic ecosystems (subject to the outcomes of the required ASS investigation) and occasional impacts on salinity in downstream waterbodies.

Is there a potential for extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems over the long-term?

☐ No ☒ Yes If yes, please describe. Comment on likelihood of effects and associated uncertainties, if practicable.

Implementation of the project will have a major impact on the aquatic environment of Third Reedy Lake. It will change from permanent open freshwater to deep freshwater marsh.

Of the six wetland types present within the Ramsar site, shallow freshwater marshes and deep freshwater marshes are amongst the most depleted wetland categories in Victoria, with only 40% of the original area of shallow freshwater marshes and 30% of deep freshwater marshes remaining. The deep freshwater marshes within the Kerang Lakes Ramsar site represent 3.8% of the area of this wetland type remaining in Victoria, while the shallow freshwater marshes represent 0.5% of this wetland type in the State (DSE 2010). Alteration of their wetland classifications will therefore contribute to increasing the area of depleted wetland categories.

The proposal does not seek to reinstate the supposed pre-European water regime of Deep Freshwater Marsh but to provide a water regime that is episodic and is considerably drier than it has been over the last 90 years. This is expected to reverse at least two of the current symptoms of a stable permanent water regime: the development of a live River Red Gum woodland, and conditions favourable to building up numbers of Common carp.

See earlier section for discussion of potential environmental effects on hydrology and salinity.

Is mitigation of potential effects on water environments proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Hydrology

No specific mitigation is proposed for hydrology. It is proposed to prepare and implement an agreed EWP, in line with the requirements of Section 15 of the GMW CP Water Change Management Framework (WCMF) to guide the management of the wetland and its water regime. (Note that the WCMF does not strictly apply to this project; however the principles of the WCMF and other Connections Project environmental approval conditions provide useful mitigation and management guidance).

Salinity management (Attachment 4 Section 20)

Dilution and flushing by natural floods or by managed flushing are the two most likely mechanisms salt concentrations and loads in the Lake can be kept within desirable limits.

Salt flushing means the dilution and downstream transport of lake water to acceptable limits. The aim is to ensure that downstream lake water EC remains within acceptable limits for irrigation . (700 EC (MDBA 2010)).

In the absence of natural flushing from unregulated flows, elevated EC levels can be managed operationally. Advice from Ross Stanton (GMW) suggests flushing from Third Reedy Lake is possible down to about 73.0 mAHD and very achievable at 74.0 (the lake is full at 74.56mAHD and empty at 72.9 mAHD). This provides plenty of scope to flush salt from Third Reedy Lake with minimal downstream EC impact. Water and salt flushed from Third Reedy Lake can be shandied using the bypass channel. Varying the ratio of lake water to bypass channel water provides the means of keeping No 7 channel EC within acceptable limits. Simple modelling suggests impacts in Kangaroo Lake, downstream, can be limited to < 100 EC. Impacts in Little Lake Charm and the 1/7 channel will be greater but can be maintained below irrigation guideline values. Shandying rates can be manipulated until acceptable outcomes are achieved.

This suggests there will be times when flushing will need to be maintained for periods longer than 30 days to ensure downstream impacts are minimised. This emphasises the need for adaptive management of water regimes (around the proposed water regime) depending on climatic conditions, unregulated flows and groundwater behaviour.

This work highlights the need to:

- Actively manage flushing to limit downstream impacts
- Manage lake levels to avoid groundwater and salt ingress during periods of high surrounding groundwater levels.

Requirement for operational plan

The management of salinity in Third Reedy Lake emphasises the need for operational rules and a plan to manage flows and salinity in the lake depending on a number of environmental variables. These variables will include:

- Groundwater levels under, and adjacent to, the lake (slow rate variable)
- Flow rates and EC in bypass channel (fast rate variable)
- EC in lake (slow rate variable)
- EC in Kangaroo Lake (slow rate variable).

The rate of change of the variable will determine the temporal scale at which the variable can be managed.

Some of these aspects may be covered in the EWP.

Conclusion

Providing salinity can be monitored and managed variation in salinity levels assessed above should not present ecological risks.

Mitigation and management of potential effects on water environments will be guided by preparation of an environmental water plan as set out in the GMW CP WCMF. This will guide the implementation of the proposed environmental water regime and set out monitoring and

evaluation criteria to assess success or otherwise.

Refer to Table in Section 18 for a full list of proposed mitigation measures.

Mitigation of potential salinity impacts will be guided by preparation of a salinity management operational plan - operational rules and a plan to manage flows and salinity in the lake depending on a number of environmental variables. These variables will include:

- Groundwater levels under, and adjacent to, the lake
- EC in lake – dependent on groundwater levels and inflows during dry phase.
- Flow rates and EC in bypass channel
- EC in Kangaroo Lake and Little Lake Charm.

Other information/comments? (eg. accuracy of information)
Flooding

SKM (2014) (Section 2.4) considered cross drainage in developing the bypass channel conceptual design. They noted:

- *Detailed survey of the alignment undertaken during the Detailed Design phase should be reviewed to identify any other minor depressions along the selected alignments that could be investigated further for localised drainage impacts.*
- *The outcomes of this may be minor earthworks to redirect localised drainage paths.*
- *The likelihood of subway structures being required to transfer drainage from one side of a bypass channel to the other is considered to be low.*

SKM (2014) (Section 2.5) also considered potential flooding impacts. The channel alignments selected effectively run parallel with the direction of overland flows during a flood event. On this basis the anticipated impact of the bypass channel on flooding events has been assessed to be minor. This assessment is based on the topographical information available from the LIDAR survey and some aerial photography taken during a moderate flood event. It should be noted that a flood study has not been undertaken to support this assessment.

Regulator structures have been designed to either retain flood flows using the gates at control structures, or be overtopped during events for open/close structures. In each case the access walkways for operating the gates have been designed to be above the known flood level.

The bypass channel generally follows the edge of the Gannawarra Planning Scheme Rural Flood Overlay but some works may occur within the RFO. Proposed works follow the edge of the Land Subject to Inundation Overlay.

14. Landscape and soils

Landscape

Has a preliminary landscape assessment been prepared?

☒ No ☐ Yes If yes, please attach.

No assessment of the landscape impact of the bypass has been undertaken. However, given that the bypass will not be impacting on the vegetation fringing the lake (i.e. the tall timber) the impact is expected to be minimal. The bypass channel will be of similar character to other irrigation channels that are nearby and scattered across the regional landscape.

Is the project to be located either within or near an area that is:

- **Subject to a Landscape Significance Overlay or Environmental Significance Overlay?**

☐ NYD ☐ No ☒ Yes If yes, provide plan showing footprint relative to overlay.

The project is to be undertaken in and adjacent to ESO3 (Lake Environs) in the Gannawarra Planning Scheme. As shown in Section 7.

- **Identified as of regional or State significance in a reputable study of landscape values?**

☐ NYD ☐ No ☒ Yes If yes, please specify.

The Lower Murray Landscape Assessment study extends over the municipal areas of the Rural Cities of Mildura and Swan Hill and Gannawarra Shire. A draft landscape assessment has been undertaken by DELWP but this work has not been finalised.

In the draft landscape assessment report the Kerang Wetlands are mapped as a State Significant Landscape within the North Central Pastures landscape character type. The Kerang Lakes are described as a variety of permanent and temporary wetlands with Regional significance. They are a scarce feature unique to the North Central Pastures and occur at the junction of three major floodplains, providing dramatic contrasts with a broad, pastoral background.

- **Within or adjoining land reserved under the *National Parks Act 1975* ?**

☐ NYD ☒ No ☐ Yes If yes, please specify.

The project is not located within or adjoining land reserved under the National Parks Act 1975.

- **Within or adjoining other public land used for conservation or recreational purposes ?**

☐ NYD ☒ No ☐ Yes If yes, please specify.

The project is not located within or adjoining other public land used for conservation or recreational purposes. The land is used for recreation but is not reserved for recreation or conservation.

The lake and adjacent public land is zoned PCRZ in the Gannawarra Planning Scheme.(See Section 7).

Is any clearing vegetation or alteration of landforms likely to affect landscape values?

☒ NYD ☐ No ☐ Yes If yes, please briefly describe.

No assessment of the landscape impact of the By-pass has been undertaken. However,

Is there a potential for effects on landscape values of regional or State importance?

☐ NYD ☐ No ☒ Yes Please briefly explain response.

Given that the bypass will not be impacting the tall standing vegetation fringing the lake (ie the tall timber) the impact is expected to be minimal.

Is mitigation of potential landscape effects proposed?

☐ NYD ☐ No ☒ Yes If yes, please briefly describe.

Revegetation of the by-pass channel can also be utilised to minimise landscape impacts.

Other information/comments? (eg. accuracy of information)

Note: A preliminary landscape assessment is a specific requirement for a referral of a wind energy facility. This should provide a description of:

- The landscape character of the site and surrounding areas including landform, vegetation types and coverage, water features, any other notable features and current land use;

- The location of nearby dwellings, townships, recreation areas, major roads, above-ground utilities, tourist routes and walking tracks;
- Views to the site and to the proposed location of wind turbines from key vantage points (including views showing existing nearby dwellings and views from major roads, walking tracks and tourist routes) sufficient to give a sense of the overall site in its setting.

Soils

Is there a potential for effects on land stability, acid sulphate soils or highly erodible soils?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

SKM (2014) (Section 2.2.3) report on geotechnical investigations undertaken as part of channel alignment selection.(SKM 2013). The nature of the soil materials encountered has been taken into account in the design of the bypass channel and associated structures.

The soils of the area are not highly erodible, although they may suffer from other production relation constraints (eg salinity, structure, permeability) (Sargeant, Newell et al. 1978).

The presence of ASS within the Kerang Lakes complex has been mapped by CSIRO (ASRIS; (Merry, Fitzpatrick et al. 2011)). The presence of ASS at Third Reedy Lake was documented, with selected soil samples from the edge of the lake exceeding the Victorian coastal acid sulfate soil action criterion of 0.03 % S. The assessments completed by CSIRO did not include any field investigations from the lake bed (i.e. the area that would be subject to wetting and drying). A desktop ASS risk assessment was completed in 2013 (URS 2013) which concluded there is a low to medium risk for ASS for the Kerang Lakes under current conditions. Field investigations were not completed as part of that assessment and (URS 2013) recommended that additional soil and water sampling be undertaken to increase confidence in the output from the desktop risk assessment.

DEDJTR (Evan Dresel, Future Farming Systems Research Division Agriculture Victoria Services,) has raised a number of concerns regarding the proposal to bypass third lake. These concerns include:

- The assessments completed by the MDBA and CSIRO did not evaluate the lake bed sediments where pre-bypass inundation is continuous. DEDJTR inferred that these sediments may contain higher concentrations of sulfide than that recorded from the lake edge.
- The potential for oxidation of any ASS present when the lake is drained.
- Inundation of the lake following 'dry' periods may results in the mobilisation of any heavy metals released during the oxidation of ASS.
- The potential for, enhanced sulfide production during lake bed inundation phases, and acidification during lake drying phases.
- The potential for acidification may be high which could result in adverse effects to local flora and aquatic fauna.

Accordingly, a proposal to further investigate ASS risk at Third Reedy Lake has been requested (and received from GHD).

The proposal has not been implemented due to cost and difficulties associated with obtaining sediment samples from the inundated lake bed. Depending on the outcome of environmental assessment and approval conditions this proposal can be activated.

The GHD proposal included provision for

- Drilling and sampling location siting based in the geology of the lake bed
- Soil sampling and lithological logging
- Laboratory analysis
- Preparation of a technical report.

The investigation will generally follow the protocol outlined in MDBA (2010).

Conclusion - ASS formation is a potential risk that requires further investigation before it can be

definitely concluded that the project should proceed.
Are there geotechnical hazards that may either affect the project or be affected by it? ☐ NYD ☐ No ☒ Yes If yes, please briefly describe. SKM (2014) (Section 2.2.3) report on geotechnical investigations undertaken as part of channel alignment selection.(SKM 2013). The nature of the soil materials encountered has been taken into account in the design of the bypass channel and associated structures.
Other information/comments? (eg. accuracy of information)

15. Social environments

Is the project likely to generate significant volumes of road traffic, during construction or operation?

☐ NYD ☒ No ☐ Yes If yes, provide estimate of traffic volume(s) if practicable.

During construction there will be a requirement for traffic access along Flood Lane. Once the construction phase is completed there will be no additional traffic generated over what occurs now.

Is there a potential for significant effects on the amenity of residents, due to emissions of dust or odours or changes in visual, noise or traffic conditions?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the nature of the changes in amenity conditions and the possible areas affected.

Traffic management and potentially traffic detours will be required during the construction phase of the project. These impacts will not be significant as changes in traffic conditions will be short-term.

Is there a potential for exposure of a human community to health or safety hazards, due to emissions to air or water or noise or chemical hazards or associated transport?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the hazards and possible implications.

Only the increase in traffic over the construction period; which will minor and short term

Is there a potential for displacement of residences or severance of residential access to community resources due to the proposed development?

☐ NYD ☒ No ☐ Yes If yes, briefly describe potential effects.

Some residences (4-5) are currently supplied with irrigation water from Third Reedy Lake and the 1C/7 channel, but will have alternative arrangements made as part of the reconnection process.

There will be no severance of residential access resulting from project implementation.

Are non-residential land use activities likely to be displaced as a result of the project?

☐ NYD ☐ No ☒ Yes If yes, briefly describe the likely effects.

Minor water based recreation impacts will occur as the lake enters drying phases.
The recreation use of Third Reedy Lake (shown in Section 7 above) will be impacted, although impacts on some activities (eg swimming) will be substituted by increases in other activities (eg walking, sightseeing and bird watching).

Do any expected changes in non-residential land use activities have a potential to cause adverse effects on local residents/communities, social groups or industries?

☐ NYD ☐ No ☒ Yes If yes, briefly describe the potential effects.

Assessment of non-residential recreation uses (Attachment 4, table 22 and 23) suggests that the impacts on these use will be minor.

Is mitigation of potential social effects proposed?

☐ NYD ☐ No ☒ Yes If yes, please briefly describe.

During construction a traffic management plans will be prepared to manage increases in traffic along Flood Lane.

Supply of water to GMW customers will be provided.

Fish management plan will be prepared.

Other information/comments? (eg. accuracy of information)

A preliminary investigation of the potential social impacts of the project was undertaken early in the project (RMCG 2013). They assessed the social and economic impact of the different watering regimes on each lake by activity type.

During the course of their work they collated a range of community responses to the early stages of the investigation. They also suggested measures to mitigate the potential social and economic impacts and manage risk.

Note that the responses they received were based on a scenario of all lakes being bypassed,

which is quite different to the final proposal of bypassing Third Reedy Lake only.

The main uses of the lakes by local people are swimming at First Reedy Lake and fishing at First Reedy Lake, Third Reedy Lake and Racecourse Lake.

The five lakes are less developed and less commonly used for recreation than the larger nearby lakes in the Kerang wetlands system, Lake Charm and Lake Kangaroo. Their value as tourism assets is largely as adjuncts to those larger lakes, providing another activity for visitors, rather than being drawcards in themselves. The likely impact of the lakes drying out will be a reduction in the average length of stay, that is, visitors will not be held as long in the region. This is with the exception of Racecourse Lake, which is the site of a caravan park.

All of the bypass options have a negative impact on the recreational uses of the lakes. The impacts become more significant with drier watering regimes. These negative impacts are countered by the benefits from water savings and flood mitigation.

While the social and economic impact is significant, it is small relative to the financial cost of the project, and the value of the water savings. The project requires a significant environmental benefit to be of net benefit to society.

Cultural heritage

Have relevant Indigenous organisations been consulted on the occurrence of Aboriginal cultural heritage within the project area?

☐ No If no, list any organisations that it is proposed to consult.
☒ Yes If yes, list the organisations so far consulted.

Search of Victorian Aboriginal Heritage Council records (accessed 23/2/2016) indicates there is no Registered Aboriginal Party for the Third Reedy Lake area.

A Notice of Intent to Prepare a Cultural Heritage Management Plan (CHMP) (NOI) has been lodged with OAAV and the owners or occupiers of any land within the area to which the CHMP relates have been notified.

Aboriginal stakeholder participation in the conduct of the assessment of this CHMP was undertaken via phone, email and meetings. The BBNAC (Barapa Nations Aboriginal Corporation) and BBNTG (Barapa Native Title Group) indicated a willingness to participate in meetings and field assessments for the standard phases of the CHMP.

Informal discussions have occurred via the Kerang Indigenous Network.

What investigations of cultural heritage in the project area have been done?
(attach details of method and results of any surveys for the project & describe their accuracy)

SKM (2013) undertook a cultural heritage assessment along potential bypass routes as part of the Investigation.
The activity area is predominantly within an area of cultural heritage sensitivity.

Is any Aboriginal cultural heritage known from the project area?

☐ NYD ☐ No ☒ Yes If yes, briefly describe:

- Any sites listed on the AAV Site Register
- Sites or areas of sensitivity recorded in recent surveys from the project site or nearby
- Sites or areas of sensitivity identified by representatives of Indigenous organisations

The cultural heritage assessment was conducted both as a desktop and field assessment.

Following an analysis of previous archaeological investigations, land systems information and Aboriginal Places in the region, the following predictive statements were made for the activity area:

- The activity area is of moderate to high archaeological potential
- Most Aboriginal Places will occur within 200 m of a hydrological feature (Kangaroo Lake, Racecourse Lake, Little Lake Charm, Third Reedy Lake, Middle Lake and Reedy Lake)
- Preservation of Aboriginal Places other than scarred trees will be dependent on the level

of ground disturbance

- Scarred trees and earth features are predicted to be the most common Aboriginal Place types in the activity area
- Scarred trees will only be present where suitably mature native vegetation occurs (Box or River Red Gum)
- Earthen mounds are obtrusive sites and do not rely on ground surface visibility for detection
- Detection of stone artefact scatters and shell deposits will rely on ground surface visibility
- Earthen mounds, stone artefact scatters and shell deposits are likely to be highly disturbed through past and current agricultural activities and rabbit activity
- Earthen mounds are most likely to be associated with existing or prior waterways (including creeks, swamps, lagoons and rivers) or sand dunes and are most likely to be located within 100 m of water
- Artefact scatters are predicted to be low density (< 10 artefacts within a 10 m² area) or isolated artefacts predominantly comprised of quartz artefacts
- Burials are likely to occur as a component of earthen mounds, but also in sand bodies (including deflated dunes).

The desktop assessment concluded:

> *The activity area is located within the elevated alluvial plain land system. It is associated with the lakes in the region, including Kangaroo Lake, Racecourse Lake, Little Lake Charm, Third Lake, Middle Lake and Reedy Lake. The activity area is likely to have been a favourable location for Aboriginal occupation and resource procurement as evidenced by the ethnographic record as well as the availability of food, fresh water and raw material resources associated with the lakes. Although there are no Aboriginal Places with in the activity area, there are two Aboriginal Places within 100 m of the activity area and the activity area is predominantly located within an area of CHS. The VAHR search and the review of regional and local archaeological studies shows that scarred trees, earth mounds and artefact scatters were likely to be present in the activity area. Therefore, there is a moderate to high potential for Aboriginal cultural heritage to be present in the activity area.*

A systematic field survey of the activity area was undertaken over three days in 2013. Ground surface disturbance was extensive within the activity area due to the agricultural land use within the area. This disturbance was predominantly due to ploughing and grazing activities which have occurred in the area. Option Five (1C/7 channel) was significantly disturbed due to a channel already being constructed along the entire alignment

No trees with evidence of cultural scarring were identified during the survey. The potential for surface Aboriginal cultural heritage to exist within the activity area is low due to the moderate to high level of ground disturbance in the activity area. There is a moderate to high potential for sub-surface Aboriginal cultural heritage as the disturbance caused by the agricultural activities is unlikely to have completely destroyed cultural heritage that may be present. No Aboriginal Places were located during the survey. The section of Option Four B which is of archaeological potential is immediately adjacent to the south western bank of Third Reedy Lake. Within this area a small amount of clay pieces were found in areas of exposure. These clay pieces were insufficient to record the area as a site; however the presence of the clay pieces increases the archaeological sensitivity of the area.

Following the field assessment, the SKM report concluded (note that only options 5 and 4B is relevant to Third Reedy Lake Bypass):

> *No Aboriginal Places were recorded during the field assessment. The likelihood of finding subsurface Aboriginal cultural material is low for Option Four B (Third Reedy Lake) which is situated upon the floodplain. Recorded areas of potential archaeological sensitivity should be tested through sub-surface excavations in order to determine if Aboriginal cultural heritage is present.*
>
> *At this stage of assessment there are no Aboriginal cultural heritage factors that would require modification of the proposal however further assessment is required in those areas mentioned above in order within the study area.*

Further assessment by sub surface testing (or avoidance) is recommended to determine the presence and nature of Aboriginal cultural heritage. This will be done as part of detailed design as will development of a CHMP.

Are there any cultural heritage places listed on the Heritage Register or the Archaeological Inventory under the *Heritage Act 1995* within the project area?

☐ NYD ☐ No ☒ Yes If yes, please list.

Assessment was conducted to determine if there were any historical sites within the study area and whether there was potential for the proposed channel to harm any historical heritage sites.

A Notice of Intention to Carry out a Historical Archaeological Survey was lodged with HV on 11 October 2013.

There are no known historical heritage sites located within, or immediately adjacent to the study area. There are two historical heritage site located within a two km radius of the study area, the Reedy Lake Farm House at First Reedy Lake and the Former Post Office in township of Lake Charm.

Field survey was undertaken. During the survey three historical sites were located. Two of the sites are historical artefact scatters (Option Seven, Kangaroo Lake Road Artefact Scatter and Option Two C, Pratt Road Artefact Scatter) and the third was a stockyard (Option One, Apex Park Road Stockyard).

None of these sites will be affected by the Third Reedy Lake proposal

Is mitigation of potential cultural heritage effects proposed?

☐ NYD ☒ No ☐ Yes If yes, please briefly describe.

Other information/comments? (eg. accuracy of information)

16. Energy, wastes & greenhouse gas emissions

What are the main sources of energy that the project facility would consume/generate?

- ☒ Electricity network. If possible, estimate power requirement/output ……
- ☒ Natural gas network. If possible, estimate gas requirement/output ……...
- ☒ Generated on-site. If possible, estimate power capacity/output ……
- ☒ Other. Please describe.

Please add any relevant additional information.

The proposed new pump station will replace an existing mains electricity powered pump station. Electricity requirements will be neutral (or positive if a more energy efficient pump motors are installed).

Other structures will be operated using solar power.

What are the main forms of waste that would be generated by the project facility?

- ☒ Wastewater. Describe briefly.
- ☒ Solid chemical wastes. Describe briefly.
- ☒ Excavated material. Describe briefly.
- ☒ Other. Describe briefly.

Please provide relevant further information, including proposed management of wastes.

SKM (2014) (Section 2.6) note that the topography of the bypass channel alignments relative to the operating water levels of the lakes predominantly results in a significant surplus of clay material for each alignment. The identification of a disposal site(s) large enough to accept the surplus material has not been identified as part of this investigation. However, a general assumption has been made that surplus clay material will be able to be disposed of in mounds adjacent to, or in close proximity of the bypass channel alignments, and within the 50 m corridor assumed for land acquisition and environmental impacts along the bypass channel alignments.

This approach is considered to be reasonable on the basis that the channel alignments run parallel with significant flow paths in flood events, and therefore are not expected to result in redirection of flood water. It is also noted that surplus spoil along the No.7 Channel downstream of Third Reedy Lake has been disposed of in a similar manner.

What level of greenhouse gas emissions is expected to result directly from operation of the project facility?

- X Less than 50,000 tonnes of CO_2 equivalent per annum
- ☒ Between 50,000 and 100,000 tonnes of CO_2 equivalent per annum
- ☒ Between 100,000 and 200,000 tonnes of CO_2 equivalent per annum
- ☒ More than 200,000 tonnes of CO_2 equivalent per annum

Please add any relevant additional information, including any identified mitigation options.

Water is currently pumped from Third Reedy Lake to the 1/7 channel. The current pump station will be relocated and will continue to supply the 1/7 channel. Therefore, there will be close to no net change in greenhouse gas emissions.

17. Other environmental issues

Are there any other environmental issues arising from the proposed project?

☒ No ☒ Yes If yes, briefly describe.

18. Environmental management

What measures are currently proposed to avoid, minimise or manage the main potential adverse environmental effects? (if not already described above)

- ☒ Siting: Please describe briefly

- ☒ Design: Please describe briefly
- ☒ Environmental management: Please describe briefly.
- ☒ Other: Please describe briefly

Add any relevant additional information.
Impact mitigation measures are tabulated and summarised below.

Table 29 Project impacts and proposed mitigation measures

Potential impact	Mitigation
Acid sulfate soil	Investigation proposed prior to commencing project. Adverse risk of ASS will stop the project.
Construction	Site Environmental Management Plan
Decommissioning	Utilise existing approvals process
Planning Scheme	Planning permit application
Flora	CEMF Permit to remove native vegetation. The loss of native vegetation by construction activities is expected to be offset, in part at least, by the improvement in quality of native vegetation achieved through re-instatement of the lake's natural watering regime [or a more natural watering regime]. Any offset requirements that cannot be met by reinstating the watering regime will be achieved through GCP normal vegetation off-set processes.
Fauna	FFG permits – already held by GCP
Ramsar LAC hydrology	Environmental watering plan (in line with GCP WCMF)
Ramsar LAC Water quality - salinity	Monitoring Salinity management operational plan - operational rules and a plan to manage flows and salinity in the lake depending on a number of environmental variables. These variables will include: Groundwater levels under, and adjacent to, the lake EC in lake – dependent on groundwater levels and inflows during dry phase Flow rates and EC in bypass channel EC in Kangaroo Lake and Little Lake Charm (slow rate variable).
Salinity downstream	Operational Plan (see above)
Cultural heritage	Cultural Heritage Management Plan
Environmental water management	Environmental Water Management Plan (in line with GWM CP WCMF)
Works on waterway	Application to be submitted to NC CMA for work on waterway linking Middle Reedy and Third Reedy Lakes.
Fish management	Fish Management Plan
Fish passage	Provision of fish passage along bypass channel.
Carp	Installation of carp screen on Third Reedy Lake inflow structure
Flooding	Impact highly unlikely but works will be subject to planning permit.

Governance – future management	Formalise agreement to amend land status and manager.

Construction

The GMW CP (then known as the Northern Victoria Irrigation Renewal Project, or NVIRP) was referred under the *Environment Effects Act 1978* on the 16 February 2009. The Minister for Planning determined on the 14th April 2009 that an environment effects statement was not required for the project, subject to six conditions. The conditions covered construction and operational impacts associated with the project.

A comprehensive suite of environmental management protocols were developed in response to these conditions including the establishment of a Construction Environmental Management Framework (CEMF) under which the GMW CP has subsequently operated. A range of subsidiary documents sit beneath the CEMF including the project Environmental Management Plan (EMP). The EMP is the operational document applicable to construction managed by the GMW CP and its Contractors. The EMP is aligned with the CEMF and any amendments to the EMP require Secretarial approval prior to implementation.

The WCMF was also established as part of the approval framework. The WCMF describes the means by which GMW CP will protect aquatic and riparian ecological values through management of water allocations and flows that may be impacted by implementation of the GMW CP within the modernised GMID. The WCMF outlines procedures for monitoring, reporting and auditing changes in hydrological conditions in relevant wetlands or waterways associated with the project's operation.

It provides the environmental commitments, processes and methods for the relevant operations of the modified system.

At present the implementation of the Third Reedy Lake bypass sits outside this approval framework.

It is expected that implementation of the KLBP will be in accord with the broader GMW CP approval framework.

Cultural Heritage Management Plan

A CHMP will be prepared for the project to ensure compliance with the Aboriginal Heritage Act.

In addition to the specific recommendations that will be identified in the CHMP the following general recommendations will also be followed for the construction phase of the project:

- A copy of the CHMP must be kept on site for reference at all times.
- All persons involved in the construction works for the project must be made aware of the location of all Aboriginal Places located near the works.
- All persons must be made aware of the procedures involved if any further cultural heritage material is uncovered.
- All employees, contractors and subcontractors must undertake a Cultural Heritage Induction prior to the commencement of works. The cultural heritage advisor should be contacted, with sufficient notice to organise this.

During the construction phase site environmental management will be carried out by a contractor, the Contractor who will be engaged to oversee the implementation of the project. The contractor will maintain regular contact with the GMW Project Manager.

19. Other activities

Are there any other activities in the vicinity of the proposed project that have a potential for cumulative effects?

☐ NYD ☒ No ☐ Yes If yes, briefly describe.

20. Investigation program

Study program

Have any environmental studies not referred to above been conducted for the project?

☒ No ☐ Yes If yes, please list here and attach if relevant.

No. for a full list see Attachment 4

Has a program for future environmental studies been developed?

☐ No ☒ Yes If yes, briefly describe.

Likely future environmental studies include:

- Acid Sulfate Soils investigation
- Future ecological monitoring

Consultation program

Has a consultation program conducted to date for the project?

☐ No ☒ Yes If yes, outline the consultation activities and the stakeholder groups or organisations consulted.

The KLBP has involved significant stakeholder engagement to date, including direct engagement with potentially affected landholders, a range of working groups involving government and non-government entities and dissemination of information on the progress of the project.

Stakeholder reaction to the project has changed over the course of the project. In the initial phases reaction could be characterized as “why are you doing this; go away; we don’t trust you; you already know the answer”. Reaction bordered on the hostile.

Towards the finish of the investigation, with the scope reduced to one lake, community reaction mellowed to neutral; some community members supported the project.

Many community concerns have been mitigated by the refinements in project scope.

Despite the substantial range of local stakeholder interactions there remains a real possibility that a small minority group will continue to oppose the project. GMW will continue to provide local stakeholders the opportunity for engagement, however some individuals may remain unsatisfied.

On-going stakeholder support will depend significantly on the establishment of trust in the on-going risk management of the lakes, and engaging the community effectively in their development and care.

Table 30 Summary of Communication and Engagement activity types (See Attachment 4 Section 21 for a detailed breakdown of activities)

Activity type	Description	Comment
Community Advisory Group	To advise the GMW CP on the implementation of the KLBP Investigation to provide local understanding and experience.	8 members; 10 meetings; provided with detailed information about investigation activities. See Section
Project Reference Group	To provide advice to GMW on development and implementation of components of the project, and to facilitate the development of the value for money assessment. It comprised agency and municipal representatives	

Newsletters	Provide general information about the project and investigations.	Distributed in electronic or hard copy to circulation list x6 Contributions to Lake Chatter (newsletter of Lakes Community)
Letters	Responses to letter received from the public.	
Fact sheets	Provide information about the project.	x5
Media articles	To local print and electronic media	
Briefings	Shire of Gannawarra	x6
	GMW Water Service Committee North Central CMA Kerang Local Aboriginal Network Agencies	
One on One discussions	Drop in sessions for interested people to meet project discuss and discuss issues.	Five sessions (2 hour) Kerang and Lake Charm. Advertised in local print media. 13 attendees
One on one discussions	Face to face meetings with landholders potentially affected by bypass channel alignment.	X6 landholders.
Shopfronts	Drop in sessions for members of the public to meet project staff and discuss issues	Advertised in local print media. July 2013 – total of 3 sessions at Kerang Library (25 attendees) December 2013 – 2 sessions at Kerang Library (8 attendees) October 2014 – 1 session at Kerang Library; 1 at Lake Charm Hall (total of 11 attendees)
Project reports	Hard copies made available at Kerang Library. Electronic copies lodged with Government Library.	
Meetings	Public meeting – Lake Charm Public meeting Kerang Regular interactions at Kerang Lakes Community Development Group meetings	~ 50 attendees (28/11/2012) ~ 40 attendees (23/1/2013)
Project Specific – eg Preliminary social and economic impacts study; cultural heritage	Amongst other things, documented community views of the preliminary stages of the project.	interview with 35 stakeholders

Has a program for future consultation been developed?

☒ NYD ☒ No ☒ Yes If yes, briefly describe.

No

Authorised person for proponent:

I, FRANK FISSELER (full name),

Project Director (position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date 31st MAY 2016

Person who prepared this referral:

I, PATRICK JOSEPH FLEEHAN (full name),

PROJECT MANAGER (position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date 19/5/2016

Attachments

Attachment 1 Maps
Attachment 2 Photos
Attachment 3 Drawings
Attachment 4 Summary Overview
Attachment 5 BIOR
Attachment 5 Investigation Reports

References

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This revision both updates and extends the first edition, which was published by CSIRO in 2000 as Water Regime of Wetland & Floodplain Plants in the Murray–Darling Basin

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