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 USB copy of all documents will be needed, especially if the size of electronic documents may cause email difficulties. **Individual documents should not exceed 10MB 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	Couriers
Minister for Planning	**Minister for Planning**
PO Box 500	**Level 16, 8 Nicholson Street**
EAST MELBOURNE VIC 8002	**EAST MELBOURNE VIC 3002**

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:	**Lower Murray Urban and Rural Water Corporation (LMW)**
Authorised person for proponent: **Position:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Josh White Project Director - VMFRP PO Box 1438, Mildura VIC 3502 Josh.White@vmfrp.vic.gov.au 0400 697 304 n/a
Person who prepared Referral: **Position:** **Organisation:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Josh White Project Director - VMFRP VMFRP PO Box 1438, Mildura VIC 3502 Josh.White@vmfrp.vic.gov.au 0400 697 304 n/a
Available industry & environmental expertise: (areas of 'in-house' expertise & consultancy firms engaged for project)	**VMFRP** The VMFRP is a regional partnership model between Lower Murray Water (LMW), Goulburn Murray Water (GMW), the Mallee Catchment Management Authority (Mallee CMA), North Central Catchment Management Authority (North Central CMA) and Parks Victoria, set up to deliver the VMFRP works on behalf of the Department of Environment, Land, Water and Planning - Water (DELWP Water). LMW is the project proponent on behalf of the partnership. **R8** Jacobs and GHD teamed in December 2018 to form a joint venture (R8 Joint Venture) to deliver an integrated program approach across all packages of work. Both Jacobs and GHD are large consultancies who are providing a comprehensive suite of technical consulting services to support the VMFRP. These services include planning and approvals, design, cultural heritage, terrestrial and aquatic ecology, landscape and

	visual, hydrology, geotechnical, survey and spatial amongst other services.

2. Project – brief outline

Project title:

Gunbower National Park Floodplain Restoration 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)

Context

The Gunbower National Park Floodplain Restoration Project (the project) is located predominantly within Gunbower National Park, which forms part of the broader Gunbower Forest on the mid-Murray floodplain of northern Victoria. Gunbower Forest covers approximately 20,218 hectares (Ramsar listing area) and is comprised of the following land tenures (DEPI, 2013):

- Gunbower National Park, often referred to as the upper forest, which is managed by Parks Victoria (9,330 hectares) (Parks Victoria 2018);
- Gunbower State Forest, the mid and lower forest, which is managed by the Department of Environment, Land, Water and Planning (DELWP);
- The Murray River Reserve (land abutting the Murray River), which is also managed by Parks Victoria and
- Spences Bridge Education Area.

Gunbower Forest is bounded to the north by the Murray River and along its southern edge by private land and Gunbower Creek. It is bordered by the localities of Koondrook, Cohuna, Gunbower and Torrumbarry within the Torrumbarry Irrigation Area (TIA) and within both the Gannawarra Shire and Campaspe Shire LGAs (**Attachment 1, Map 1 – Project Location Map**).

Gunbower Forest as a whole is recognised as internationally significant under the international Ramsar Convention and forms part of an 'Icon Site' under The Living Murray (TLM) Program; Gunbower-Koondrook-Perricoota (GKP) Forest, one of six environmental assets of the Murray River that have the highest priority for rehabilitation through water management. The majority of the Gunbower Forest is also listed as a Directory of Important Wetlands in Australia (DIWA); where it is referred to as Gunbower Island. Gunbower National Park features permanent wetlands, temporary wetlands, River Red Gum (*Eucalyptus camaldulensis*) Forests, Black Box (*E. largiflorens*) and Grey Box (*E. microcarpa*) Woodlands and supports a range of communities and species - many of which are listed as rare or threatened under state and national legislation. River regulation has altered the inundation regime of these high value floodplain habitats, and the significant reduction in the frequency and duration of natural flood events has impacted the condition of the ecological values, by reducing the availability and quality of wetland and river red gum floodplain habitat. The location of the project is shown in **Attachment 1, Map 1 – Project Location Map**.

The project is designed to facilitate managed inundation regimes in the targeted water regime classes within the project area in the middle and upper Gunbower Forest (operating scenarios are detailed further in Section 3 below).

- Flows to the Gunbower Middle Forest are pumped from the Murray River to address the deficit of overbank flow and wetland inflows

- Flows to the Gunbower Upper Forest (through Camerons Creek) are pumped from the National Channel (Gunbower Creek) and controlled gravity fed to enable delivery of water to wetland and floodplain habitat and to address a leaking regulator.

Under natural conditions, inundation would have occurred seven years in ten and at present inundation is only occurring on average four years in ten (North Central CMA, 2014a). More recently, the forest has only received five natural inundation events in the past 20 years, almost half of the long-term average expected under current conditions. The managed inundation aims to restore a more natural inundation regime over a similar extent to that of flows between 30,000 and 50,000 megalitres per day over Torrumbarry Weir in the Murray River by providing a combination of pumped inflows from the Murray River and the National Channel and gravity flows through the Camerons Creek system into the Forest. The project will enable the inundation of approximately 704 hectares of the Gunbower National Park (457 hectares in Middle Gunbower Forest and 247 hectares in Upper Gunbower Forest). The managed inundation events will require a much lower volume of water than that involved in a natural flooding event, as the proposed infrastructure will enable a combination of pumping and gravity-fed mechanisms to deliver water to target areas in the floodplain. By achieving these environmental outcomes with less water, more water can remain in the Murray River system for other users.

A component of the project involves changing the point of irrigation supply for eight Goulburn Murray Water (GMW) customers that currently draw water from within the National Park. Their point of supply will move from Camerons Creek to the proposed irrigator pipeline off the Torrumbarry Irrigation System, thereby allowing Camerons Creek to be managed solely for its ecological values. This action will enable delivery of environmental water to the lagoons in the Camerons Creek system and to Black Charlie Lagoon and Baggots Swamp, enabling a more natural, fluctuating inundation regime to be implemented within the system managed entirely for ecological benefit. An offtake from the pipeline into the creek will also enable water to be delivered to supplement environmental water needs.

The existing TLM environmental water works in place for the Lower Gunbower Forest are complementary to the proposed Gunbower National Park Floodplain Restoration Project described here, however are separate to this project.

GMW will be the final asset owner for the project infrastructure.

Project area definitions

The project location is shown in **Attachment 1, Map 1 – Project Location Map**. Throughout this referral the following terms are used to describe the project:

- Development footprint - this is the indicative area that the project infrastructure (e.g. regulators, pump stations, pipelines and drop structures) would occupy, based on the current design, and includes laydown areas to be used during construction. This does not include power supply and associated poles, stays or cables, levees or access tracks used for access during construction and operation. No construction working buffer is included in the development footprint.
- Construction footprint – this includes the current design footprint of the project infrastructure (included in the development footprint) as well as the indicative area of land required to construct the infrastructure, including access tracks. The construction footprint is the area that may be directly impacted by the proposed works and is the area that has been used for calculating impacts to native vegetation and listed threatened species and communities. This area may change in response to design refinements. To the extent practicable, any changes to the design and construction footprint would occur within the area of investigation.
- Area of investigation - this includes the development footprint, as well as a buffer around the development and construction footprint. The location of existing levees (representing potential

works) have been included in the area of investigation for completeness). This area has been used to inform desktop investigations for this referral.

- Inundation area - area of land subject to inundation during managed events, up to a specific design water level

Reference to 'the project area' throughout this referral includes both the construction footprint and the inundation area.

Construction footprint location

The construction footprint occurs within both Crown land and freehold land within Victoria and a small portion of NSW. The majority of the Crown land is associated with the Gunbower National Park, under ownership and management of Parks Victoria. Camerons Creek Pump Station and a section of the Camerons Creek pipeline is located within Crown land managed by DELWP and an additional section of Camerons Creek pipeline and a small section of access track is located on land managed by Campaspe Shire Council. The intake pipes associated with the Brereton Road Pump Station will be located within the Murray River in NSW, which is a Crown Land Waterway. A number of other land parcels which are intersected by the project are under private ownership. Works on private land include an outlet and associated pipelines, Camerons Creek pipeline, access tracks and potential upper Gunbower levee works.

The construction footprint is shown in **Attachment 1, Map 2 – Project Structures, Construction and Access**.

Inundation area location

The project involves works to support the inundation of approximately 704 hectares of floodplain across the Gunbower National Park. The project comprises the following three water management areas (WMAs):

- 247 hectares in the Upper Gunbower Forest WMA, inundating the wetlands containing Upper Camerons Creek, Camerons Creek Lagoon 1, 2, 3 and 4, Black Charlie Lagoon and Baggots Swamp.
- 336 hectares in the Middle Gunbower Forest (upstream of Deep Creek) WMA, inundating the areas containing Deep Creek, Middle forest floodplain area and including the wetlands, Pig Swamp and Emu Hole Lagoon.
- 121 hectares in the Middle Gunbower Forest (downstream of Deep Creek) WMA, inundating the Red Rise Swamp wetlands containing Broken Axle Creek, Spur Creek, and associated floodrunners in the swamp complex.

The inundation area is located entirely within Victorian jurisdiction as shown in **Attachment 1, Map 3/4 – Managed Inundation Area**. The majority of the inundation area falls within Crown land; however due to the location of the existing forest perimeter levee being outside of the National Park boundary, there are some existing freehold properties that would be subject to a level of inundation within Upper Gunbower Forest (all used for general rural farming - livestock and cropping). VMFRP are currently in consultation with these potentially affected private landowners to discuss planned environmental watering events. Options to manage potential areas of inundation include purchasing private land, creating flood easements, or a combination of the two approaches. Agreement will be obtained prior to project implementation commencing.

Access track location

The proposed access arrangement for construction and operation of the project is illustrated in **Attachment 1, Map 2 – Project Structures, Construction and Access.** This would involve use of existing access tracks where practicable including Tickells Track, River Track near Camerons Creek, River Track between

Brereton Road and Spur Creek, Munroe Track, Baggots Creek Track, Brereton Road and Straight Road. Maintenance and or upgrades will need to be undertaken to the existing access tracks to ensure they are suitable for use during construction and operation in all weather conditions. If existing tracks can't be upgraded, minor new access tracks may be constructed in localised areas to facilitate operation of infrastructure. The construction footprint assessed in this referral provides for a 5 m wide corridor (i.e. 2.5 m either side of the centre line) along existing access tracks to carry out maintenance.

Short project description (few sentences)**:**

The Gunbower National Park Floodplain Restoration Project aims to reinstate a more natural inundation regime across approximately 704 hectares of high-ecological-value Murray River floodplain within the Gunbower National Park, through the construction of new infrastructure and the modification of existing infrastructure within the River Murray Reserve. The project involves the construction of 12 small regulators, one fishway, three pipelines, two pump stations, power supply, one channel upgrade, one drop structure, three culvert crossings, two drainage outlets, access track upgrades (approximately 25 km), erosion control works and a series of containment banks to divert, retain and release water in the upper and middle areas of Gunbower National Park.

The project is designed to enable managed inundation up to a design water level of 83.0 m AHD at the downstream end of middle Gunbower Forest to close to 85.0 mAHD at upper Gunbower Forest and Camerons Creek (depending on location, see Section 3 below), using water from a combination of natural inundation events, pumped inflows from the Murray River and the National Channel and also via gravity flows through the Camerons Creek system into the Forest. The proposed works will facilitate an inundation of up to 704 hectares, including River Red Gum forests and woodlands; approximately 457 hectares in Middle Gunbower Forest and 247 hectares in Upper Gunbower Forest. In addition to the above inundation and pumping; operation of the project will include, operation, monitoring and maintenance of environmental watering infrastructure (pumps, regulators etc.), environmental water delivery to target floodplain areas in accordance with seasonal watering and delivery plans, monitoring of inundation extent, water depth and inflows and return flows throughout the event, dewatering activities on ceasing delivery of environmental water.

3. Project description

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

Purpose

Through the construction of new infrastructure and the modification of existing infrastructure the project aims to restore an inundation regime which replicates more natural hydrological conditions across approximately 704 hectares (refer **Attachment 1, Map 3/4 – Managed Inundation Area**) of Murray River floodplain within Gunbower National Park. The infrastructure enables more efficient use of environmental water and effective management control and operations.

The Gunbower National Park is of significant ecological importance in the Murray-Darling Basin, covering an area of 9,330 hectares, forming part of the broader Gunbower Forest Ramsar site and Gunbower-Koondrook-Perricoota TLM Icon Site, and comprising considerable areas of floodplain forest that support rare and threatened species, wetlands and stands of River Red Gum (*Eucalyptus camaldulensis*), Black Box (*Eucalyptus largiflorens*) and Grey Box (*Eucalyptus microcarpa*). The condition of ecological values within the National Park relies on frequent inundation, where the extent and duration of inundation within Gunbower Forest is determined by the height of the Murray River below the Torrumbarry Weir. Inflows commence when

flows in the Murray River exceed 17,000 ML/day and increase substantially at flows greater than 30,000 ML/day when overbank flooding occurs (North Central CMA, 2014a). As the upper forest is higher on the floodplain, higher flows than those required for the mid to lower regions are required to inundate the project area. River regulation and climate change has significantly decreased the frequency and duration of inflows to Gunbower Forest, reducing the ecological response as a result of flooding in these high value floodplain habitats. For example, 35,000 ML/day flow frequency has halved to 37% of years compared to 80% of years under natural conditions. At 40,000 ML/day the median duration of events has halved (e.g. the median duration of 45,000 ML/day flows have reduced from 2.2 months under natural conditions to just one month at present). The significant reduction in natural inundation events has impacted biodiversity values and reduced the productivity and habitat value of the wetlands and River Red Gum Forest (North Central CMA, 2014a). Reinstating a more natural inundation regime will protect and enhance the ecological values within the Gunbower National Park, restoring healthy floodplain communities to ensure that indigenous plant and animal species and communities survive and flourish (North Central CMA, 2014a).

The project aims to deliver water to floodplain habitats at a similar extent to that of flows between 30,000 and 50,000 megalitres per day over Torrumbarry Weir in the Murray River. The planned inundation events will require a much lower volume of water than that required in a natural inundation event as the proposed infrastructure will enable pumping to deliver water to target areas in the floodplain, whilst still achieving a similar frequency and duration of inundation as a natural event. By achieving these environmental outcomes with less water, this means that more water can remain in the Murray River system for other users.

The key WMAs that will be targeted for managed inundation from the Murray River include:

- Upper Gunbower Forest - inundation of approximately 247 hectares (Upper Camerons Creek, Camerons Creek Lagoon 1, 2, 3 and 4, Black Charlie Lagoon and Baggots Swamp) from a level of approximately 85.0 mAHD in Camerons Creek to a level of 84.8 mAHD in Baggots Swamp.
- Middle Gunbower Forest (upstream of Deep Creek WMA) - inundation of approximately 336 hectares (Deep Creek, Middle forest floodplain area, Pig Swamp and Emu Hole Lagoon) up to a level of 84.4 mAHD within the Old Straight Cut Channel and between 84.25 at the discharge point into the forest from the Old Straight Cut Channel and 83.7 mAHD just upstream of Deep Creek. Emu Hole Lagoon would be watered to a level of approximately 84.2 mAHD and 84.12 mAHD in Pig Swamp.
- Middle Gunbower Forest (downstream of Deep Creek WMA) to provide inundation of approximately 121 hectares (Broken Axle Creek, Spur Creek, Red Rise Swamp) up to a level of 83.0 mAHD in Red Rise Swamp.

Ecological objectives

Four water regime classes (WRCs) comprising 12 ecological vegetation classes (EVCs), plus non-EVC Billabong Aggregate, have been specifically identified for restoration through this project as described by Ecological Associates (2014a) and North Central CMA (2014a). The WRCs include Permanent Wetlands, Temporary Wetlands, River Red Gum Forest with Flood-dependent understorey and Box Woodlands. North Central CMA (2014b) developed ecological objectives for the project, along with ecological targets to measure progress towards achieving the ecological objectives. These ecological objectives and targets are being refined as part of the development of the VMFRP Ecological Monitoring Evaluation and Reporting (MER) Framework (ARI, 2020a), to provide more specific ecological objectives and targets against which progress can be measured and to support quantification of the degree of environmental benefit expected from the project.

Attachment 2 – Gunbower National Park Ecological Objectives and Hydrological Requirements Justification Paper contains the detailed ecological objectives and targets for the project (as detailed in the

project Business Case) and an overview of how these have been developed. The specific ecological objectives for the project can be summarised as:

- Healthy River Red Gum and temporary wetlands.
  - Achieve an appropriate cover and diversity of specific characteristic of the plant functional groups found in the River Red Gum with flood dependent understory.
  - Maximise the proportion of trees with healthy canopy condition in the River Red Gum flood dependent understory.
  - Maintain and where possible increase the current diversity of threated flora species.
  - Reduce the area of high threat weed species.
- Drought refuge habitat provided for fauna (particularly small-bodied native fish communities) in Black Charlie Lagoon (Permanent Wetland)[1].
  - Maintain and where possible improve the current diversity of the small-bodied native fish community in Black Charlie Lagoon.
  - Promote recruitment of small-bodied native fish in Black Charlie Lagoon.
- Healthy Wetland bird community through improved access to food and habitat that promote breeding and recruitment
  - Support waterfowl breeding events in most years.
  - Contribute to the success of breeding events of colonial nesting waterbirds in the lower Gunbower Forest by providing foraging areas in Gunbower National Park.
  - Maintain and where possible increase the current diversity of threatened wetland bird species.

To achieve the ecological objectives and targets, the project aims to more closely align the frequency, duration and timing of future inundation events within the managed inundation area, with the natural (pre-regulation) inundation events experienced by the targeted water regime classes. Analysis presented in the Business Case (North Central CMA, 2014a), compares the frequency, interval and duration of inundation events based on implementation of the proposed operating scenarios for the project ('proposed measure') with inundation events under natural, baseline (current) and Basin Plan (2750) flows without the proposed measure through modelling (Gippel, 2014). This analysis was used to guide the required inundation regime, hence the proposed frequency, duration and timing of managed inundation events is considered to address hydrological deficits and align with the natural (pre-regulation) inundation frequency, duration and timing. A summary of the analysis by North Central CMA (2014a) is presented in **Table 2** and further discussed in the background / rationale section of this referral.

The project aims to achieve the optimal frequency, interval and duration of inundation events by using constructed works to manage the delivery of environmental water in the absence of natural flooding and to 'piggyback' where possible on natural inflows from the Murray River to increase the duration and depth of individual inundation events (i.e. hybrid events). Specifically, for Middle Gunbower Forest, the project will pump water onto the floodplain to water River Red Gum flood dependent understorey and into wetlands, and will piggy-back off natural events to top up wetlands and increase the duration and depth of inundation. For the upper Gunbower Forest, the project will maintain permanent water in Black Charlie Lagoon, and will deliver higher volumes via Camerons Creek, either through gravity or a pump mechanism, to overtop Black Charlie Lagoon and spill water onto the floodplain to fill Baggots Swamp. The infrastructure will also enable environmental water delivery to piggy back off natural events to increase depth and duration of inundation events for Baggots Swamp.

[1] Camerons Creek was added to these objectives following the business case completion.

Expected benefits

Environmental water delivery to the Gunbower National Park will generate a range of environmental benefits in line with the ecological objectives of the project. These are summarised in **Table 1** below. Many of the ecological benefits of environmental watering have and continue to be demonstrated through a rigorous monitoring program in Gunbower Forest as part of The Living Murray (TLM) program. As such, many of the demonstrated outcomes in the lower forest, which receive environmental water through infrastructure built under The Living Murray, are expected to also result from environmental watering at Gunbower National Park as part of this project.

Long-term monitoring results at Gunbower Forest for example show that River Red Gum areas that have received the combination of water for the environment and natural inundation over the past 10 years, typically have healthier canopies, faster tree growth and support more native floodplain plants, than areas that only received natural inundations and those that remained dry over the same period. At monitoring sites that have received no inundation since 2005, less than half of the River Red Gum trees had at least 50 per cent intact canopy (a measure of tree condition), and these trees continue to suffer from the Millennium Drought and lack of natural inundation caused by river regulation. At sites that received only natural inundation since 2005, the trees are in slightly better condition with almost 60 per cent with at least 50 per cent intact canopy. However, the greatest improvement is seen at sites that received both natural inundations and water for the environment, where 75 per cent of trees are now considered healthy (Bennetts and Jolly, 2019). A range of surveys are also undertaken to monitor the direct response of water-dependent flora and fauna to environmental water delivery, including but not limited to fish monitoring (Bloink et al. 2018), frog monitoring (Durkin and Howard, 2020) wetland productivity monitoring including the response of vegetation, micro and macroinvertebrates, fish and birds (Brown, 2020), and water quality monitoring of return flows to improve instream productivity for native fish (Baldwin, 2019). While there is some variability in ecological responses to environmental water due to the complexity of the systems and multiple contributing external factors (e.g. the impact of carp on aquatic vegetation), the results of this monitoring overall show a positive response of water-dependent flora and fauna to the environmental water deliveries.

Table 1: Summary of anticipated ecological benefits in Gunbower National Park (North Central CMA, 2014a)

Floodplain area	Ecological benefits of inundation
River Red Gum Forest	• Delivery of optimum inundation regime to maximize the condition and function of the significant River Red Gum floodplain dependent understorey (FDU), including vulnerable and depleted EVCs • Increase in diversity of FDU in the upper Gunbower Forest, over time • Support and enhance the presence of threatened flora • Enhance tree canopy health • Promote growth of drought-tolerant plants and habitats to support aquatic fauna, including frogs, fish and water birds • Increase resources for woodland fauna • Increase riverine food web contributing to improved fish recruitment and productivity
Wetlands	• Promotion of diverse wetland habitats • Enhanced inundation regime will mineralize organic matter and support microbial and planktonic productivity, providing abundant resources for aquatic fauna and wetland birds, including migratory waders • Provision and enhancement of critical habitat for threatened fauna species, including threatened fish, frogs, turtles and birds • Improved wetland vegetation diversity, abundance and recruitment • Provision of diverse habitats for threatened flora

For further detail on expected ecological benefits, refer to Section 2 of **Attachment 3 - Flora and Fauna Assessment**.
In addition to the ecological benefits summarised in **Table 1**, the project is also expected to contribute to the following socio-economic benefits:

- Enhanced tourism and recreational opportunities by improving the health, condition and amenity of riverine landscapes that attract visitors to the region;
- Increased health of River Red Gums, and other flowering plants in the area, as a result of environmental watering will increase apiary site opportunities;
- Improved health of wetlands and floodplain ecosystems that are highly valued by Traditional Owners; and
- Reduced requirements to buyback water from consumptive users (e.g. irrigators) and associated impacts on regional communities, while still contributing to achievement of the environmental objectives set by the Murray-Darling Basin Plan.

These socio-economic benefits present opportunities to collaborate with stakeholders to achieve key actions in the Cultural and Socio-Economic MER Plan for the VMFRP project (Aither, 2020). Complementary activities could include collaboration on the following:

- Addressing potential negative effects of works and environmental watering on cultural heritage sites by identifying issues and managing through appropriate planning mechanisms
- Complementary works and measures such as pest plant and animal control programs, habitat restoration, riparian management activities and support for cultural, recreational and tourism activities
- Shared funding to undertake additional data collection activities.

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

Legislative and policy context

The Murray-Darling Basin Plan establishes the legal and policy framework for the use of environmental water in the Murray-Darling Basin and places a Sustainable Diversion Limit (SDL) on the water that can be extracted from the system for irrigation and other consumptive uses. The SDL is based on an assessment of the water that must be left in the system to maintain ecosystem health. To comply with the initial Basin Plan SDL, water must be sourced from existing entitlement holders and applied to environmental needs. However, the Basin Plan includes a mechanism to adjust the SDLs (i.e. the SDL may be increased) if there are supply measures available that achieve an equivalent environmental benefit with less water.

Central to the SDL adjustment mechanism is a requirement that the environmental benefit of a proposed offset measure must exceed that of the base case (benchmark) scenario to justify an offset. Environmental benefit can be assessed in terms of how well the proposed measure addresses the Basin Plan's priorities for environmental water use, including, among other things, delivering benefits to ecosystems that are rare, near-natural or unique; provide vital habitat; support threatened species or communities; and support significant biodiversity.

The River Red Gums Management Plan (Parks Victoria, 2018), which encompasses the parts of the Gunbower National Park, including Gunbower Forest within the project area, recognises the diversity of natural values within the reserve but also recognises that many of these natural values are under serious threat from changing patterns of water flows and use. The Management Plan suggests that if insufficient inundation continues, further deterioration of the expanse and condition of wetlands and forests, already in poor condition, would have long-term impacts on the plant and animal communities and ecosystems, providing little resilience to the future impacts of climate change. For this reason, improving inundation regimes and delivering environmental water through the use of regulators and levees, is identified as a priority action in the River Red Gums Management Plan (Parks Victoria, 2018) to halt the decline of the parks and reserves, build resilience and lead to recovery.

Similarly, the River Red Gums Parks and Reserves Conservation and Action Plan (RRGPRAP) (Parks Victoria, 2019) defines and prioritises conservation strategies for the River Red Gum Park Landscape and broadly describes the expected outcomes of these strategies. The plan is designed to evolve and adapt according to changes in circumstance and scientific evidence. The plan outlines what can be realistically achieved to tackle the threats that pose the most risk to ecosystems. There is a focus on eight riverine ecosystems and four Ramsar wetlands, and some of these areas are targeted in the Gunbower National Park Floodplain Restoration Project (e.g. Riverine Forest and Woodland, Permanent Freshwater Wetlands, Gunbower Forest as a Ramsar site). A range of nested assets, such as threatened species and important ecological assemblages, have also been identified within each of these assets. Key threats to the conservation assets that are a focus of the plan include: inappropriate hydrological regimes, fire regimes and management, grazing by introduced mammalian herbivores and overabundant native macropods, invasive exotic fish, introduced terrestrial predators, invasion by introduced and native flora, climate change, and recreational activities and resource extraction. River regulation in particular has had serious consequences in this landscape. Many of the wetlands and floodplains within the River Red Gum Park Landscape now remain dry for extended periods of time. Consequently, the plant and animals that have evolved in these wetter environments no longer flourish (Parks Victoria, 2019). The aims of the Gunbower National Park Floodplain Restoration Project align with the objectives of the RRPRCAP.

In early 2019, the VMFRP secured funding from the Commonwealth government to progress engagement with communities and the development of detailed designs and approvals for nine sub-projects designed to deliver water to floodplain ecosystems to directly address environmental water needs. Together, these projects aim to return a more natural inundation regime across more than 14,000 hectares of high ecological value Murray River floodplain in Victoria through the construction of new infrastructure and the modification of

existing infrastructure designed and operated to mimic the impact of natural inundation events and improve the ecological condition of floodplain ecosystems.

Rationale

To support the Business Cases for the two VMFRP sub-projects located in the North CMA region and to justify the SDL offset mechanism, an environmental benefits assessment was prepared by Ecological Associates (2014a) to describe the ecological and hydrological characteristics of the upper Gunbower Forest floodplain; and set preliminary objectives for the use of water (hydrological targets) to promote ecosystem function and health.

A copy of this assessment *Ecological Objectives and Hydrological Targets in Upper Gunbower Forest (October 2014)* prepared by Ecological Associates is available on request. Subsequent to this assessment, which focussed on the proposed environmental watering in the Upper Gunbower Forest, North Central CMA (2014b) prepared a *Justification report for the SDL Business Case*, which further refined the ecological objectives and hydrological targets established by Ecological Associates (2014a) for the upper Gunbower Forest. In 2012, the MDBA prepared the *Gunbower Forest Environmental Water Management Plan* which was a requirement of The Living Murray program. Whilst this plan is applicable to the Gunbower Forest Icon Site as a whole, an update will be required in future to encapsulate the new scientific information and understanding of the upper Gunbower Forest that has been investigated through the Gunbower National Park Floodplain Restoration Project.

Further discussion of the floodplain hydrology and ecological objectives for the Gunbower National Park floodplain project is provided below.

Modified floodplain hydrology

Gunbower Forest is situated in the central Murray River system, comprising the Murray River and its anabranches from Yarrawonga to the confluence with the Darling River at Wentworth. Major tributaries of the central Murray system include the Goulburn, Campaspe and Loddon rivers in Victoria, and the Murrumbidgee and Wakool rivers in New South Wales.

Flows downstream of Torrumbarry Weir - the major regulating structure adjacent to Gunbower Forest - are the cumulative result of flows from the Murray River downstream of the Barmah Choke, Goulburn River flows entering upstream of Echuca, and flows from the Campaspe River entering at Echuca. At Barmah, river flows are limited by geomorphological features, with channel capacity restricted to approximately 10,000 ML/day. As levels rise, the Edward River and Gulpa system carry a larger proportion of flows, by-passing Torrumbarry Weir and the Gunbower-Koondrook-Perricoota floodplain system downstream (CSIRO, 2008; Atkins et al. 1991). Flood flows at Gunbower and Koondrook–Perricoota forests therefore depend heavily on flows from the Goulburn River.

The extent of inundation within Gunbower Forest is determined by the height of the Murray River below Torrumbarry Weir. Natural inflows from the Murray River into the broader Gunbower-Koondrook-Perricoota forest via low-lying flood runners commence at about 17,000 ML/day, with flow diversions increasing substantially as flow in the Murray River rises above 30,000 ML/day. When the observed flows downstream of Torrumbarry Weir are 30,000, 40,000 and 50,000 ML/day, the proportions of combined flow naturally diverted into the Gunbower and Koondrook–Perricoota forests are 14%, 30% and 41% respectively (NSW DECC, 2008, cited in North Central CMA, 2014a). Flows in the Murray River at Torrumbarry Weir generally do not exceed about 60,000 ML/day even in the biggest floods (e.g. 54,000 ML/day peak flow during 2010-11 floods).

Gunbower Forest is characterised by wetlands in low-lying areas surrounded by broad areas of River Red Gum forest at a slightly higher elevation on the floodplain, and Black Box and Grey Box woodland communities situated on the highest areas. The highest elevations in the upper forest fall away to the middle and lower sections of the forest. The average fall across the island is in a north-westerly direction at a slope

of 1 in 5,000 (URS, 2001). Accordingly, the dominant flow path through the forest is in a north-westerly direction.

Water begins to enter Gunbower Forest at Spur Creek, Yarran Creek and Barham Cut when flows in the Murray River reach around 14,000 - 16,000 ML/day. Combined inflows through these effluents fill the wetland complexes in the lower parts of the forest (Ecological Associates, 2003, cited in North Central CMA, 2014a).

At flows of about 27,000 ML/day, the Murray River is 'bank full' and there is significant flow into Gunbower Forest through the various effluents. To create widespread inundation of River Red Gum communities, flows in the Murray River must be sustained above 30,000 ML/day to generate overbank flooding (URS, 2001). During these overbank flood events the River Red Gum areas operate as a 'through-flow' system where inflow rates cause water to spread out of the forest waterways and wetlands. This water moves gradually through the forest eventually draining back into either the Gunbower Creek or Murray River.

When flows reach 40,000 – 50,000 ML/day and above, the highest elevations in the upper Gunbower Forest are inundated, flooding a large component of the Black Box and Grey Box communities.

A comparison of the modelled extent of inundation across the Gunbower National Park floodplain under natural (pre-regulation) and existing conditions by Gippel (2014) and DHI (2017) illustrates that floodplain works combined with river regulation have reduced the extent of inundation of the Gunbower National Park floodplain and increased the flow threshold required to achieve through flows along the length of Cameron's Creek. A copy of the DHI (2017) report, which further describes the effects of river regulation on floodplain hydrology, and summarises previous options is available on request.

Modelling by Gippel (2014) is presented in the Business Case (North Central CMA, 2014a) which compares the frequency, interval and duration of inundation events based on implementation of the proposed operating scenarios for the project ('proposed measure') with inundation events under natural, baseline (current) and modelled Basin Plan flows without the introduction of inundation measures. This analysis was used to guide the required inundation, hence the proposed inundation frequency, duration and timing of managed inundation events is considered to address hydrological deficits and align with the natural (pre-regulation) inundation frequency, duration and timing for Middle Gunbower. (refer **Table 2**).

Although the additional water that is modelled to be available under the Basin Plan scenario would contribute towards addressing current deficiencies in the environmental water requirements of Gunbower National Park compared to baseline conditions, the project is required to bridge the gap between the Basin Plan scenario and the hydrological requirements of Gunbower National Park. Importantly, the Basin Plan scenario does not account for climate change, so the frequency of operation may be higher than what is described here. The deficit in optimal frequency and duration of inundation and longer periods between inundation events has resulted in considerably altered vegetation communities and habitat across the floodplain. Key ecological impacts associated with the hydrological deficit include:

- Shift towards terrestrial vegetation (terrestrialisation) including canopy and understorey species, and gradual decline in condition and eventual death of River Red Gums
- Recruitment of large numbers of River Red Gum saplings, creating closed canopy, reducing productivity and composition of understorey plants
- Decline in extent, duration, frequency and diversity of aquatic habitat present for aquatic plants, fish, frogs, waterbirds and other water-dependent fauna
- Decline in the quality, quantity and frequency of food resources available for water-dependent and terrestrial fauna

- Potential decline in condition of terrestrial communities at higher floodplain elevations (e.g. woodland communities that support a variety of threatened species).

- Loss of hydrological connectivity between Gunbower Forest, the Murray River and Gunbower Creek, limiting fish access to floodplain resources and reducing instream productivity due to lack of carbon-rich floodplain return flows.

Table 2: Spells analysis for downstream of Torrumbarry over 114 year modelled period (North Central CMA, 2014a)

Flow threshold exceeded (ML/day)	Natural Conditions		Current Conditions*		Basin Plan (2750,000 ML)	
	Mean frequency (events/100 yrs)	Mean duration (days)	Mean frequency (events/100 yrs)	Mean duration (days)	Mean frequency (events/100 yrs)	Mean duration (days)
>10,000	103.5	204	103.5	83	113.2	133
>15,000	100.9	174	79.8	76	95.6	97
>20,000	98.2	149	63.2	77	80.7	87
>25,000	93.9	118	50.0	81	69.3	76
>30,000	83.3	101	45.6	67	54.4	84
>35,000	79.8	79	36.8	63	47.4	73
>40,000	68.4	84	37.7	39	40.4	62
>45,000	60.5	68	30.7	30	34.2	55
>50,000	51.8	53	24.6	37	28.1	35
>55,000	39.5	37	10.5	35	10.5	37

Source: Gippel 2014: * Benchmark conditions (run 6575)

Ecological condition

Gunbower National Park, as part of the Gunbower Forest, is an integral part of the Murray River floodplain. At a local (site-specific) level, the forest is critical to support water-dependent values, including but not limited to: food production for a range of biota from zooplankton and macroinvertebrates to higher order consumers; provision of shade and shelter, ephemeral wetlands and shallow mudflats provide drought refuge, and feeding and breeding habitat for waterbirds, frogs and turtles; provision of water for consumption for all biota to support growth and development, survival and reproduction (North Central CMA, 2014a).

The condition of Gunbower National Park has declined in response to river regulation and artificial changes to the floodplain (e.g. levees/ raised tracks, blockages in effluents, pest plants and animals) along with increased drought conditions as a result of climate change. Regulation of the Murray River and its tributaries and changes to inflow points (e.g. blockages) has created drier conditions across Gunbower National Park causing an overall shift towards more terrestrial vegetation types.

The temporary wetland environments in the central forest floodplain (between Pig Swamp and Deep Creek) would naturally have supported an open River Red Gum canopy with a diverse and productive understorey of aquatic plants. The wetlands would have included dense aquatic macrophyte vegetation suitable as habitat for a variety of native fauna (Ecological Associates, 2014a). The current inundation regime has instead promoted the mass recruitment of River Red Gums in many areas, creating a closed canopy that prevents light penetration to the forest floor thereby limiting the growth of wetland vegetation. The combination of reduced inundation and light penetration limits the productivity of the understorey and promotes more

drought-tolerant aquatic plants such as Rush Sedge (*Carex tereticaulis*) in place of seasonal aquatic species. Consequently, the wetlands provide lower quality habitat and less diversity of habitat which is critical to supporting a diversity of fauna (Ecological Associates, 2014a).

Similarly, the current inundation regime has resulted in the 'terrestrialisation' of the River Red Gum forests and temporary wetlands in the Gunbower National Park. Changes include an increased tree density, closing of the canopy and pronounced alterations in understorey species composition. The understorey of the River Red Gum communities has exhibited significant loss of floristic diversity and high levels of weed invasion (Australian Ecosystems, 2009). There are a greater proportion of dry phase floodplain plants in place of the original understorey of perennial aquatic macrophytes such as Water Ribbons (*Triglochin procerum*) (Ecological Associates, 2014a). The River Red Gum forests in the Gunbower National Park now provide lower quality habitat for fish, frogs and waterbirds, given it is inundated for shorter periods and less often, compared to natural conditions and the extent of habitat for aquatic understorey plants has declined (Ecological Associates, 2014a).

This decline in condition has been exacerbated by the Millennium Drought. Natural inundation in 2010/2011 and 2012 resulted in some improvements in the condition of the forest, indicating that it retains the capacity to respond positively to an enhanced inundation regime (North Central CMA, 2014a).

In 2014, an Ecological Objectives and Hydrological Requirements Justification Paper (**Attachment 2**) was developed for the Gunbower National Park to support the preparation of the project Business Case (North Central CMA, 2014a). These ecological objectives and targets have been adopted for this project and are being refined as part of the VMFRP Ecological MER Plan (ARI, 2020).

Ecological Objectives and extent of project benefit

As outlined in 'aim/objectives of the project' above, ecological objectives have been established to address the problems identified above and to restore the four specific water regime classes on the Gunbower National Park Floodplain: Permanent Wetlands, Temporary Wetlands, River Red Gum: flood dependent understory and Box Woodlands. A summary of water regime classes and constituent EVCs within Gunbower Forest is provided in **Table 3**.

Table 3: Water Regime Classes in Gunbower National Park

Water regime class	Associated High Value EVCs
Permanent Wetlands	Billabong Aggregate
	EVC 56 – Floodplain Riparian Woodland
Temporary wetlands	EVC 815 – Riverine Swampy Woodland
	EVC 821 – Tall Marsh
	EVCs 816/821 – Sedgy Riverine Forest/Tall Marsh Complex
	EVCs 812 /945– Riverine Swamp Forest/Floodway Pond Herbland Complex
	EVCs 106/814 – Grassy Riverine Forest/Riverine Swamp Forest Complex
River Red Gum: flood dependent understory	EVC 815 – Riverine Swampy Woodland
	EVC 816 – Sedgy Riverine Forest
	EVC 814 – Riverine Swamp Forest
	EVC 106 – Grassy Riverine Forest
Box Woodland	EVC 103 – Riverine Chenopod Woodland
	EVC 803 – Plains Woodland

	EVC 823 – Lignum Swampy Woodland

The required frequency and duration of inundation for each water regime class targeted for restoration by the project has been determined through a number of studies undertaken by Ecological Associates (2014a) and North Central CMA (2014b) by analysing where each vegetation community associated with the water regime class occurred on the floodplain (mapped extent, elevation range) supported by hydrological modelling (Gippel, 2014; DHI, 2014 and 2017) to determine the Murray River flow threshold that would have inundated these elevation ranges under natural, pre-regulation conditions.

The majority of EVCs identified within the Gunbower inundation areas (refer **Attachment 1, Map 3/4 – Managed Inundation Area**) are swampy or wetland vegetation communities that require or are tolerant of inundation and therefore are expected to positively respond to the proposed inundation. There is a small area of non wetland EVC, 0.98 hectares of terrestrial woodland (EVC 803 Plains Woodland) (Bennetts, 2014a) within the inundation area. Over the long-term, following the return of a forest floodplain inundation regime, the understorey species composition of some of these areas may become more aquatic. However, it is not considered that the level of inundation would result in any detrimental impact to the community that would lead to identified areas of the community no longer meeting the classification criteria for the EVC (R8, 2020b).

On this basis, pumping water into the potential inundation area to enhance the existing inundation regimes of the forests is considered to be the most effective method to improve the ecological condition of the area, undertaken in combination with other complementary activities as per the Cultural and Social-Economic MER Plan (Aither, 2020; refer Section 18) and the River Red Gums Parks and Reserves Conservation and Action Plan (Parks Victoria, 2019). To replicate a more natural inundation regime, the project must have the flexibility to operate under a range of flow conditions. This flexibility is also required to enable the inundation regime to trigger a range of ecological responses across a representative area of flood dependent communities.

Main components of the project (nature, siting & approx. dimensions; attach A4/A3 plan(s) of site layout if available):

The project involves the construction of 12 small regulators, one fishway, three pipelines, two pump stations, power supply, one channel upgrade, one drop structure, three culvert crossings, two drainage outlets, road / access track upgrades (approximately 25 km), erosion control works and a series of containment banks to divert, retain and release water in the Gunbower National Park. Refer to **Attachment 1, Map 1 – Project Location Maps.**

The design, number and location of project structures and extent of access track upgrades will be refined through the project design process, however will be similar in nature to the works described in the sections below. The location of power supply, borrow pits and extent of levee works will also be confirmed through the project design process. Findings from on-site assessments particularly ecology fieldwork and cultural heritage complex assessment (undertaken for the Cultural Heritage Management Plan) have and will continue to be progressively fed into the design, with modifications made to avoid and minimise impacts. Design and construction of the project would need to comply with the mitigation measures outlined in Part 2 of this referral.

Proposed works

A summary of the proposed works is provided in **Table 4** and shown **Attachment 1, Map 2 – Project Structures, Construction and Access**. The proposed works are described in more detail below.

Table 4: Summary of proposed works at Gunbower National Park

Water Management Area	Main Components	Area of inundation (hectares)	Top Environmental Watering level (m AHD)
Upper Gunbower	• Three small regulators: – Camerons Creek River Track Regulator – Camerons Mid Creek Regulator – Dry Tree Creek Outlet Regulator • Dry Tree Creek culvert • Containment banks / levees – adjacent to and supporting the Camerons Mid Creek Regulator • One cone fishway – Camerons Mid Creek Fishway • One spillway located within Baggots Creek Track • One Pump Station located on GMW's National Channel • One Pipeline to deliver environmental water into Gunbower National Park. The pipeline will also include several irrigation and stock and domestic supply offtakes to replace existing customer points. • Power supply to new pump station.	247	84.8 to 85.0
Middle Gunbower (upstream Deep Creek WMA)	• One Pump Station located on the bank of the Murray River and associated discharge pipeline at Brereton Road. • Power supply to new pump station. • Five regulators: – Pig Swamp Offtake Regulator – Emu Hole Lagoon Offtake Regulator – Middle Forest Offtake Regulator – Deep Creek River Return Regulator – Dalley Bend Inlet Regulator • Emu Hole Lagoon offtake pipeline • Middle Forest offtake pipeline (main discharge to OSCC) • Old Straight Cut Channel minor upgrade works • Road and car park works: – Brereton Road works – Riverside car parking area • Containment banks / levees as required	336	83.7 – 84.4
Middle Gunbower (downstream Deep Creek WMA)	• Three spillways: – Broken Axle Creek Regulator Spillway – Munroe Track Spillways x2 • Four regulators: – Broken Axle Creek Regulator – Tickells Track Regulator – Spur Creek River Return Regulator – Spur Creek Forest Regulator • One drop structure: Spur Creek Drop Structure at Murray River	121	83.0

	• Three culverts:
	  – Broken Axle Creek Culvert/bridge
	  – Munroe Track Culvert 1
	  – Munroe Track Culvert 2
	• Drainage Outlets within the containment banks (2 No.)
	• A series of containment banks on Munroe Track, Tickells Track and River Track as required.		

Upper Gunbower WMA

Works in the Upper Gunbower WMA include:

- Camerons Creek River Track Bridge and Regulator – The existing bridge and regulator are currently condemned. A small regulator to replace the existing Camerons Creek River Track Regulator will be located in the same location as the existing regulator and bridge, thereby minimising impacts to the existing environment, and will be designed to deliver environmental flows down Camerons Creek, isolate Camerons Creek from the Murray River and hold water within Camerons Creek when Murray River water levels are dropped and maintain access along River Track. The bridge will be designed to PV specifications and the regulator to GMW specifications. The two have been designed to integrate but can be built separately if required. At times the regulator would be closed completely to prevent flows to exclude certain water conditions in the Murray River from entering the creek (e.g. blackwater events, major carp intrusion / spawning events).
- Camerons Mid Creek Regulator – a small regulator to replace the existing Camerons Mid Creek Regulator. The existing regulator is old, leaks (causing continuous loss of water downstream and constant over watering of semi-permanent wetlands and overwatering of forest downstream, but out of season) and is difficult to operate with manual drop-boards and no railing for safe operator access. The new regulator will be located immediately downstream of the existing regulator in order to tie into higher land on both sides to avoid the construction of wider containment banks at other locations and to minimise impact on vegetation and cultural assets in the area. The regulator would be set to supply level to maintain upstream pool levels in Camerons Creek and deliver environmental flows. During major natural inundation events, the regulator would likely be left closed as overbank flood waters would fill the forest area. At times the regulator would be closed completely to prevent flows and topped up with pumped water if required; or potentially closed to exclude certain water conditions in the Murray River from entering the creek (e.g. blackwater events, major carp intrusion / spawning events). A fishway is also proposed to be located on the northern side of the regulator. A walkway will be provided over the fishway to provide access to operate and maintain the regulator. The fishway will be a cone type fishway consisting of a simple channel with precast cones.
- Dry Tree Creek Outlet Regulator – small regulator located at the low point where Baggots Creek Track crosses Dry Tree Creek. The regulator enables the environmental watering of the Baggots Swamp area to the full level desired without water spill into Baggots Creek and water inundating Baggots Creek Track. It could provide an emergency outlet for the top layer only of Baggots Swamp area if overwatering occurs.
- Containment banks/ levees – upper Gunbower Forest is likely to have one main containment bank adjacent to and supporting the Camerons Mid Creek Regulator and Fishway. Levees may also be required around the southern and western perimeter of the project area. All containment banks/ levees are subject to further risk assessment and therefore have not been confirmed.
- Spillway – one spillway comprising rock beaching with concrete sills, located within Baggots Creek Track adjacent to the Dry Tree Creek Outlet Regulator to maintain flow distribution across the floodplain during high river flows and to protect the regulator during natural inundation.

- Camerons Creek Pump Station – located on GMW's National Channel (Gunbower Creek), designed to provide environmental water into Camerons Creek at Lagoon 4, which will then flow downstream into Black Charlie Lagoon and Baggots Swamp. There are eight irrigators currently using Camerons Creek as their supply point. These customers will be transferred onto the Camerons Creek Pump Station and pipeline to remove their reliance on water and infrastructure within the National Park. This will provide available water from Camerons Creek to supplement the pumping. The pumping rate is 46 ML/d in total, 20 ML/d for environmental watering purposes and 26 ML/d for irrigation supply. All pumps will contain screens on the pump inlets with a 2 mm hole aperture, a screen approach velocity of 0.12 m/s and automatic screen cleaning mechanisms.
- Camerons Creek Pump Station power supply – Powercor will be the service provider for Camerons Creek Pump Station. The pump station design is in progress and will inform power requirements to enable Powercor to complete a preliminary design. There is an existing power supply on the south side of the National Channel, which crosses overhead to an existing pump station approximately 200 m from the proposed Camerons Creek Pump Station.
- Camerons Creek Pipeline and Offtakes - The pipeline is approximately 5,500 m in length and will have a capacity of 46 ML/d, 20 ML/d for environmental watering purposes and 26 ML/d for irrigation supply. There are several offtakes along the pipeline for irrigation and stock and domestic supply, the location and quantity of which are currently being discussed with the relevant landholders.

Middle Gunbower (upstream Deep Creek) WMA

Work within the Middle Gunbower (upstream Deep Creek) WMA include:

- Brereton Road Pump Station – located on the Murray River at the end of Brereton Road (near an accessable boat ramp on public land) to enable pumping of water from the river to Pig Swamp, Emu Hole Lagoon and the Middle Forest floodplain area. The design flow rate for the pump station will be 125 ML/d. All pumps will contain screens on the pump inlets with a 2 mm hole aperture, a screen approach velocity of 0.12 m/s and automatic screen cleaning mechanisms.
- Brereton Road Pump Station power supply – Powercor will be the service provider for Brereton Road Pump Station. There is existing power adjacent to the proposed pump station site, which supplies a private property located close to the river and surrounded by the National Park. The works will involve a new pole, pole mounted transformer and underground power supply to Brereton Road Pump Station. Upgraded works upstream of the existing overhead power supply are required which include approximately 2 km of reconductoring and some new power poles.
- Pump station discharge pipeline - main delivery pipeline for Brereton Road Pump Station to the existing Old Straight Cut Channel – approximately 180 m in length. Includes riser pit and erosion protection works at the pipe outlet.
- Pig Swamp Offtake Regulator – a small regulator that enables delivery of water to Pig Swamp by allowing it to continue flowing downstream through the Old Straight Cut Channel.
- Emu Hole Lagoon Offtake Regulator and Pipeline – a small regulator and pipeline will deliver water into an existing flood runner that feeds into Emu Hole Lagoon, approximately 50 m from the Old Straight Cut Channel. The regulator will enable delivery of water to Emu Hole Lagoon from Old Straight Cut Channel and the pipeline enables gravity delivery of the water through high ground to the lagoon floodrunner. Regrading works are required along the existing flood runner for approximately 300 m to remove the high points and reshape the channel to the required level in order to gravitate from the pipeline discharge level.
- Middle Forest Offtake Regulator – a small regulator from the Old Straight Cut Channel and dual pipelines underneath Brereton Road to enable delivery of water to the Middle Gunbower Forest.

- Deep Creek River Return Regulator – a small regulator that is designed to regulate the water level in the Middle Forest northern area and enable return of water to the Murray River. The regulator also enables delivery of water from the Murray to the Middle Forest at higher river levels.
- Dalley Bend Inlet Regulator – A small regulator designed to improve and return pervious connectivity between the Murray River and Middle Gunbower Forest, increasing the frequency of natural floods entering the Middle Forest. This regulator is not required during planned inundation events (exclusively). At times the regulator would be closed completely to prevent flows to exclude certain water conditions in the Murray River from entering the forest (e.g. blackwater events, major carp intrusion / spawning events).
- Old Straight Cut Channel – Minor upgrades to approximately 1,000 m of existing channel, involving the removal of sapling growth and the clearing of debris from the base of the channel. These works will improve flow control in the channel and minimise debris impact on regulator structures, gates and culverts. The visual treed appearance of a majority of the channel would be maintained.
- Brereton Road works - raising of Brereton Rd in the vicinity of the Middle Forest Offtake Regulator over a length of approximately 400 m. Realignment of Brereton Road will also be required in the vicinity of the pump station and power supply point to allow for pump station siting and construction works areas and room to significantly improve the general amenity, access and safety of the area once construction is completed.
- Riverside car parking area - Redesign of the riverside car parking area in the vicinity of the boat ramp will be required for improved access and amenity.
- Containment banks/ levees – Existing levees are required around the southern and western perimeter of the project area. All levees are subject to further risk assessment and therefore any works required to the existing levees have not been confirmed.

Middle Gunbower (downstream Deep Creek) WMA

Since completion of the Gunbower National Park Supply Measure Business Case (NCCMA, 2014), further investigations including additional hydraulic modelling of Middle Gunbower Forest was undertaken and identified a range of additional infrastructure in the Middle Gunbower forest downstream of Deep Creek to extend the environmental watering into the Red Rise Swamp area. This infrastructure will enable the projects ecological objectives to be achieved across the whole Middle Gunbower area. The design of this infrastructure may require refinement in the final detailed design.

The proposed works for the Middle Gunbower (downstream Deep Creek) WMA include:

- Tickells Track/Munroe Track Containment Bank and Culverts 1 and 2 – works are required along approximately 900 m of existing track to maintain access during environmental water events for maintenance, operation and public access and provide fully on or off operation for containment of local flows in the upper sub-tier.
- Broken Axle Creek Regulator – situated in a key downstream containment area, this is a small regulator designed to contain water within Middle Gunbower area (downstream of Deep Creek) Tier 3b and enable through flows to move out to the Murray River via Spur Creek when water is released to the river during planned inundation. This regulator will also allow natural inundation events to be conveyed down Broken Axle Creek.
- Tickells Track Regulator – a small regulator structure designed to contain water within Middle Gunbower area (downstream of Deep Creek). When closed it prevents water inundating the area south of Frees Road, private land and allows water to continue down Broken Axle Creek. The regulator could be operated to enable watering of the forest area to the west within the containment of the existing levee. This location is also a key point for local farm drainage exchange.

- Spur Creek River Return Regulator – a small regulator structure designed to contain water within the Middle Gunbower area (downstream of Deep Creek). When closed it prevents water from inundating the top end of Spur Creek and prevents water outflowing to the Murray River. When open it needs to be operated in conjunction with the Spur Creek Forest Regulator to release flows to the Murray River.
- Spur Creek Forest Regulator – a small regulator designed to contain water within the Middle Gunbower area (downstream Deep Creek). When closed it prevents water from flowing down Spur Creek and instead enables water from the top end of Spur Creek to flow out into the Murray River. It is only required to be closed when flow is being released from the planned inundation area. Will allow natural inundation events to pass unobstructed. At times the regulator would be closed completely to exclude certain flows in the Murray River from entering the forest (e.g. unseasonal short, sharp river peaks; riverine blackwater events).
- Spur Creek Drop Structure – designed to transfer flows between Spur Creek and the Murray River without causing erosion and consisting of gabion weirs and rock beaching. It is located within Spur Creek at the confluence with the Murray River.
- Broken Axle Creek Bridge - to maintain access during environmental water events for maintenance, operation and public access.
- River Track, Tickells Track and Munroe Track Spillways to provide protection of structure and embankments during natural inundation and limit the impediment of natural inundation events across the floodplain.
- Drainage Outlets on Tickells/ Munroe Track – comprising two small pipe structures installed within the containment banks to facilitate cross drainage during periods when planned inundation is not undertaken.
- A series of containment banks on Munroe Track, Tickells Track and River Track to support planned flooding regulators or containment of planned inundation flows.

Regulator Design

The following design philosophy for regulators has been applied:

- The regulating structures are designed to allow natural flows to pass unhindered, to and from the floodplain when the structures are fully open.
- The arrangement of regulating structures and containment banks have been developed to minimise the potential for erosion over the whole range of flow conditions.
- The regulating structures are designed to provide fish passage when fully open.

A summary of design specifications for the Upper Gunbower and Middle Gunbower (upstream Deep Creek) works areas is provided in **Table 5**.

Table 5: Summary of regulator and culvert design specifications – Upper and Middle Gunbower

Regulator	Open / close / regulate flow	Proposed design*	Proposed gates
Upper Gunbower			
Camerons Creek River Track Regulator	Open/Close	3 No. 1800W x 1800H	Dual leaf gates
Camerons Mid Creek Regulator	Regulate	2 No. 1200W x 1200H	Penstock
Dry Tree Creek Outlet Regulator	Open/Close	1 No. 1200W x 600H	Penstocks

Middle Gunbower – upstream Deep Creek (Tier 1 and Tier 2)			
Pig Swamp Offtake Regulator	Open/Close	1 No. 1200W x 1200H	Penstock
Emu Hole Lagoon Offtake Regulator	Open/Close	DN450 Mann Pit	Sluice Gate
Middle Forest Offtake Regulator	Open/Close	2 No. DN900 pipe outlets	Penstock
Deep Creek River Return Regulator	Open/Close	1 No. DN525 pipe outlet (existing)	Penstock
Dalley Bend Inlet Regulator	Open/Close	2 No. 1200W x 1200H	Penstock
Middle Gunbower – downstream Deep Creek (Tier 3)			
Munroe Track Culvert 1	Open/Close	2 No. 1200W x 600H	N/A
Munroe Track Culvert 2	Regulate	6 No. 1800W x 1200H	N/A
Tickells Track Regulator	Open/Close	3 No. 1800W x 1800H	Penstock
Broken Axle Creek Regulator	Regulate	4 No. 2400W x 2400H	Dual leaf gates
Spur Creek River Return Regulator	Regulate	4 No. 1200W x 900H	Dual leaf gates
Spur Creek Forest Regulator	Open/Close	4 No. 1800W x 1800H	Dual leaf gates
Broken Axle Creek Bridge	N/A	6 No. 1800W x 1800H	N/A

* Proposed design, where No. (number), W (Width), H (Height), unit (mm), Diameter Nominal (DN)

Pumping Infrastructure

Brereton Road Pump Station

To enable pumping to occur at varying water levels in the Murray River one pump station is proposed adjacent to the Murray River within the Middle Gunbower WMA. Refer to **Attachment 1, Map 2 – Project Structures, Construction and Access**. The proposed pump station on the bank of the Murray River will include fine fish screens on the suction pipes which would have 2 mm hole apertures, a screen approach velocity of 0.12 m/s and automated mechanical cleaning.

The pump station will consist of a reinforced concrete open structure on the bank housing the pumps and motors, with the suction pipes extending into the Murray River. The concrete structures on the river bank will be mostly below ground and have a removable cover (e.g. grate) that will be flush with the ground surface. The suction pipework would be below the estimate 10th percentile river water levels. Construction associated with the pipe suction would occur within the Murray River and river banks, with excavation and structural works required for the pumps.

Consistent with recent GMW pump station designs, weatherproof switchboards for the electrical works, variable speed drives and other components are proposed. These would be raised above the 1% planned inundation level and 1 in 100 year flood level and be protected from the direct heat with an awning structure. A fenced compound would be provided around the switchboard and the back of the pump station structure with a hardstand area for maintenance, pump removal and installation and other operational activities.

Pedestrian access along the river will be retained by providing access around the forest side of the Pump Station (i.e. not immediately at the riverbank, access would be restricted by the fenced compound).

Navigation warnings such as signage and buoys would also likely be required around the submerged offtake works, with final requirements to be provided by NSW Maritime.

The pumps would be electrically powered, with the power supply extending from the nearby Powercor supply system to the pump station. Details for the proposed power supply are discussed below.

Two higher flow rate pumps and two lower flow rate pumps are proposed to meet the flow rate range required from less than 10 ML/d to 125 ML/d.

Camerons Creek Pump Station

The Camerons Creek Pump station is proposed on the bank of The National Channel, just off Headworks Road within Crown Land. Refer to **Attachment 1, Map 2 – Project structures, construction and access**.

The pump station will consist of a reinforced concrete open structure, with a removable cover (e.g. grate), set belowground to house the submersible pumps. There will be a concrete channel connecting the wet well and National Channel to provide the required water level for pump operation. There will be a screen on the interconnecting channel inlet to prevent fish entry into the system. The site will be provided with the appropriate level of security to prevent public access.

The pump station will be electrically powered with Powercor as the supply authority. Design of the pump station is yet to be finalised and as such preliminary power supply design has not yet been completed by Powercor. There is existing power on the south side of the National Channel, with an overhead supply to an existing private pump station adjacent to the Camerons Creek Pump Station site.

There are several irrigators within the area whose current supply is from Camerons Creek. There is an opportunity here to transition those customers onto the Camerons Creek Pump Station system to remove the need to divert water from within the National Park for irrigation supply. A number of supply points along the pipeline will be provided to existing irrigators within this area. This pump station is required to deliver a maximum flow rate of 46 ML/d, of which 20 ML/d is required for environmental watering and 26 ML/d for irrigation supply. The pump station and pipeline will be owned, operated and maintained by GMW.

The pipeline will be underground and located in a mixture of Crown Land, private property and within Gunbower National Park. The pipeline will be constructed by open trenching methods, except where crossings of Hall Road Lagoon and the incoming supply channel from Camerons Creek are required. The pipeline is proposed to be underbored in these locations (three places).

The pipeline will enter the National Park from the end of Forster Rd and follow the alignment of a cleared section of forest and access track, parallel to an existing overhead power line. The pipeline will deliver environmental water into Lagoon 4 of the Camerons Creek system above Black Charlie Lagoon.

Fish passage

Where required, the regulating structures will be designed to provide safe fish passage in accordance with the recommended design criteria for native fish (R8, 2019c).

The project specifically includes:

- Provision of safe downstream fish passage for native fish through all new regulating structures. This includes safe fish passage from the floodplain and into the Murray River during forest draining events and low Murray River flow water levels;
- Provision of screens for fish protection on each intake structure associated with the pump stations.
- Active fish passage is planned to be provided at the proposed Camerons Mid Creek Regulator to maintain connectivity for small bodied fish between the wetland areas separated by this structure, aligning with the Upper Gunbower Creek Fish Management Plan (ARI, 2020b). The fish passage

provision at Camerons Mid Creek Regulator is a cone type fishway consisting of a simple channel and precast cones.

Small regulator structures will be operated either in fully open or fully closed position. When water is released with the regulator gate in fully open position, fish have passage through the regulator both in managed release and natural flood scenarios. Structures will be designed to have flow velocities appropriate for fish passage (based on ARI, 2015).

Operational activities required

Various operational activities will be required at different times, they may include things such as; operation, monitoring and maintenance of environmental watering infrastructure (pumps, regulators etc.) environmental water delivery to target floodplain areas in accordance with seasonal watering and delivery plans, monitoring of inundation extent, water depth and inflows and return flows throughout the event, dewatering activities on ceasing delivery of environmental water.

Structures to be decommissioned

The existing Camerons Mid Creek Regulator and Camerons Creek River Track Regulator will be replaced with new regulators (as described above) as part of the project. The existing regulators will be removed to prevent obstacles to fish passage.

A number of existing assets associated with the current Camerons Creek irrigation supply will be decommissioned as part of the VMFRP works. Discussions will be held with the private landholders to confirm the scope of these works.

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

Containment banks / access tracks

Typically, access to the project structures during construction and operation would be provided via existing tracks. The main access tracks include:

- Tickells Track
- Broken Axle Track
- Camerons Creek River Track
- River Track (multiple locations)
- Munroe Track
- Baggots Creek Track
- Brereton Road
- Straight Road.

The locations of the proposed containment banks and access tracks are shown in **Attachment 1, Map 2 – Project structures, construction and access**. Access is proposed utilising existing tracks, however some of these tracks would need to be upgraded as part of the project, the extent of which would be confirmed following outcomes from geotechnical investigations, complex cultural heritage assessment (as part of the Cultural Heritage Management Plan for this project) and ground truthing. Design and construction of the final access tracks will comply with the mitigation measures as outlined in Part 2, Section 18 (Environmental management) of this referral.

Maintenance would be undertaken to existing access tracks so that they are suitable for use during construction and operation. This would involve grading and applying additional road base to the surface undertaken in consultation with Parks Victoria and Campaspe Shire Council as the land managers.

Levees

An extensive perimeter levee system, which anecdotally commenced construction in the 1870s, and was formally constructed after the 1916 floods, exists to protect the significant area of farmland located between Gunbower Forest and Gunbower Creek. The levee runs along the southern boundary of the Gunbower Forest intermittently from the National Channel Headworks in the south to Deep Creek in the north (Water Technology, 2014a). The Gunbower forest levee system then continues intermittently to the north of Deep Creek at locations where natural surface levels have required.

A Levee Risk Assessment is currently being undertaken by VMFRP to determine the specific works to be undertaken at existing sections of levees to support the project and provide protection of private land during managed inundation events. It is estimated that between 1.5 – 3 km of levee works, ranging from maintenance to minor refurbishment/remodelling will be required. The location of existing levees (representing potential work areas) have been included in the area of investigation for completeness, but not the construction footprint (as the need for work is currently unknown) and considered at a desktop level in this referral. Where work on levees are deemed to be required, further assessment and ecological fieldwork will be carried out in the areas of construction.

Power supply

New power supply connections would be required to facilitate operation of the pump stations at Brereton Road Pump Station and Camerons Creek Pump Station. The key design components include new poles, stays and cables/power lines.

Works associated with power supply are required across both public and private land. Within the National Park boundary, new power lines would be directly buried (or bored depending on requirements) generally following the alignment of containment banks, levees or access tracks to minimise the area of impact. Consultation with private landowners is currently being undertaken regarding the power lines.

Powercor will be the service provider for Brereton Road Pump Station and have provided VMFRP and GMW with a preliminary design for Brereton Road Pump Station power supply using an existing power line adjacent the proposed pump station site which supplies a private property in the area. The works will involve a new pole, pole mounted transformer and underground power supply to Brereton Road Pump Station. There are upgrade works required upstream along the existing overhead power supply which include approximately 2 km of reconductoring and some new power poles. VMFRP and GMW are working to finalise power supply requirements for Camerons Creek Pump Station to inform Powercor preliminary design. There is an existing power supply on the south side of the National Channel, which crosses overhead to an existing pump station approximately 200 m from the proposed Camerons Creek Pump Station location.

As the preferred option for power supply to Camerons Creek Pump Station is unknown at this stage, and due to the preliminary nature of the designs for the Brereton Road Pump Station, the power supply infrastructure (power lines, poles and stays) is not included in the construction footprint identified in **Attachment 1, Map 2 – Project Structures, Construction and Access**, and not considered in the specialist assessments prepared for this referral. However, and indicative location for the substation at each pump station has been included in the area of investigation and construction footprint, assuming that this would be located adjacent the pump stations. Following the selection of the preferred option, the infrastructure requirements will be included within the construction footprint and potential impacts assessed.

Concrete batching

Commercially sourced concrete for construction of the proposed works would be transported to the project area with no requirement for on-site concrete batching facilities.

Borrow pits / quarry sites

Construction of the project would require the import of material (clay/rock). VMFRP is in the process of identifying possible borrow pits to acquire this material, the locations of the borrow pits will be as close as possible to the project, on private land outside of Gunbower National Park, while also avoiding and minimising impacts. Rock (rock beaching for erosion protection works) would be sourced from an existing commercial quarry.

Key construction activities

Construction activities would occur within the area identified in the construction footprint map (**Attachment 1, Map 2 – Project Structures, Construction and Access**). Construction activities would include:

- Establishment of construction sites, including removal of vegetation, stripping and stockpiling of topsoil, establishing temporary parking and truck turnaround areas, laydown and stockpiling areas
- Removal of existing structures where required
- Construction / installation of new structures

Importation of construction materials, including regulators and imported soils, would comply with Parks Victoria consent under the *Forests Act 1958* and the future *Environment Protection Act 2017* (this was due to commence on 1 July 2020 however has now been postponed until 1 July 2021 (or earlier by proclamation) due to the COVID-19 emergency).

A Construction Environmental Management Plan (CEMP) will be prepared for the works and will detail the measures to avoid and minimise impacts during construction. Once construction of regulators, containment banks and all associated works are complete, all waste and surplus spoil will be removed from the sites and disposed of in accordance with the measures outlined in the CEMP.

Construction in the Murray River

The Brereton Road Pump Station, drop structures for Deep Creek and Spur Creek as well as some inlet works near Dalley Bend will require construction works within the Murray River within NSW. For the pump station this would include excavation and construction of intake pipes which will draw water levels down to near the minimum river water level. The portion of the intake pipes near the edge of the bank profile will be concrete encased serving as protection for bank scouring / erosion.

Construction footprint and laydown areas

The proposed construction footprint includes a working area (approximately 10 m) around the development footprint for proposed infrastructure to accommodate movement of vehicles and machinery and some limited storage of equipment and materials.

Construction laydown areas included in the construction footprint are proposed within proximity to Camerons Mid Creek Regulator and Camerons Creek River Track Regulator in Upper Gunbower. The location of laydown areas in Middle Gunbower will be determined as design progresses. All locations are currently under review by VMFRP and it is proposed to move these laydown areas to private land outside of the forests to minimise and avoid impacts. Consultation with relevant landholders is currently being undertaken.

Laydown areas would provide the primary location for site offices, amenities, vehicle manoeuvres / parking, storage of equipment and materials, etc.

Smaller, more localised laydown areas would also be provided at or within proximity to the other infrastructure sites which are within the construction footprint.

Project area rehabilitation

Following completion of works, rehabilitation of construction areas would be undertaken in accordance with Parks Victoria consent under Section 27 of the *National Parks Act 1975*. General principles for site rehabilitation include:

- Use of local indigenous plant species
- Placement of habitat logs
- Retention and reuse of topsoil

Details of rehabilitation will be included in the CEMP.

Key operational activities

The proposed works are intended to enable areas of the Gunbower National Park floodplain to be inundated with pumped inflows from the Murray River through Brereton Road Pump Station on the Murray River, a pump station and pipeline on the National Channel (upstream section of Gunbower Creek) and gravity fed flows through Camerons Creek.

Activites may include:

- operation, monitoring and maintenance of environmental watering infrastructure (pumps, regulators etc.)
- environmental water delivery to target floodplain areas in accordance with seasonal watering and delivery plans
- monitoring of inundation extent, water depth and inflows and return flows throughout the event
- dewatering activities on ceasing delivery of environmental water.

Three operating scenarios have been identified for water delivery to the Gunbower National Park. These have been proposed to meet the ecological objectives of the project and include:

- Permanent wetland watering – targeted water delivery to wetlands only. The optimal inundation regime for permanent wetlands (Camerons Creek and Black Charlie Lagoon) is 10 years in 10 for a duration of 12 months. The expected frequency of operation is 10 years in 10 to achieve the optimal frequency. Black Charlie Lagoon will be filled in winter/spring and allowed to drawdown throughout the year while maintaining minimum residual pool water levels; some years will only require top-up water delivery. The lagoons and waterway of Camerons Creek will be allowed to fluctuate and periodically topped up to maintain sufficient water depth and connectivity to support aquatic biota.
- Forest floodplain watering – water delivery to the broader floodplain (including temporary wetlands) and a semi-permanent wetland, including:
    - River Red Gum (RRG) forest with flood dependent understorey (Baggot Swamp and mid-forest floodplain), temporary wetlands (Emu Hole and Red Rise Swamp) and associated creeks and low-lying areas. The optimal inundation regime is on average six years in 10 for between two to five months and would require pumping on average three years in 10 to achieve the optimal inundation regime. Inundation in other years is assumed to be provided through natural inundation under the Basin Plan 2750 scenario; and
    - Semi-permanent wetlands (Pig Swamp). The optimal inundation regime is on average seven years in 10 for six months and would require pumping on average four years in 10 to achieve the optimal inundation regime. Environmental water will be delivered to Pig Swamp three

years in 10 under the RRG forest and temporary wetland scenario outlined above, with an additional one year in 10 delivered to achieve the optimal inundation regime for the semi-permanent wetland. Inundation in other years is assumed to be provided through natural inundation under the Basin Plan 2750 flow scenario.

- Hybrid events – topping up natural inundation events for the forest floodplain, temporary wetland and semi-permanent wetland watering due to natural inundation duration deficits. There are two options for extending the duration of natural floods that inundate the broader forest and associated wetlands:
    - Flood capture to retain floodwater on the floodplain for the required duration by closing the outlet regulators and low-lying inlet regulators from the Murray River after the river flow peak has passed; and
    - Follow up watering of the forest floodplain and wetlands following natural flow peaks and/or flood capture to achieve the required inundation extent and/or duration where the natural inundation extent or duration is inadequate to achieve ecological objectives.

A summary of the proposed operating scenarios for Gunbower National Park is provided in **Table 6** and discussed further below.

Table 6: Modelled frequency of operational scenarios for the Gunbower National Park Floodplain Restoration Project.

Scenario	Site	Optimal watering frequency	Modelled inundation frequency*	Expected frequency of operation	Peak filling inflow rate (ML/d)	Required timing of operation	Duration of inundation
Permanent wetland watering	Black Charlie Lagoon (BCL) & Camerons Creek (CC)	10 years in 10		10 years in 10	15	Winter/Spring (BCL) Throughout year (CC)	1-12 months
Forest floodplain watering/ semi-permanent wetland inundation	Baggots Swamp	6 years in 10	3 years in 10	3 years in 10	20	Winter / Spring	2-3 months
	Pig Swamp	7 years in 10	3 years in 10	4 years in 10**	20	Winter / Spring	6 months
	Emu Hole Lagoon	6 years in 10	3 years in 10	3 years in 10	10	Winter / Spring	4 months
	Red Rise Swamp	6 years in 10	3 years in 10	3 years in 10	125	Winter / Spring	3-5 months
	Middle Forest floodplain	6 years in 10	3 years in 10	3 years in 10	125	Winter / Spring	3-5 months

* Based on Basin Plan 2750 flows (Gippel 2014).
** Pig Swamp requires 1 year in 10 in addition to filling during the middle forest floodplain watering to achieve the 7 year in 10 optimal inundation frequency.

Permanent wetland watering (Upper Gunbower Forest)

Water will be delivered to Black Charlie Lagoon and Camerons Creek in Upper Gunbower via the Camerons Mid Creek Regulator, with the option to deliver top-up flows via Cameron Creek and/or a new pump station on the National Channel and associated pipeline, if required. The proposed watering will include two phases:

- Filling phase: A gradual ramp up will be delivered in winter/spring, with peak inflow rate of up to a maximum of 15 ML/d through Camerons Creek (although lower flows will likely be delivered), filling Black Charlie Lagoon to full supply level (FSL) of 85.05 m AHD and achieve the maximum inundation extent in Camerons Creek Lagoons 1, 2, 3 and 4.
- Maintenance phase: Wetlands will be allowed to draw down naturally to minimum levels throughout summer and autumn. Constant flows through Camerons Creek will likely be required throughout the year to maintain minimum levels in the lagoons, however some fluctuation in water levels will be targeted. Top-ups to Black Charlie Lagoon may also be required to maintain minimum levels. The pipeline will enable delivery directly to Lagoon 4 and Black Charlie Lagoon, allowing these wetlands to be topped-up independently of Lagoons 1, 2 and 3 if water levels in these wetlands require drawing down. However, the preference is to deliver water via the natural waterway of Camerons Creek where possible.

Forest floodplain and semi-permanent wetland watering (Upper and Middle Gunbower Forest)

The forest floodplain and associated wetland watering includes inundating the RRG forests with flood dependent understorey and the lower lying temporary wetlands in the Upper and Middle Gunbower Forest. The one semi-permanent wetland in the Middle Forest (Pig Swamp), is included in this operating scenario as it will be watered via the same infrastructure and in the same years as the Middle Forest floodplain, with one additional watering every 10 years to achieve the optimal watering frequency for the wetland. The proposed watering scenarios and operation of infrastructure for each of these areas is outlined below.

Upper Gunbower

The Upper Gunbower WMA contains an area of RRG forest with flood dependent understorey immediately downstream of Black Charlie Lagoon. Watering events for Baggots Swamp will commence with the filling of the permanent wetlands to the FSL of Black Charlie Lagoon (as described above), followed by overtopping the wetland into the surrounding floodplain of Baggots Swamp to the west. Once Black Charlie Lagoon is full, both the Camerons Mid Creek Regulator and pipeline outlet will be opened to provide a combined peak inflow rate of about 20 ML/day over a period of about 15 days to achieve the target water level of 84.8 m AHD in Baggots Swamp. RRG with flood dependent understorey vegetation fringing Camerons Creek will also be inundated at these higher target water levels. Inflows will then cease and the area will be allowed to drawdown naturally through evaporation and seepage, with a target inundation duration of 60 days.

Middle Gunbower

The Middle Gunbower floodplain proposed watering includes the inundation of RRG forest with flood dependent understorey, temporary wetlands and one semi-permanent wetland within the Middle Forest (upstream and downstream of Deep Creek WMA). Water will be delivered to meet the shortfall in frequency and duration of natural inundation (assuming Basin Plan 2750 flows) in the Middle Forest.

The proposed watering for Pig Swamp and Emu Hole Lagoon will include two phases:

- Filling phase: A gradual ramp up will be delivered through the Pig Swamp Regulator and Emu Hole Regulator in Old Straight Cut Channel (via the Brereton Road Pump Station) in winter/spring. Peak inflow rates of up to 20 ML/d will be delivered into Pig Swamp for approximately 10 days to achieve target water level of 84.12 m AHD, and 10 ML/d into Emu Hole Lagoon for 13 days to achieve 84.2m AHD.

- Maintenance phase: The wetlands will be allowed to drawdown naturally throughout summer and autumn. Small top-up flows will be delivered if and as required to achieve the target inundation duration of six months for Pig Swamp and four months for Emu Hole Lagoon.

The proposed watering for Middle Gunbower Forest floodplain area will include three phases:

- Filling phase: Gradual ramp up will be delivered through the Middle Forest Offtake Regulator in Old Straight Cut Channel (via the Brereton Road Pump Station) in winter/spring, at peak flows of 125 ML/day to achieve the desired inundation extent.
- Maintenance phase: Reducing inflows from 125 ML/day to approximately 55 ML/day from the pump station to offset losses and provide return flows to the Murray River. Continue providing maintenance inflows to meet the optimal inundation duration of three to five months for the RRG forest and temporary wetland (with approx. 20 ML/day return flows to the Murray River during this period)
- Ramp down phase: gradual ramp down of inflows.

Pig Swamp and Emu Hole Lagoon

Watering events for Pig Swamp (semi-permanent wetland), will be delivered via the Pig Swamp Offtake Regulator in the Old Straight Cut Channel. Pig Swamp will be filled at a peak flow rate of 20 ML/d for approximately 10 days to achieve the target water level of 84.12 m AHD, at which stage the regulator gate will be shut and the wetland will be allowed to drawdown naturally through evaporation and seepage. If required, the regulator will be operated to deliver water for short periods of time following the initial filling to achieve the target watering duration of six months.

Watering events for Emu Hole Lagoon (temporary wetland) will be delivered via the Emu Hole Lagoon Offtake Regulator in the Old Straight Cut Channel. Emu Hole Lagoon will be filled at a peak flow rate of 10 ML/d for approximately 13 days to achieve the target water level of 84.2 m AHD, at which stage the regulator gate will be shut and the wetland will be allowed to drawdown naturally through evaporation and seepage. If required, the regulator will be operated for short periods of time to deliver water following the initial filling to achieve the target inundation duration of four months.

Middle Forest

Watering events for the Middle Forest (excluding Pig Swamp and Emu Hole Lagoon) will be delivered via the Middle Forest Offtake Regulator in the Old Straight Cut Channel. Flows are conveyed beneath Brereton Road through pipes and through the forest along flood runners and low ground in a north-westerly direction, before passing through the broken banks of the Old Cohuna Main Channel (Tier 1) and forming a pool from the natural surface levels of the breaks in the downstream banks of Deep Creek (Tier 2). During the initial filling and subsequent top-up to achieve the target watering duration, the Deep Creek River Return Regulator would be closed to prevent any return flows to the Murray River. From Deep Creek, flows continue in a northerly direction to the Middle Forest (Tier 3), where water is contained by a number of containment banks and regulators, firstly at Munroe Track (Tier 3a) then at the Broken Axle Creek Regulator and Spur Creek River Return Regulator (Tier 3b). The Munroe Track Regulators would be closed prior to the commencement of the watering event and likely remain closed throughout to achieve the target water level of 83.4 m AHD upstream of Munroe Track (Tier 3a). Once Tier 3a is inundated, Munroe Track Regulators would be fully opened and the Spur Creek River Return Regulator, Broken Axle Creek Regulator and Tickells Track Regulator would each be closed prior to commencement of the watering event to achieve the target water level of 83.0 m AHD in Red Rise Swamp (83.4 m AHD in Red Rise Swamp Upper).

Once the target inundation extent has been achieved, the Spur Creek River Return Regulator and Deep Creek River Return Regulator will be opened to allow floodplain return flows into the Murray River and maintenance flows will be provided via the Brereton Road Pump Station to achieve the target inundation

duration of three to five months for the RRG forest with flood dependent understorey and temporary wetlands (note: inundation duration includes combined filling, maintenance flow and ponding times).

Hybrid events

During natural (unregulated) inflows into the Middle Forest, environmental water may be used to extend the extent and/or duration of inundation via the Brereton Road Pump Station. In the event of natural inundation, the Dalley Bend Inlet Regulator and Deep Creek River Return Regulator would be fully opened to maximise natural inflows and all internal forest regulators fully opened to allow floodwater to follow the natural flow path through the forest. If the duration of natural inflows is expected to be short, then the Tier 3a and 3b Regulators would likely be closed prior to the flood recession to capture floodwater on the floodplain and extend the duration of inundation, with the addition of pumped inflows through the Brereton Road Pump Station to achieve the optimal duration. The Spur Creek Forest Regulator would remain open throughout the event to allow inflows through the Spur Creek flood runner into the lower Gunbower Forest (i.e. TLM area). Water could also be released in a controlled fashion from the Broken Axle Creek Regulator down Broken Axle Creek.

Fish passage has been considered in preliminary designs and will be further refined during subsequent stages of design and development of the operating plan. Carp screens will be required on the Murray River regulators to exclude large numbers of adult carp entering the floodplain, causing ecological damage to wetlands and spawning on the floodplain. Fish passage will also be required to allow native fish to enter and exit the floodplain during natural and hybrid events. Active upstream fish passage targeting small-bodied native fish will be provided through a cone fishway at Camerons Mid Creek Regulator.

Key decommissioning activities (if applicable):

The existing Camerons Mid Creek Regulator and Camerons Creek River Track Bridge and Regulator will each be replaced with a new regulator / bridge (as described above) as part of the project. The existing regulators will be removed to prevent obstacles to fish passage. Eight irrigators currently use Camerons Creek as their water supply point. These supply points will be decommissioned and the customers transferred onto the Camerons Creek Pump Station and pipeline.

The design life of the proposed structures is 100 years. If the structures are no longer required at the end of life, all structures will be removed to a practical extent from the site by the operator, and the area rehabilitated to the satisfaction of Parks Victoria.

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).

Environmental water was delivered to Pig Swamp in 2016 as part of pumping trial. The trial was discontinued after the area was inundation naturally. There is a possibility that the trial may recommence and environmental water will be delivered again to Pig Swamp prior to the infrastructure, which is part of this project, being constructed.

A pumping test of the flow capacity of Camerons Creek was undertaken in 2016 to inform concept determination. Temporary pumps were installed just above the existing Camerons Mid Creek Regulator and water pumped via temporary pipelines back to the Murray River. This test resulted in a determination that the upper section of Camerons Creek had a continuous flow ability of just under 15 ML/day when the Murray River and Torrumbarry Weir pool were at normal full operating level.

No further stages are currently proposed at Gunbower National Park beyond the current project.

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

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

The Gunbower National Park Floodplain Restoration Project is one of nine discrete environmental works sub-projects being undertaken as part of the VMFRP, which is being implemented as part of Victoria's obligations under the Murray-Darling Basin Plan. The VMFRP aims to return a more natural inundation regime across more than 14,000 hectares of high ecological value Murray River floodplain in Victoria through the construction of new infrastructure and modification of existing infrastructure.

The VMFRP is being implemented by a partnership between LMW, GMW, Mallee CMA, North Central CMA, Parks Victoria and the DELWP, and is funded by the Commonwealth Department of Agriculture, Water and Environment (DAWE). LMW is the project proponent.

Attachment 1 – Map 5 shows the project locations, with further details of these projectsavailable at: https://www.vmfrp.com.au/

Separate referrals are being prepared for these sub-projects under the *Environment Effects Act 1978* and the *Environment Protection and Biodiversity Conservation Act 1999***.**

What is the estimated capital expenditure for development of the project?

$11,680,000 (approximate)

(Upper Gunbower = $2,240,000)

(Middle Gunbower = $9,440,000)

4. Project alternatives

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

Do nothing (maintain status quo)

One alternative is to not undertake the project. However, this alternative is not being considered further as it would:

- Lead to ongoing deterioration of floodplain ecosystems in the targeted inundation area. The targeted inundation area is displaying significant evidence of ecological stress caused primarily by river regulation, which has significantly reduced the frequency, depth and duration of inundation events entering these areas.
- Mean foregoing an opportunity to deliver long-term positive impacts to areas that are significant at a local, regional, national and international level.
- Impact on the ability for Victoria to meet its obligation under the Murray-Darling Basin Plan as the project is a supply measure project designed to off-set the Basin Plans' water recovery targets.

Alternative design/ reduced project area

A range of alternative design options have been evaluated. The preferred design of the works is the result of detailed assessments drawing on extensive investigations at the site and overseen by ecological, hydrological, and engineering expert review panels. The preferred option was the result of detailed options assessments, prior to and post the submission of the 2014 business case for this project (North Central CMA, 2014a). The project business case was approved within the Basin Plan process as part of a package of 36 SDL projects which collectively achieve targeted environmental outcomes for the Basin. Refinements will be considered in finalising the design to respond to environmental and heritage assessment and any stakeholder or landholder requirements. Alternatives could include minor re-alignments of banks and siting of structures to avoid and minimise impacts. However, consideration of fundamental project alternatives which would result in a lesser area of targeted EVCs being watered would compromise Victoria's ability to achieve the required SDL offset.

Alternatives Considered to Avoid Impacts on Sensitive Biodiversity Values

Many and various project alternatives were considered throughout development and refinement of the project concepts and some of the key ones are discussed in the following section. Of prime consideration during option assessment for environmental watering infrastructure requirements was the minimisation of impacts on vegetation and other biodiversity values. Particular consideration and effort was put to minimising the impact on, and unavoidable environmental watering of, the Riverine Chenopod Woodlands (RCW) community.

At many points in time over the last number of years there have been assessment processes involving project stakeholders specifically looking to minimise impacts and maximise ecological outcomes. Minimising biodiversity value impacts has been front of mind for the project.

RCW vegetation communities exist through the Upper and Middle Gunbower Forest areas and extensive modelling and option assessment has gone into minimising the watering of these areas. However, it is not possible to achieve the project objectives without some impact on, and overwatering of, these areas.

For the Upper Gunbower Forest area the rate of fill and location of discharge points have been developed with close consideration to minimising the watering of RCW areas as well as ensuring that the Baggots Swamp area does not hold water for too long a period.

For the Middle Gunbower Forest area there were multi-criteria assessments and workshops undertaken with many stakeholders, including Parks Victoria and DELWP, to determine the location for the pump station and environmental water inflows that would achieve requirements and minimise impacts including of RCW areas. There was detailed assessment and consideration undertaken of main environmental watering inflows coming from either Dalley Bend or Old Straight Cut Channel. Both had RCW area impact but just in different locations. Ultimately the Old Straight Cut inflow location had fewer impacts, required less infrastructure and would cost less money to construct and operate.

For the Middle Gunbower Forest area inflows from the Old Straight Cut Channel supplied by the Brereton Road Pump Station, detailed consideration was given to the approximately 7 hectares of RCW overwater that occurs downstream of the discharge point. Various discharge locations were considered as was an alterative to cut a channel through the RCW area to minimise the spread of water. Ultimately the stakeholders felt that the overwatering was acceptable, was a lesser impact than cutting a channel through the forest and also that the area would likely have been of a more riverine vegetation type in the past before drying transformation.

Proposed project

Planning and design of the project has considered a range of alternatives to achieve the specific ecological objectives described in Section 3 (Project description: Aims/objectives of the project) of this referral. This has

involved numerous studies over the last decade to evaluate and refine water management options to identify the most effective and efficient design for environmental watering of the Gunbower National Park. This optimised design seeks to maximise the benefits of the project, whilst minimising construction impacts. Key investigations that informed and considered project design alternatives (are summarised below).

Pre Business Case Development – Upper Gunbower Forest

A Phase 1 Feasibility Study proposed a large-scale engineering solution to supplement the inundation deficit in the upper Gunbower Forest. The solution involved a major channel which would convey water from the Torrumbarry Weir pool to the forest. The proposed channel was 280 m in length, 30 m in width and supplied through three overshot flume gates, each 2.3 m wide and 2.2 m high.

The impact footprint for a channel of this magnitude meant that the ecological and cultural implications were significant. In addition, the option provided very little operational flexibility and would have resulted in overwatering of terrestrial vegetation communities.

Subsequent work was then undertaken to scope an option which could deliver water to meet the specific inundation regime requirements of the water dependent vegetation communities in the upper and middle forest, while reducing the footprint and avoiding inundation of the less flood tolerant communities. The resulting options were to deliver water through:

- Camerons Creek into the high value permanent wetland - Black Charlie Lagoon - and provide watering to River Red Gum areas surrounding the wetland in the upper part of the forest.
- Old Cohuna Main Channel to provide broad scale inundation of River Red Gum, in the middle and lower parts of the forest.

Sustainable Diversion Limits Project Gunbower Upper Forest Channel Camerons Creek Diverters (GJM, 2014)

In 2014, GJM Civil investigated alternative options for the irrigation diverters on Camerons Creek. These options aimed to assist in determining the viability of Camerons Creek as a source of supply for the Upper Gunbower National Park flood enhancement works. The options assessed are listed in **Table 7** below.

Table 7: **Summary of options assessed for the Camerons Creek Diverters**

Option number	Option	Description
1	Do nothing	Proceed with traditional engineering solution
2	Share the Creek	Improve the flow capacity of the creek via dredging (significant environmental impact), share capacity
3a	New Berrys Weir + Pipeline	New inline weir, 3,900 ML/day capacity, Reinforced Concrete Pipeline
3b	New Berrys Weir + Channel	New inline weir, 3,900 ML/day capacity, Earth Channel
4a	Pump Station & Pipeline	50 ML/day pump station, Reinforced Concrete Pipeline
4b	Pump Station & Channel	50 ML/day pump station, Earth Channel
5	Structural Adjustment	Water buy out & dry off, decommission assets

The report recommended that further investigations into Creek Sharing (option 2) and Structural Adjustment (option 5) be undertaken. The preferred option, outlined by North Central CMA in the Supply Measure Business Case, was option 2 due to the option being cost effective, achieving ecological outcomes and generating minimal disruption. This was further supported by the assumption at the time that there was capacity within the irrigation system to support both irrigation and environmental needs.

Confirming Concepts for Gunbower National Park (URS, 2014)

In 2014, URS undertook the concept design work for the Gunbower National Park. This consisted of conceptual designs for the four components of the project being proposed under the Gunbower National Parks Flood Enhancement Project: Camerons Creek Regulator, Camerons Creek Irrigation Supply Works, Baggots Swamp Drainage/Pumping and Old Cohuna Main Channel Works.

A description of each key concept design component is as follows:

- **Camerons Mid Creek Regulator** - Construction of new irrigation weir regulator structure to provide controlled environmental flows from upper reaches of Camerons Creek, connected to the Torrumbarry weir pool, into downstream wetland and swamp complex including Black Charlie Lagoon and the Baggots Creek area. The same regulator will also provide irrigation supply to two current irrigation Camerons Creek diverters.
- **Camerons Creek Diverters** - Includes irrigation supply improvement works to supply two current irrigation customers (creek diverters).
- **Baggots Swamp Temporary Pumping** - Provision of permanent access and civil works to facilitate pumping to drain Baggots Swamp and to overcome a natural high point in the forest and to discharge water some 2 km further down the forest. This was considered after it became problematic and not considered effective to drain the forest out of the original natural flow path due to the need to traverse private land and use of downstream waterways as part of the GMW irrigation system.
- **Old Cohuna Main Channel** - Enhancement of the Old Cohuna Main Channel (OCMC) and flow control works to enable inflows to the lower half of the Gunbower National Park. Works include flow capacity improvements to the OCMC existing vehicle crossings.

The development of the concept designs was based on a number of overall design criteria including the consideration of environmental and cultural heritage impacts.

The decision to pursue an irrigation supply arrangement over a pump station was based on the following assumptions at the time:

- There was sufficient capacity within the GMW Torrumbarry irrigation system to meet the requirements of the forest.
- The GMW Connections Project, an irrigation infrastructure modernisation project being implemented at the time, further supported the expectation that the irrigation system had the capacity to provide the required water.
- Diesel pump stations on waterways were not supported by Parks Victoria.
- There would be significant costs associated in getting power to the proposed pump station site.
- The Hipwell Road Channel and Regulator, used to deliver irrigation water to the Gunbower Forest as part of The Living Murray program, had become operational.

SDL Phase 2 Assessment Supply Measures Business Case: Gunbower National Park Environmental Works Project (North Central CMA, 2014a)

The Supply Measures Business Case for the Gunbower National Park (Phase 2), was developed by the North Central CMA in 2014 and was supported by the earlier concept design work undertaken by URS. The water management options proposed complement and build on the ecological outcomes of TLM environmental works and measures program, which targets the lower and middle sections of Gunbower Forest. The project will enable an additional 500 hectares of permanent and temporary wetlands and River Red Gum forest to be inundated. The components of the water management option proposed in the business case is summarised in **Table 8** below.

Table 8: Water management infrastructure and function proposed in the business case.

Infrastructure	Function
Camerons Creek	
Regulator	Deliver environmental water from upper reaches of Camerons Creek connected to the Torrumbarry Weir pool, into Black Charlie Lagoon and the Baggots Creek area
Diversion weir (approximately 1.5 km downstream of the new regulator), pump pads and sump, short pipeline	Deliver environmental water while maintaining irrigation supply to two diverters
Baggots Creek Area	
Hardstand area for a temporary pump and temporary piping	Enable drainage of the low lying Baggots Creek area
Remedial works on levees	Minimise risk of flooding to adjacent private land
Access tracks	Access to the hardstand for pumping operations
Old Cohuna Main Channel	
Irrigation channel offtake regulator	Delivery of environmental water from the Old Cohuna Main Channel (2/4/1 Channel) part of the Torrumbarry Irrigation Area (TIA)
Upgrades to three road culvert crossings	Increase capacity for delivery of water along Old Cohuna Main Channel
Forest regulator at the Old Cohuna Main Channel and forest intersection	Retain high river flooding flows within the forest

Several ecological based investigations contributed to the development of the proposed watering option which aimed to quantify both the current value of the site as well as the anticipated ecological benefit of reinstating a more natural inundation regime.

Environmental Impacts from the proposed works were assessed through a risk assessment process. Impacts to native vegetation from construction related activities would be mitigated against, as outlined in the risk register, through detailed designs and site surveys. In addition, a Cultural Heritage Management Plan would outline the measures used to avoid impacts to Aboriginal cultural heritage.

Confirming Concept Design Phase - Key Decisions Summary Report (Mid forest only) (North Central CMA, 2017)

In 2017, the North Central CMA developed a summary report on the key decisions made for the Middle Gunbower Forest to date. At the time the report was prepared, landowner consultation at Cameron's Creek was ongoing, consequently the report focused on Middle Forest only. The decisions report outlines that there were a number of areas of uncertainty around the hydraulic modelling for the Old Cohuna Main Channel and that the level of uncertainty was in fact very high. In addition, further investigations into the available capacity on the gravity irrigation network revealed that the Gunbower Creek was highly constrained and could not provide the flows required to meet the ecological objectives of the project. A pumping option was highlighted as a more appropriate way to deliver water into the middle forest.

The North Central CMA commissioned GHD to undertake a high-level assessment of four pumping options for Middle Forest. The North Central CMA later assessed a fifth option. The five options investigated were:

- Option 1 – Pump from Old Cohuna Main Channel (OCMC) at Flood Stop Bank
- Option 2 – Pump from OCMC at offtake
- Option 3 – Pump from Gunbower Creek to OCMC
    - Electric motor
    - Diesel motor
- Option 4 – Pump from Murray River at Old Headworks
- Option 5 – Pump from Murray River at Old Straight Cut

A Stakeholder Reference Group meeting was held on 3 February 2016 and discussed each of the options. A summary of the outcome is outlined in **Table 9** below.

Table 9: Stakeholder Reference Group meeting outcome

Option	Summary of outcome
One	Proposed to install a pump station at the stop bank at the end of OCMC at the edge of Gunbower Forest to pump water over the stop bank and discharge 50ML/d into Gunbower Forest. There would still be a reliance on the Torrumbarry Irrigation system to deliver water to the end of the OCMC (4/2/1) and therefore desilting and vegetation clearance works within the 4/2/1 would still be required. Does not reduce the reliance on the capacity of the irrigation system. It also requires vegetation clearance with the 4/2/1 channel and significant cost to supply power to the pump station.
Two	Proposed to install pump station on the OCMC at the future end of GMW backbone2 and a pipeline to deliver water from the irrigation channel to the edge of the Gunbower Forest. The pipeline would then discharge up to 50ML/d directly into Gunbower Forest. Four pipeline alignments were also assessed with the intention to compare construction costs and impacts to native vegetation.
Three	Provided an alternative to installing a pump station to pump out of the 4/2/1 channel by installing a 50 ML/d pump station directly on the Gunbower Creek near the Flume to pump water directly into the OCMC. Once water was pumped into the OCMC from the Gunbower Creek it would be delivered via gravity into the forest via a regulator at the end of the OCMC at the edge of the forest. This option overcomes the hydraulic issues associated with supplying water from the irrigation system however there are still capacity constraint with the Gunbower Creek.
Four	Proposed to install a pump station (permanent electric, permanent diesel or temporary diesel) and connecting pipework on the Murray River near the Old Headworks (i.e. Murray River end of OCMC) to deliver environmental water into Gunbower Forest. European heritage requirements would need to be considered at the Old Headworks site.

	Diesel powered pump stations are against current Parks Victoria policy. An electric powered pump station would require significant cost to install and may not be technically feasible.
Five	Proposes to install a pump station and connecting pipework on the Murray River within the vicinity of Old Straight Cut. The pump station would pump water from the Murray River into the Old Straight Cut and water would be delivered into Pig Swamp and the Middle Forest through a series of regulators. There is existing power in a more accessible location meaning that the cost would be reduced. Concerns were raised around the flooding of less flood tolerant vegetation classes.

Option 5 was the preferred option with the Stakeholder Reference Group preferring an electric powered pump station option in a location that reduced construction impacts and cost. The issue of inundating the less flood tolerant vegetation classes was identified to be further explored to ensure all options to reduce this impact were investigated.

Further to this, a number of options were investigated into the pump station location. These included two locations along the Old Straight Cut Channel as well as one further north at Dalley Bend. When comparing the cost, ecological impact/benefit and construction impact, the electric pump on the Old Straight Cut channel was the preferred option.

The option of installing a temporary pump station was discussed with the Stakeholder Reference Group. At this meeting Parks Victoria noted that a temporary diesel pump may be permissible on the Murray River, however a permanent diesel pump station would be against Parks Victoria policy due to the risk of a diesel spill. Parks Victoria noted that an electric power supply is the preferred option.

The use of temporary diesel pumps still introduces the undesirable risk of a diesel spill within the National Park.

The use of temporary pumps creates further operational risk associated with noise, fire, time / administration required to secure funding, organise temporary diesel pumping contractors and approvals. This additional administration time would reduce the ability to react quickly to opportunities to deliver water to the forest. For example, hybrid events which would attempt to take advantage of windows within the hydrograph to ‘piggy back’ environmental water onto natural inundation events. This operational risk was seen to compromise the ability to achieve the ecological outcomes of the proposed works by meeting the required watering frequency if hybrid evets were not achieved as intended.

Camerons Creek Supply Options

Subsequent to the watering option presented in the business case for Camerons Creek, investigations were undertaken to further refine the water delivery arrangement. Pump and pipeline options have been investigated which look at delivering water from the Murray River or the National Channel. These options alleviate the need to manage Camerons Creek for both irrigation and environmental water.

The current option seeks to use Camerons Creek solely for environmental purposes with the aid of flow management structures being upgraded in the waterway. The capacity of Camerons Creek is not sufficient to meet environmental watering requirements alone. The pump and pipeline off the National Channel will provide additional capacity to support environmental watering when required. The existing GMW customers, who were originally supplied from the Murray River via Camerons Creek, can also be supplied via the pump and pipeline from the National Channel (Gunbower Creek).

R8 Interim Concept Design Report

In September 2019, R8 developed an interim Concept Design Report with the intent to collate and summarise the early options and concepts as well additional project developments resulting from investigation outcomes

and options development. A summary of the proposed works for the forest areas at this point in the design development process is as follows:

Upper Gunbower Forest

- 1 regulator with combined fishway - located midway along Camerons Creek
- 1 regulator - Camerons Creek River Track Regulator
- 1 Containment Bank - located adjacent to the Camerons Mid Creek Regulator and fishway
- 1 Pump Station - Camerons Creek Pump station on the Murray River near Torrumbarry Weir
- 1 Pipeline and Offtakes - A 3,000 m pressure pipeline for 10 irrigation supply points plus environmental water supply

Middle Gunbower Forest

- 1 Pump Station & power supply - located at Brereton Road and pumping into the Old Straight Cut Channel
- 3 Regulators - Pig Swamp Offtake Regulator, Emu Hole Lagoon Pipeline Offtake Regulator, Middle Forest Offtake Regulator
- 2 Containment Banks – Brereton Road outlet containment bank and block bank to Pig Swamp
- Public Road Upgrade Works - Raising and reinstate sections of Brereton Rd and riverside car parking area
- 1 Channels – minor upgrade of Old Straight Cut Channel

Key refinements of the design which were proposed to the Upper and Middle Forest areas after the Interim Concept Design Report (R8, 2019a) and into the Concept Design Report include:

- The introduction of a tiered inundation approach for both sections of the forest.
- An additional regulator at the northwestern end of Baggots Swamp (Upper Forest) to contain environmental water
- The installation of a gated culvert and minor channel works to encourage natural inundation events at Dalley Bend (Middle Forest). This includes the formalisation of sills and locally removing minor remaining levee banks on the Murray River.

The interim Concept Design Report was then taken to a full concept design, as described below.

R8 Concept Design Report

In Decemeber 2019, R8 developed a Concept Design Report with the intent to further develop the interim concept designs as well as outline additional project developments and discernments resulting from investigation outcomes and options development. A summary of the proposed works for the forest areas at this point in the design development process is as follows:

Upper Gunbower Forest

- 1 Regulator with combined fishway - located midway along Camerons Creek
- 2 Regulators - Camerons Creek River Track Regulator and Dry Tree Creek Outlet Regulator
- 1 Containment Bank - located adjacent to the Camerons Mid Creek Regulator and fishway
- 1 Spillway - located within Baggot Creek Track adjacent to the Dry Tree Creek Outlet Regulator
- 1 Pump Station - Camerons Creek Pump station on the Murray River near Torrumbarry Weir

- 1 Pipeline and Offtake - A 3,000 m pressure pipeline for 10 supply points for irrigation, stock and domestic, and environmental water supply

Middle Gunbower Forest

- 1 Pump Station & power supply - located at Brereton Road and pumping into the Old Straight Cut Channel
- 1 Pump Statio discharge pipeline – main delivery pipeline for Brereton Road Pump Station to Old Straight Cut Channel
- 7 Regulators - Pig Swamp Offtake Regulator, Emu Hole Lagoon Pipeline Offtake Regulator and Pipeline, Middle Forest Offtake Regulator, Middle Forest Southern Tier Regulator, Deep Creek Lower Forest Regulator, Deep Creek River Return Regulator and Dalley Bend Inlet Regulator
- 3 Levees - Emu Hole Lagoon Southern Levee, Pig Swamp Western Levee and Middle Forest Western Levee
- 2 Containment Banks – reinstate breached section in the Old Cohuna Main Channel southern bank and Deep Creek northern bank
- Public Road Upgrade Works - Raising and reinstate sections of Brereton Rd and riverside car parking area
- 1 Channel – minor upgrade of Old Straight Cut Channel

Key refinements of the design which have been proposed to the Upper and Middle Forest areas since the Concept Design Report (R8, 2019b) include:

- The introduction of a third tier (Tiers 3a and 3b) downstream of Deep Creek (Middle Forest).
- Change in location of the Camerons Creek Pump Station from supply from the Murray River to supply from the National Channel.
- Removal of two Deep Creek Regulators, which would have controlled flow to contain it within Deep Creek, but with the introduction of the third tier these are no longer required to regulate.

The changes made to the overall design of the water management option have increased the potential ecological benefits which can be realised by the project. This includes improving connectivity between the Murray River and Gunbower Forest floodplain (for the exchange of carbon, nutrients and propagules), and in particular the ability to deliver on the project objectives for fish by delivering carbon-rich return flows back to the Murray River which is critical for instream productivity.

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

No alternatives to the project are being further investigated. The Business Case for this project have been submitted to and approved by the Commonwealth Government and included extensive documentation of the alternatives investigated. The options assessment and design development have been informed by various investigations, which were undertaken with a view to minimising impacts on ecology and heritage values, whilst maximising the area to receive benefit from watering.

Design of the proposed structures, in particular levees and tracks, will continue to be refined through the design process to respond to environmental and heritage assessments, and stakeholder / landowner requirements.

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:

No other ancillary activities or further project stages have been excluded from this assessment.

6. Project implementation

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

LMW will be the implementing organisation responsible for managing construction of the project, the project will then be transferred to GMW for operation. As such, GMW will be primarily responsible for operation and maintenance of the environmental watering infrastructure.

In order to minimise potential adverse environmental effects and maximise environmental benefits across the nine sub-projects being undertaken as part of the VMFRP, existing frameworks for collaborative and adaptive environmental water management will be used. The Victorian Environmental Water Holder (VEWH) is the independent statutory body responsible for holding and managing environmental water entitlements on behalf of the state. VEWH administers the ongoing collaborative management of water available under environmental entitlements, which are used to improve the health of Victoria's rivers and wetlands and the native plants and animals that depend on them, through regulation of the river systems.

VEWH works collaboratively with a range of partners to plan the release and delivery of environmental water, including:

- The Commonwealth Environmental Water Holder and the MDBA to access water held on behalf of the Commonwealth Government
- Water authorities (e.g. GMW) and waterway managers (e.g. Mallee CMA, North Central CMA) which oversee investigations to determine water requirements, undertake water planning and coordinate the delivery of water and monitoring programs that support a process of learning and adaptation.

Environmental watering at Gunbower National Park would be undertaken in accordance with the VEWH's annual seasonal watering plan and in partnership between GMW, the North Central CMA and Parks Victoria, with input from the local community and Yorta Yorta Traditional Owners.

Before a watering action can commence, a Seasonal Watering Proposal must be prepared by the North Central CMA and approved by the VEWH. Submissions for environmental water allocations are presented by the VEWH to the relevant water holders who subsequently prioritise the watering proposals against all other watering proposals. Once a watering action is approved, the VEWH ensures sufficient water is in the appropriate allocation bank account (ABA). This may require a transfer of water from one ABA to another. The VEWH would then issue a Seasonal Watering Statement to the North Central CMA allowing access to an allocation of water in the ABA. Once the Seasonal Watering Statement is approved, a water order can be placed by North Central CMA with GMW, enabling a diversion to commence.

Implementation timeframe:

Construction is currently scheduled to commence in January 2023 and is anticipated to be completed by June 2024.

Proposed staging (if applicable):

Not applicable.

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).

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):

General

The project area is located on the mid-Murray floodplain in Northern Victoria. Gunbower National Park covers approximately 9,330 hectares and includes a large part of the Gunbower Forest (Parks Victoria, 2018). The broader Gunbower Forest is also listed as a Ramsar site (20,218 hectares), and together with the adjacent NSW Koondrook-Perricoota Ramsar site comprises the second largest River Red Gum (*Eucalyptus camaldulensis)* forest in Australia **(Attachment 1 – Map 4 Ramsar site).**

Gunbower forest is bounded to the north by the Murray River and along its southern edge by private land and Gunbower Creek, northwest of Echuca. The forest extends for approximately 150 km between the townships of Torrumbarry and Koondrook, also bordered by the localities of Cohuna and Gunbower within the Torrumbarry Irrigation Area (TIA), and within both the Gannawarra Shire and Campaspe Shire LGAs.

The surrounding landscape is typical of the Riverina bioregion featuring ox-bows, meander scrolls and isolated wind-blown dunes and low-lying River Red Gum forests. There are areas of frequently flooded River Red Gum forest and less frequently inundated areas that support Black Box and Grey Box woodlands (*E. largiflorens* and *E. macrocarpa*). Dune areas that are not subject to inundation support small areas Native Pine (*Callitris gracilis*) / Buloke (*Allocasuarina leuhmannii*) and Mallee vegetation (RIS, 2006).

The area also comprises private property which includes large areas of irrigated agriculture. Gunbower Creek has historically been used to convey irrigation water used by irrigators who own land adjacent to the Creek. The flow regime in Gunbower Creek is therefore highly modified. A series of levees were formed on the south-west border of the Gunbower Forest to contain floodwaters within the Forest and prevent floodwaters from inundating private land. Several sections of existing levee are located on private land (R8, 2019a).

Geomorphology, topography and landform

The Gunbower Forest area is situated within the Northern Riverine Plain (RP). The NRP is a very extensive and complex alluvial plain associated with the Murray River.

The project area is located in the Murray Fans bioregion, which is characterised by a flat to gently undulating landscape on recent, unconsolidated sediments with evidence of former stream channels, braided old river meanders and paleochannels, and broad floodplains areas associated with major river systems and prior streams (DPI, 2009).

The Gunbower Forest floodplain is relatively flat with a regional east-west slope of 0.2 m / km and elevations ranging from 85 mAHD near Torrumbarry Weir to 72 mAHD near Koondrook Weir. Yarran Creek banks are higher than the surrounding land and form a hydraulic barrier across the floodplain (Water Technology, 2009). There is an area in the mid forest (downstream of Spur Creek) that is characterised by a network of channels, some of which are deeply incised. The north-western (downstream) areas of the site are at the lowest elevation where larger depressional floodplain wetland complexes occur (Water Technology, 2009 cited in Hale and Butcher, 2011).

Wetlands, waterways and drainage

The project area comprises low-lying habitats that include both permanent wetlands and temporary wetlands (refer **Attachment 4 - Waterways and Wetland Map**).

Gunbower Forest occurs in the Victorian Murray River catchment downstream of Torrumbarry Weir, between the Campaspe and Loddon Rivers. The forest is a Murray River floodplain system located on the southern bank of the river between Torrumbarry and Koondrook. The northern bank of the river is occupied by the Koondrook-Perricoota Forest (NSW). Flows in the Murray River under regulated flow conditions are sourced largely from Hume Reservoir and Lake Eildon. Hume Dam releases water to Yarrawonga Weir and to the Murray River downstream (Cooling and SKM, 2012).

The part of Gunbower Forest that includes Gunbower National Park is characterised by wetlands in low-lying areas surrounded by broad areas of River Red Gum forest at a slightly higher elevation on the floodplain, and Black Box and Grey Box woodland communities situated on the highest areas. The highest elevations in the upper forest fall away to the middle and lower sections of the forest. The average fall across the island is in a north-westerly direction at a slope of 1 in 5,000 (URS, 2001 cited in North Central CMA, 2014a). The dominant flow path through the forest is in a north-westerly direction.

The principal sources of water for Gunbower Forest are (Cooling and SKM, 2012):

- Murray River, upstream of Albury where water is stored in Hume and Dartmouth Reservoirs
- Ovens River, which provides unregulated river inflows to the Murray River below Hume Reservoir
- Goulburn River inflows; water is stored in Lake Eildon
- Campaspe River inflows; water is stored in Lake Eppalock.

Water quality within the Gunbower Forest Ramsar site is influenced by both river sources and floodplain interactions including with groundwater during cycles of wetting and drying. Water quality in the main channel of the Murray River is generally fresh with salinity below 400 micro Siemens per centimetre from 1992 to 2008 (data from Victorian Water Resources Data Warehouse, cited in Hale and Butcher, 2011). Water quality in permanent and frequently flooded wetlands on the floodplain can vary considerably between sites and over time and is greatly influenced by floodplain inundation. In Gunbower Creek water quality is highly variable and dependent on water quality in the Murray River, the floodplain and hydrology of the creek itself. Salinity is mostly low, but in times of low or no flow can be considered brackish with electrical conductivity rising above 2000 micro Siemens per centimetre. Similarly, turbidity varies from low to relatively high (Hale and Butcher, 2011).

The inundation of ephemeral wetlands and floodplain forests triggers carbon stored in organic plant matter to dissolve into the water. This process is critical for wetland and stream productivity as the dissolved carbon provides a key source of food for microorganisms which support the aquatic food web. Therefore, inundation events are considered important in maintaining productivity of river and floodplain environments (Junk et al. 1989). However, as microorganisms utilise the dissolved carbon they also use up oxygen in the water column, which may cause hypoxic blackwater events (Howitt et al. 2005). Hypoxic blackwater is associated with reduced levels of dissolved oxygen in the water column, both on the floodplain and in receiving channels and wetlands, to concentrations that are detrimental to fish. This is a higher risk when flooding occurs in warm temperatures (late spring/summer) which speeds up the rate of biotic processes, and when

there is a large build-up of carbon on the floodplain. If there is a long period between inundation events, organic matter builds up on the floodplain and dissolved oxygen concentrations can fall below the tolerances of fish and other aquatic fauna (Howitt et al. 2005) (all cited in Hale and Butcher, 2011).

At Gunbower Forest, there are examples of hypoxic blackwater events caused by natural flooding, however environmental water deliveries are managed to reduce the risk of any adverse impacts to receiving waters. The most notable and recent example is the natural floods of 2010, which inundated large areas of floodplain that had been dry for a decade prior. Water discharging from the forest was very low in dissolved oxygen (less than one milligram per litre) causing decreased oxygen concentrations in lower Gunbower Creek below Koondrook Weir, noting that this was a small section of the creek just above the confluence with the Murray River which passed volumes sufficient to dilute the Gunbower Forest return flows (MDBA unpublished; Hale and Butcher, 2011). However, no hypoxic blackwater return flows have been associated with the delivery of environmental water to Gunbower Forest. More frequent inundation of wetlands and floodplains is expected to reduce the risk of blackwater events by managing the build-up of organic loads between inundation events.

Hydrogeology

The project area occurs in the Murray Geological Basin where the thick Shepparton Formation overlays the Calivil Formation, with the Renmark Group aquifer underlying both. Bedrock underlies these stratigraphic units at a depth of around 180 m across the project area. **Figure 1** below shows a generalised hydrogeological cross section for this area, identifying the main units and their relationships. For this assessment, the focus is on the groundwater environment and current conditions of the shallow (upper) aquifer systems (R8, 2020a).

There are two surficial groundwater aquifers relevant to the project present across the project area. These aquifers are in hydraulic connection to deeper aquifers that also underly the project area. The project is to the east of the extent of the Blanchetown Clay aquitard unit, which act as a confining layer above regional aquifers elsewhere in the region. The Loxton-Parilla Sand aquifer is present in western parts of the Gunbower National Park but is absent in the project area (R8, 2020a).

The relevant aquifer sequence at the project area is summarised by the following hydrogeomorphic units (from the surface downward; numbers refer to Aquifers as defined in the Victorian Aquifer Framework (DELWP, 2020a)). The Calivil and Renmark Group units are too deep under the project area to be of direct relevance to this assessment:

- Coonambidgal Formation (100): Quaternary alluvial sedimentary deposits, where saturated, consisting of clay, sands and sandy clays that are part of the contemporary floodplain and the recent geological past. The upper layer of the formation is predominantly finer grained and can act to retard vertical infiltration. The unit is around 8 m thick across the project area.
- Shepparton Formation aquifer (102): A thick sequence of Upper Tertiary to Quaternary aged, generally fine grained sediments, with occasional shoestring sands throughout. Sometimes split into the Upper and Lower Shepparton Formation, the Upper part is thinner, around 25 m thick in the project area, and contains small and discrete sand lenses thought to be limited in connection. The Lower Shepparton Formation is thicker, between 40 and 110 m thick, and sand is generally absent. This formation is a regional aquifer and is typically saline or brackish in water salinity.

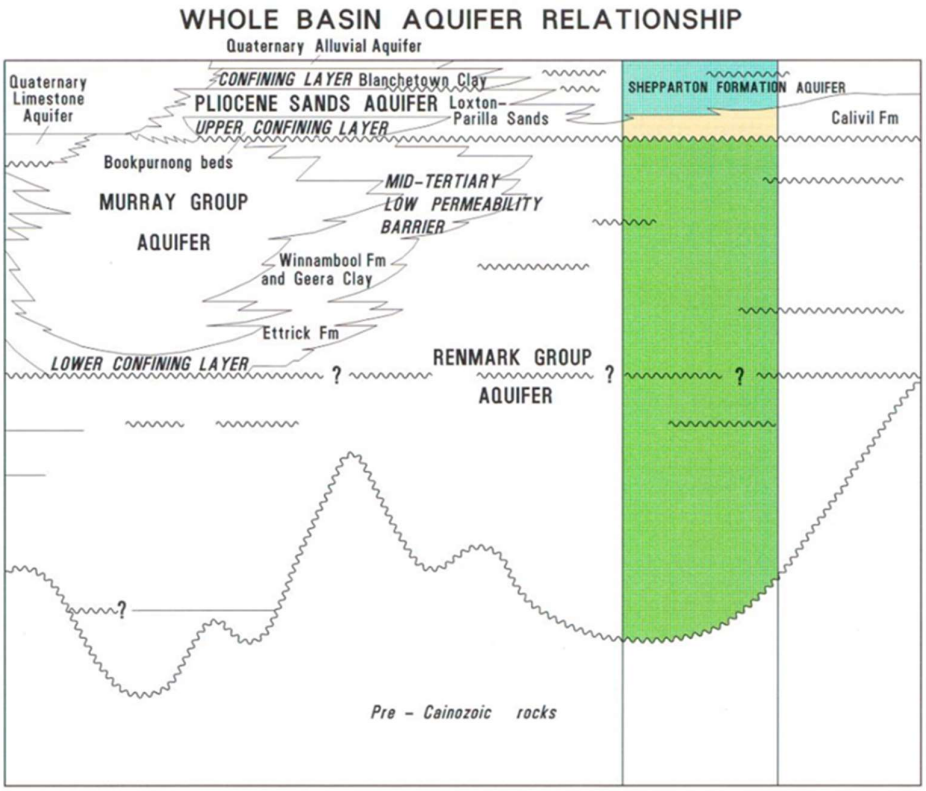

Figure 1: Regional hydrogeological units and their relationship within the Gunbower National Park project area (Indicative project area marked - Source: Deniliquin 1:250,000 Hydrogeological Map, R8, 2020a)

Regional groundwater flow is to the north-west, parallel to the general course of the Murray River in this area. In some cases, there will be localised flow toward the Murray River or other directions.

The project area is underlain by groundwater typically between 5 -10 m depth below ground surface but is less than 5 m in the southern portion of the Upper Gunbower Forest project area. Impacts of forest transpiration lowering groundwater levels within the forest area, and widespread irrigation (on the plains to the west and south of the forest) to keeping groundwater levels elevated are evident. Outside of the forest, groundwater levels are typically 5-10 m shallower than under the forest (R8, 2020a).

Due to the generally saline nature of the regional aquifer, the proximity to fresh water from the Murray River and limited access to floodplain aquifers by private landowners, there are no licenced groundwater users within 1 km of the project area. The nearest licenced bore is 1.3 km from the south eastern extent of the inundation area, but this bore is screened between 119 and 135 metres below the surface and so is in a separate aquifer system from the shallow aquifer which is potentially relevant to this project. The closest licenced bore that is screened in the shallow aquifer system is a bore located approximately 5 km from the south east extent of the inundation area. This bore is considered to be too distant from the inundation to be affected. The primary use of groundwater at the project area is therefore considered to environmental use associated with floodplain vegetation and ecosystems.

The whole of the project area is mapped as having a high potential terrestrial groundwater dependence. The ecosystems identified as having high groundwater dependence broadly include Ecological Vegetation Classes (EVCs) associated with Riverine Swamp Forest, Riverine Chenopod Woodland, Plains Woodland and Spike-sedge Wetland. There are no aquatic GDEs mapped within the project area. It is anticipated that the project will have a beneficial impact on potential GDEs within the inundated areas (R8, 2020a).

Further detail on the groundwater environment is provided in **Attachment 6 – Groundwater Assessment.**

Salinity

There is limited available salinity data from groundwater bores in the Gunbower Forest which indicates the high variability of water table salinity, with results ranging from 3,200 to 30,400 µS/cm, although typically over 10,000 µS/cm (FedUni 2020).

Groundwater salinity in the water table aquifer across the project area is relatively high, although may be fresher close to the surface of the water table. State-wide mapping indicates that groundwater salinity in the project area is expected to range from about 7,000 to 13,000 mg/L across Middle Gunbower (upstream Deep Creek) and the eastern half of the Upper Gunbower inundation extent. Elsewhere in the Gunbower National Park, groundwater salinity is expected to range between 13,000 to 35,000 mg/L (FedUni, 2020. **Figure 2** presents this spread of salinity values.

Soil salinity has been mapped over the project area and for the riverine corridor in the area by airborne electromagnetic surveys (AEM). The project area falls in the Barr Creek to Gunbower (South) AEM survey area (Cullen et al. 2008). Soil salinity in the project area has been mapped as generally low (most of the project area is below 100 t/hectares/m) (see **Figure 3**), with small areas of moderate soil salinity (100 - 200 t/hectares/m) noted in the centre of Middle Gunbower (upstream Deep Creek) inundation extent.

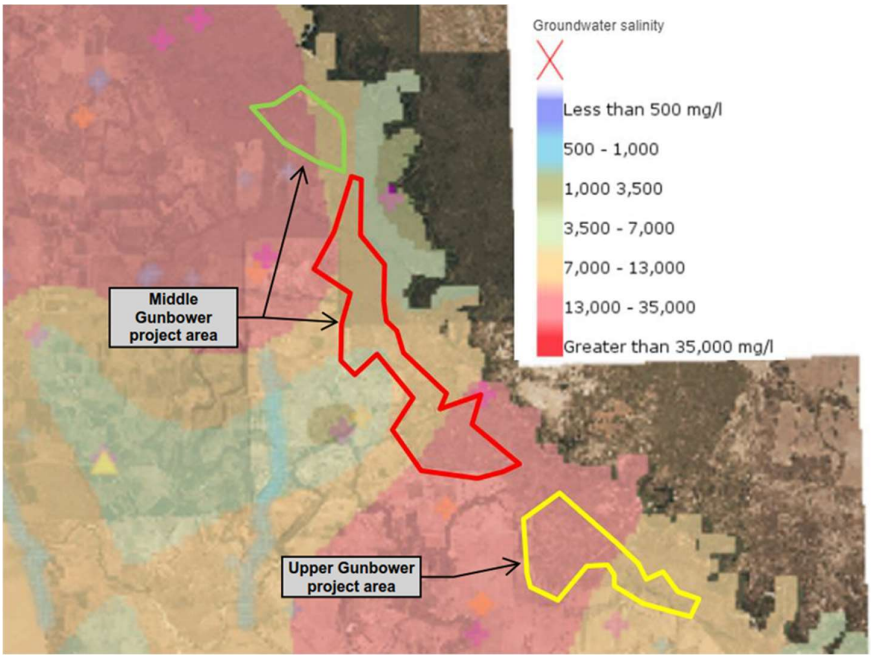

Figure 2: Interpreted groundwater salinity for the project area with project inundation overland (Source FedUni, 2020 cited in R8, 2020a)

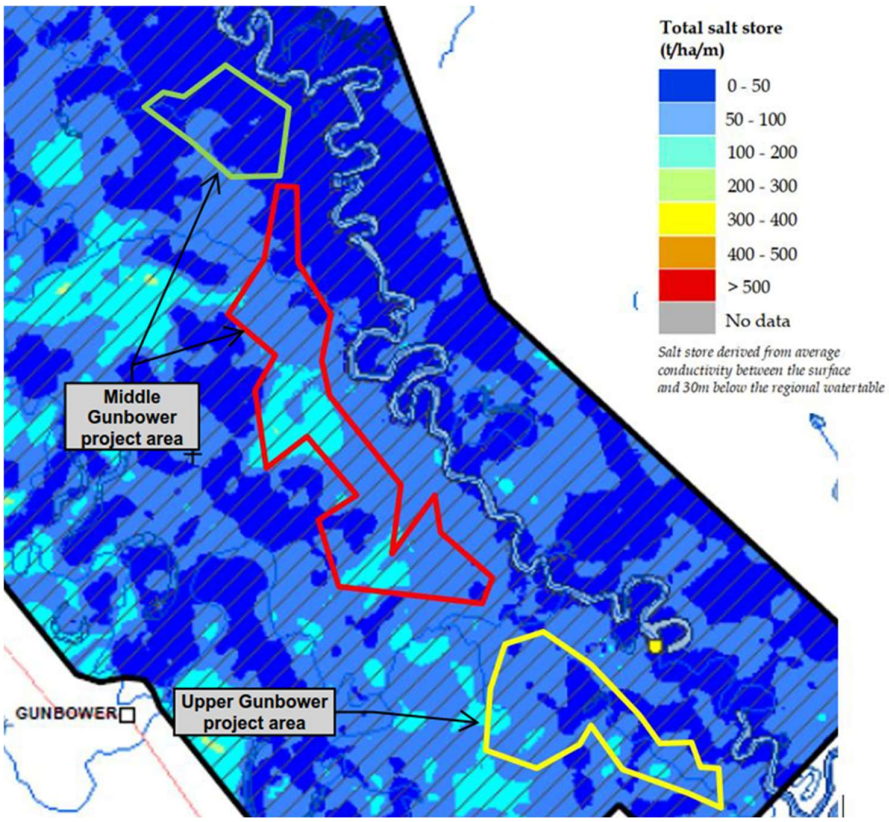

Figure 3: Interpreted salt store in the unsaturated zone for the project area (Cullen et al, 2008 cited in R8, 2020a)

Vegetation and habitat

Gunbower Forest (19,450 hectares, in Victoria), when combined with the contiguous Koondrook-Pericoota Forest (34,546 hectares, in NSW)), forms the second-largest remaining River Red Gum forest in Australia (Cooling and SKM, 2012). Gunbower National Park includes a large area of the broader Gunbower Forest, on the mid-Murray floodplain of northern Victoria (Parks Victoria, 2018). Gunbower Forest is recognised as internationally significant under the Ramsar Convention and as an 'Icon Site' under The Living Murray (TLM) Initiative; one of six environmental assets of the Murray River that have the highest priority for rehabilitation through water management (Hale and Butcher, 2011).

The Gunbower National Park was created (in 2010) in recognition of the importance of the upper part of Gunbower Forest and its need for greater protection. This part of the forest features permanent wetlands, temporary wetlands, River Red Gum forest and Black Box and Grey Box woodlands.

Gunbower Forest is located within the Murray Fans Bioregion, one of three bioregions along the Murray River floodplain. The Murray Fans Bioregion supports a mosaic of Plains Grassy Woodland, Pine Box Woodland, Riverina Plains Grassy Woodland and Riverina Grassy Woodland Ecological Vegetation Classes (VEAC, 2008) which help to maintain the ecological diversity of the bioregion by supporting vegetation communities representative of it. A summary of the EVCs making up the 704 hectares of vegetation within the proposed managed inundation area of this project is outlined in **Table 10**.

Table 10: EVC extent (hectares) within managed inundation area based on field data (Bennetts, 2014) and DELWP modelled EVCs

EVC	Ecological Vegetation Class	Inundation Area (hectares)
56	Floodplain Riparian Woodland	-
334	Billabong Wetland Aggregate (EVC 334)	12.84
168	Drainage Line Aggregate	9.17
812	Grassy Riverine Forest - Riverine Swamp Forest	85.95
815	Riverine Swampy Woodland	10.77
821	Tall Marsh	12.58
954	Riverine Swamp Forest - Floodway Pond Herbland	1.26
1071	Sedgy Riverine Forest - Tall Marsh Complex	78.10
106	Grassy Riverine Forest	56.75
295	Riverine Grassy Woodland	-
814	Riverine Swamp Forest	5.95
815	Riverine Swampy Woodland	316.37
816	Sedgy Riverine Forest	3.94
103	Riverine Chenopod Woodland *	92.69
823	Lignum Swampy Woodland ^	8.92
803	Plains Woodland	0.98
	No EVC Mapping	7.84
	Total	**704.1**

*Categorised as 'Box Woodland' in Bennetts 2014a mapping, this EVC has been assigned to flood-dependent woodlands to fit with the Water Regime Classes provided in Ecological Associates (2014).

^ Categorised as 'Red Gum Forest and Woodlands' in Bennetts 2014a mapping, this EVC has been assigned to Flood-dependent Woodlands to fit with the Water Regime Classes provided in Ecological Associates (2014).

The core ecosystem communities of the forest that are influenced by the project include permanent wetlands, temporary wetlands, River Red Gum forest, native birds and native fish communities. The area provides habitat and resources for a range of species - many of which are listed as rare or threatened under state and national legislation. The site supports a high diversity of flora species creating habitats that support more than 130 species of birds including water and woodland birds, and important migratory birds covered by international agreements. The forest also provides critical floodplain habitat to mammals such as the Sugar Glider, as well as amphibians and reptiles such as the Broad-shelled Turtle (North Central CMA, 2014a; Hale and Butcher, 2011).

Further detail on the native vegetation communities, and flora and fauna present within the project area is provided in Part 1, Section 8 (Existing environment) and Part 2, Section 12 (Native vegetation, flora and fauna) of this referral.

Site area (if known): …… (hectares) ……

Design of the project infrastructure is currently being refined as part of the design process and in response to environmental and cultural heritage studies. An area of investigation of 98.8 hectares has been

established and assessed at a desktop level for the purposes of this referral. This area of investigation is the area within which any future design changes are anticipated to occur.

The proposed construction footprint is located within the area of investigation and is based on the current design. This has an area of approximately 25 hectares (which includes approximately 12 hectares of access tracks). The construction footprint has provided the basis for ecology fieldwork and native vegetation removal calculations described in Part 2, Section 12 (Native vegetation, flora and fauna) of this referral.

The location and size of any borrow areas / quarry sites is yet to be determined.

The Gunbower National Park inundation area is approximately 704 hectares, 457 hectares in Middle Gunbower Forest and 247 hectares in Upper Gunbower Forest.

Refer to **Attachment 1, Map 2 – Project Structures, Construction and Access** and **Attachments 1, Map 3/4 – Managed Inundation Area)**.

Route length (for linear infrastructure) …… (km) **and width** …….. (m)

Not applicable.

Current land use and development:

The project is located within both Crown land and freehold land. All of the Crown land is associated with the Gunbower National Park. These are owned and managed by Parks Victoria in accordance with the objectives of the *National Parks Act 1975*. Camerons Creek Pump Station and a section of the Camerons Creek pipeline is located within Crown land managed by DELWP and an additional section of Camerons Creek pipeline and a small section of access track is located on land managed by Campaspe Shire Council. The intake pipes associated with the Brereton Road Pump Station will be located within the Murray River in NSW, which is a Crown Land Waterway. Works on freehold land include a number of outlets and associated pipelines, Camerons Creek pipeline, access tracks and potential levee works.

The Gunbower National Park is a popular recreational area for tourists to the region as well as for its local communities. Recreational use includes fishing, camping, boating, canoeing, bird and wildlife watching, photography, motor biking and four-wheel driving.

The area also forms part of the Murray River Trail for tourism and recreation purposes and provides direct access to the Murray River for water-based activities and river camping or caravanning.

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

The project is located approximately 40 km north-west of the regional town of Echuca, Victoria. Echuca has a population of around 14,043 people (ABS, 2016) and has a strong connection with the township of Moama directly across the border in NSW.

Directly west / south-west of Gunbower National Park is the local town Gunbower. The town has a population of approximately 550 people (ABS, 2016) and is located within a dairy farming area of the region. Its proximity to Gunbower National Park is a major attraction for visitors to the town.

The project is accessible from the Murray Valley Highway which is the main arterial road running north-south from Swan Hill to Echuca. The road is managed by the Regional Roads Victoria.

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

A desktop land use planning assessment has been prepared and is provided in **Attachment 7** – **Land Use Planning Assessment.**

Campaspe and Gannawarra Planning Scheme

The project is situated within the Shire of Campaspe and the Shire of Gannawarra and is therefore subject to the provisions of the Campaspe and Gannawarra Planning Schemes.

Planning Policy Framework

The Planning Policy Framework relevant to the project under the planning scheme is discussed in Section 4.1 of **Attachment 7 – Land Use Planning Assessment**.

Zones and overlays

The following zones and overlays from the Campaspe Planning Scheme apply to the area of investigation:

- Public Conservation and Resource Zone (PCRZ)
- Farming Zone (FZ1)
- Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1)
- Floodway Overlay (FO)
- Land Subject to Inundation Overlay (LSIO)
- Bushfire Management Overlay (BMO)

The following zones and overlays from the Gannawarra Planning Scheme apply to the area of investigation:

- Public Conservation and Resource Zone (PCRZ)
- Environmental Significance Overlay (Schedule 1 – Waterway Environs)
- Land Subject to Inundation Overlay (LSIO)
- Bushfire Management Overlay (BMO)

Refer to **Attachment 7 – Land Use Planning Assessment.**

Planning permit triggers

In accordance with the controls identified in **Table 11** and **Table 12** the project will require planning approval in relation to:

- Use
- Buildings and works, including earthworks
- Removal, destruction or lopping of native vegetation, and
- Removal, destruction or lopping of any vegetation, including dead vegetation in ESO1.

Table 11: Summary of potential planning permit triggers, Campaspe Planning Scheme

Campaspe Planning Scheme	**Planning approval**		
Planning control	**Use**	**Building and works**	**Vegetation removal**
Zones			
Clause 36.03 Public Conservation and Resource Zone (PCRZ)	Y	Y	NA
Clause 35.07 Farming Zone (FZ)	Y	Y	NA

Overlays			
Clause 42.01 Environmental Significance Overlay (Schedule 1 Murray River Corridor) (ESO1)	NA	Y	Y
Clause 44.03 Floodway Overlay (Schedule to Clause 44.03 Floodway Overlay) (FO)	NA	Y	N
Clause 44.04 Land Subject to Inundation Overlay, Schedule to the Land Subject to Inundation Overlay (LSIO)	NA	Y	N
Clause 44.06 Bushfire Management Overlay (BMO)	NA	N	N
Particular provisions			
Clause 52.17 Native Vegetation	NA	NA	Y

Table 12: Summary of potential planning permit triggers, Gannawarra Planning Scheme

Gannawarra Planning Scheme	**Planning approval**		
Planning control	**Use**	**Building and works**	**Vegetation removal**
Zones			
Clause 36.03 Public Conservation and Resource Zone (PCRZ)	Y	Y	NA
Overlays			
Clause 42.01 Environmental Significance Overlay (Schedule 1 Murray River Corridor) (ESO1)	NA	Y	Y
Clause 44.04 Land Subject to Inundation Overlay, Schedule to the Land Subject to Inundation Overlay (LSIO)	NA	Y	N
Clause 44.06 Bushfire Management Overlay (BMO)	NA	N	N
Particular provisions			
Clause 52.17 Native Vegetation	NA	NA	Y

Relevant strategies and management plans

The following North Central CMA strategies and plans provide land use and planning objectives and plans for action associated within the region that includes the investigation area:

- Gannawarra Urban and Rural Strategy Plan 2007
- Shire of Campaspe Environment Strategy 2018-22
- North Central Regional Floodplain Management Strategy, 2018 – 2028
- North Central Waterway Strategy 2014-2022
- DRAFT North Central CMA Regional Catchment Strategy (for consultation)
- North Central CMA Regional Catchment Strategy 2013-19
- River Red Gum Parks Management Plan (Parks Victoria, 2018)
- River Red Gum Parks and Reserves Conservation Action Plan (Parks Victoria, 2019).

NSW Planning Framework

The proposed works will involve installing a permanent pump station on the Murray River which is referred to as the Brereton Road Pump Station. Works within the Murray River and its banks associated with the suction pipe only will include excavation and structural works for the pump station on the southern bank and infrastructure extending into the river. Some other works will be required within the Murray River associated with the Dalley Bend Inlet work, Deep Creek River Return Drop Structure and the Spur Creek River Return Drop Structure.

Development in NSW is assessed in accordance with the provisions of the NSW *Environmental Planning and Assessment Act 1979* (NSW EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). The EP&A Act institutes a system for environmental assessment, including approvals and environmental impact assessment for proposed developments. The need or otherwise for development control is set out in environmental planning instruments.

The Gunbower National Park Floodplain Restoration Project is located on land that is zoned W1 Natural Waterways under the Murray Local Environmental Plan 2011 (Murray LEP). No activities are permitted without development consent within the W1 zone (**Attachment 7 – Land Use Planning Assessment)**.

The pump station will be used to transport water and would be part of a water reticulation system (clause 125(5)(e)) and be permissible with development consent due to the application of clause 126A.

The proposed work would be undertaken in the Murray River Shire and the consent authority is Murray River Council. A development application would need to be submitted to the Murray River Council and this would need to be supported by a Statement of Environmental Effects that addresses section 4.15 of the NSW EP&A Act.

Local government area(s):

Campaspe Shire Council and Gannawarra Shire Council

A part of the project area (associated with the installation of the pump station) is in the NSW local government area of the Murray River Shire.

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) 7)**:**

The key environmental assets and sensitivities in the project area and vicinity, include:

- The project is located within and adjoining land reserved under the *Crown Land (Reserves) Act 1978*. This includes the Gunbower National Park which is owned and managed by Parks Victoria in accordance with the objectives under the *National Parks Act 1975*.
- Gunbower National Park (9,330 hectares) includes a large area of the broader Gunbower Forest, on the mid-Murray floodplain of northern Victoria (Parks Victoria, 2018). Gunbower Forest (20,218 hectares) is recognised as internationally significant under the Ramsar Convention. Gunbower Forest when combined with the contiguous Koondrook-Pericoota Forest (34,546 hectares, in NSW), forms the second-largest River Red Gum forest in Australia; Gunbower-Koondrook-Perricoota (GKP) Forest and is an 'Icon Site' under The Living Murray (TLM) Initiative; one of six environmental assets of the Murray River that have the highest priority for rehabilitation through water management.
- The Gunbower National Park was created (in 2010) in recognition of the importance of the upper part of Gunbower Forest and its need for greater protection. This part of the forest features

permanent wetlands, temporary wetlands, River Red Gum forest and Black Box and Grey Box woodlands. The core ecosystem communities of the forest that are influenced by the project comprise these permanent wetlands, temporary wetlands, River Red Gum forest, native birds and native fish.

- The project area includes wetlands of the 'Gunbower Island' complex which is a wetland of National significance listed in the Directory of Important Wetlands (DIWA) in Australia.
- The proposed construction footprint contains approximately 19.57 hectares of native vegetation, including 58 large trees, 4.04 hectares of endangered EVC (103: Riverine Chenopod Woodland) and 4.19 hectares of endangered EVC (803: Plains Woodland).
- One EPBC Act listed threatened ecological community has been mapped or modelled to occur in the project area; Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia. This TEC was located in field assessments of Upper Gunbower Forest and is expected to occur in areas mapped as Plains Woodland (EVC 803) in Middle Gunbower (downstream of Deep Creek). A total of 2.50 hectares of this threatened community was identified during surveys in the construction footprint in Upper Gunbower Forest (excluding Camerons Creek pump station and pipeline) and Middle Gunbower Forest (upstream) and 1.68 hectares is predicted to occur in Middle Gunbower Forest (downstream of Deep Creek) based on EVC Plains Woodland mapping (Bennetts, 2014a). Approximately 1,300 hectares of this TEC is estimated to occur within the Gunbower Forest more broadly (North Central CMA, 2012).
- One FFG Act listed threatened vegetation community is mapped within the inundation area; 0.98 hectares of terrestrial woodland, (EVC 803 Plains Woodland, Bennetts, 2014a). Over the long-term following the return of a forest floodplain inundation regime, the understorey species composition of some of these areas may become more aquatic.
- One FFG Act listed fauna community occurs in the project area; Victorian Temperate Woodland Bird Community (VTWBC). The VTWBC occurs throughout the Gunbower National Park project area, due to the presence of significant River Red Gum Forest and Black Box woodland with an abundance of tree hollows for nesting sites and fallen timber.
- One FFG Act listed fish community (Lowlands Riverine Fish Community of Southern Murray-Darling Basin) and one Lower Murray River aquatic ecological community (NSW endangered ecological community) occur in the project area.
- Six EPBC Act listed flora species are known to occur or possibly occur in the project area. River Swamp Wallaby-grass (*Amphibromus fluitans*, Vulnerable) was located during field assessments, and five others, Stiff Groundsel (*Senecio behrianus*, Endangered), Winged Peppercress (*Lepidium monoplocoides*, Endangered), Slender Darling-pea (*Swainsona murrayana,* Vulnerable), Ridged Water-milfoil (*Myriophyllum porcatum,* Vulnerable) and Floodplain Rustyhood (*Pterostylis cheraphila*, Vulnerable), are either known to occur close to the project area or suitable habitat exists within the project area..
- Eight FFG Act listed flora species are known to occur or possibly occur in the project area. Umbrella Wattle (*Acacia oswaldii*), and Buloke (*Allocasuarina luehmannii*) were recorded in recent field assessments. One species, Wavy Marshwort (*Nymphoides crenata*) was previously recorded (Bennetts, 2014a, Biosis 2014) and the Winged Peppercress, Ridged Water-milfoil, Floodplain Rustyhood, Stiff Groundsel and Slender-Darling Pea (all also EPBC listed) have the potential to occur.
- Eighteen flora species listed on the DEWLP Advisory list are considered to possibly occur; with Umbrella Wattle, Buloke, (also FFG Act listed) and Leek Flax-lily (*Dianella porraceae*) and Long Eryngium (*Eryngium ovinum*) being recorded during recent field assessments. DEWLP species with previous records include: Blue Burr-daisy (*Calotis cuneifolia*), Spear-grass (*Austrostipa trichophylla*), Umbrella Grass (*Digitaria divaricatissima var. divaricatissima*); Slender Bottle-washers (*Enneapogon*

gracilis), Smooth Minuria (*Minuria integerrima*), Waterbush (*Myoporum montanum*), Dwarf Bitter-cress (*Rorippa eustylis*), Floodplain Firewed (*Senecio campylocarpus*), and species already mentioned (Winged Peppercress, Wavy Marshwort, Stiff Groundsel, Slender Darling-Pea, Ridged Water-milfoil, Floodplain Rustyhood)

- Eleven EPBC Act listed threatened fauna species are known to occur or possibly occur in the project area: South-eastern Long-eared Bat (*Nyctophilus corbeni*, Vulnerable), Australasian Bittern (*Botaurus poiciloptilus*, Endangered), Australian Painted Snipe (*Rostratula australis*, Endangered), Painted Honeyeater (*Grantiella picta*, Vulnerable), White-throated Needletail (*Hirundapus caudacutus*, Vulnerable), Superb Parrot (*Polytelis swainsonii*; Vulnerable), Growling Grass Frog (*Litoria raniformis*; Vulnerable), Sloane's Froglet (*Crinia sloanii*, Endangered), Silver Perch (*Bidyanus bidyanus*, Critically Endangered), Murray Cod (*Maccullochella peelii*), Vulnerable) and Trout Cod (*Maccullochella macquariensis*), with suitable habitat for the fish, bittern and snipe only potentially present in inundation area.
- FFG Act Listed fauna species known to occur or possibly occur in the project area include:
  - Six fish species (including the EPBC listed Silver Perch, Murray Cod, and Trout Cod, as well as Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*), Freshwater Catfish (*Tandanus tandanus*), and Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*)
  - Seventeen birds (five are also EPBC listed, Painted Honeyeater, Australasian Bittern, White-throated Needletail, Superb Parrot, Australian Painted Snipe, all have Vic Adv status)
  - One mammal (EPBC listed South-eastern Long-eared Bat)
  - One amphibian (EPBC listed Growling Grass Frog)
  - Two reptiles (Carpet Python and Broad-shelled Turtle)
  - One invertebrate (Murray Crayfish)
- Thirteen listed migratory species have been highlighted in the EPBC PMST output as potentially occurring in the project area) In addition, the Glossy Ibis, not highlighted by the PMST but with previous records identified nearby, may occur in the inundation footprint (see Table 16 in Section 12.2), however the proposed construction footprint is not considered to support habitat that would be considered important for foraging or breeding activities for any of these migratory species, and significant impacts are considered unlikely.
- The project area is located in an area of Cultural Heritage Sensitivity, with 30 registered Aboriginal Places located within 50 m of the project area, and 13 registered Aboriginal Places identified within the project area.
- The project area is identified by the Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1) as having environmental values of state and regional importance
- The majority of the area of investigation is located within the Public Conservation and Resource Zone, however some Farming zoned land is also within the area of investigation (Campaspe Planning Scheme only). The project area is subject to an Environmental Significance Overlay (ESO1 Murray River Corridor), Floodway Overlay (FO), Land Subject to Inundation Overlay (LSIO), and Bushfire Management Overlay (BMO) under the Campaspe Planning Scheme and an Environmental Significance Overlay (ESO1 Waterway Environs), LSIO and BMO under the Gannawarra Planning Scheme.

9. Land availability and control

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

☒ No ☒ Yes If yes, please provide details.

The project is predominantly located within Crown land. All of the Crown land is associated with the Gunbower National Park, under ownership and management of Parks Victoria.

Crown land parcels associated with the area of investigation are reserved under either the *Crown Land (Reserves) Act 1978, National Parks Act* or the *Forests Act 1958*. The majority of the land is reserved as 'Permanent National Park' associated with Gunbower Forest National Park. A number of parcels are reserved as 'Temporary Forest and the remainder of the Crown land is reserved as 'Permanent Public Purpose' for uses such as camping grounds, parks and other public purposes'. Two parcels are reserved as 'Government Road'.

A number of Crown land parcels are also privately held under Crown grants.

A number of other land parcels which are intersected by the project are also under private ownership, works on these parcels include outlets and associated pipelines, Camerons Creek pipeline, access tracks and potential levee works.

The location of Crown land and freehold land affected by the project is shown in **Attachment 7 – Land Use Planning Assessment.**

Current land tenure (provide plan, if practicable):

The construction footprint occurs within both Crown land and freehold land within Victoria, with the exception of a small portion of the construction footprint (associated with the pump station) which extends into the Murray River (NSW). Works on freehold land include levees, outlets, pipelines and access tracks (nine land parcels).

The proposed inundation area is located entirely within Victoria as shown in **Attachment 1, Map 1 – Project Location Map**. The majority of the inundation area falls within Crown land, however modelling indicates that a small number of freehold properties may be subject to minor inundation within Upper Gunbower Forest (all used for general rural farming (livestock and cropping), in some cases due to the location of the existing forest perimeter levees being outside the National Park boundary. VMFRP are currently in consultation with these potentially affected private landowners to discuss planned environmental watering events, and no inundation on private land will occur without prior consent and agreement from landowners. Options to manage water include levee bank works and maintenance, purchasing private properties, creating flood easements for the inundation extent, or a combination of approaches with agreements obtained prior to commencing operations that would inundate these properties.

Further detail on the location and tenure of land parcels within the construction and inundation area is provided in **Attachment 7** – **Land Use Planning Assessment.**

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

The project may purchase existing freehold land or create flooding easements/agreements to enable the full planned environmental watering extents to occur. No Crown land is proposed to change tenure.

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

A search of the National Native Title Tribunal online register and maps shows:

- Native title Determination VID6001/1995 under the *Native Title Act 1993* applies to the area of investigation. The claim was lodged by the Members of the Yorta Yorta Aboriginal Community. A determination was given on 9/10/2019 determining that Native Title does not exist on the land.
- There are no current native title claims lodged under the *Native Title Act 1993* in relation to land within or adjacent to the area of investigation
- No Indigenous Land Use Agreements cover the area of investigation.

A search of the Victorian Department of Justice and Community Safety website indicates that no current applications or registered agreements under the *Traditional Owner Settlement Act 2010* (Vic) apply over land within or adjacent to the area of investigation (DoJCS, 2020).

An Aboriginal heritage assessment will need to be undertaken in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW to confirm whether the proposal would impact on any items of heritage significance and whether an Aboriginal Heritage Impact Permit (AHIP) is required under Section 90 of the NPW Act.

Other relevant features

The region also supports other features that form an important part of the general land use of the project area and surrounds:

- The Torrumbarry Irrigation Area (TIA) lies directly to the west of the project inundation area and is part of the largest irrigation system in Victoria – the Goulburn-Murray Irrigation District (GMID) managed by GMW. Approximately 2000 landowners rely on this system for irrigation within the area
- Current public data indicates the location of 14 apiary sites located in close proximity to the area of investigation. Approximately 6 of these could be directly impacted by project works and inundation.
- The hives are part of annual licence agreements that are dependent on seasonal flowering of River Red Gum forests. Bees rely on adequate water source to thrive, and it is expected that the objectives of the project will increase the regularity and reliability of flowering. Consultation with owners of apiary sites may be required to determine measures for management of potential impacts during construction and inundation.
- The area has a long history of timber harvesting and dairy farming, from as far back as the 1800's. The early settlers took advantage of the abundance of nearby red gum forests to support growing settlements. Timber harvesting in the area is now focused on selective harvesting of local forests to produce high quality building products.
- Solar farming is a growing activity within the region. The Gannawarra Shire Council has approved building permits for seven solar farm projects, and currently supports a network of infrastructure including a large capacity terminal station and connecting transmission lines. The proposed new farms are located around the area of Kerang in the vicinity of the current 220 kV transmission line.
- The Gunbower National Park is a popular recreational area for tourists to the region as well as for its local communities. Recreational use includes fishing, camping, boating, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving.
- The area also forms part of the Murray River Trail for tourism and recreation purposes and provides direct access to the Murray River for water-based activities and river camping or caravanning. It forms part of the Murray River Trail for tourism purposes. The Gannawarra and Campaspe Shire Councils have committed to supporting and promoting nature-based tourism within this area. The Gunbower National Park would likely be traversed by this trail and thus the projects are complimentary.

10. Required approvals

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

The following Victorian State and Commonwealth referrals, notifications and approvals are likely to be required for the project:

Commonwealth

- Referral to the Minister for the Environment under the EPBC Act to determine whether the project is a controlled action requiring formal assessment and approval under the Act (concurrent to this referral)
- Notification of a 'future act' under the *Native Title Act 1993* (Cth) for activities on Crown land that may affect native title rights and interests
- Notification of the MDBA of a proposal which may affect the flow, use, control or quality of any water in the upper Murray River under clause 49 of Schedule 1 of the *Water Act 2007*.

Victoria

- Referral (this document) to the Minister for Planning (via DELWP) under the *Environment Effects Act 1978* to determine whether or not an Environment Effects Statement is required for the project
- A planning scheme amendment or planning permit under the Gannawarra Planning Scheme, pursuant to the *Planning and Environment Act 1987*
- A Cultural Heritage Management Plan approved by Aboriginal Victoria under the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2018.* (The Yorta Yorta Nation Aboriginal Corporation is the Registered Aboriginal Party (RAP) for the project area.)
- A licence or lease from Parks Victoria under section 17 of the *Crown Land (Reserves) Act 1978*
- Licence to take and use water (s51) and licence to construct works (s67) from Lower Murray Water under section 51 of the *Water Act 1989*
- Works on waterways permit from North Central CMA under section 188 of the *Water Act 1989* and North Central CMA By-law No.1 Waterways Protection 2014
- Permit to take protected flora on Crown land from DELWP under the *Flora and Fauna Guarantee Act 1988.*
- Potential need for a Work Plan and/or Work Authority under *the Mineral Resources (Sustainable Development) Act 1990* for potential borrow sites / quarry sites – noting the location and therefore potential approval requirements for borrow/quarry sites are yet to be determined.

Other legislation

Other environmental legislation of potential relevance to the project includes, but is not limited to:

Commonwealth

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*

Victoria

- *Catchment and Land Protection Act 1994*
- *Environment Protection Act 1970 (or Environment Protection Act 2017* post 1 July 2021*)*
- *Fisheries Act 1995*
- *Heritage Act 2017*

- *Land Act 1958*
- *Wildlife Act 1975.*
- *Crown Land (Reserves) Act 1978*
- *National Parks Act 1975*
- *Parks Victoria Act 2018*
- *Forests Act 1958*
- *Road Management Act 2004*
- *Traditional Owner Settlement Act 2010*
- *Water Act 1989*

NSW

- *Biodiversity Conservation Act 2013*
- *Crown Lands Management Act 2016*
- *Environmental Planning and Assessment Act 1979*
- *Fisheries Management Act 1994*
- *Maritime Safety Act 1998.*
- *National Parks and Wildlife Act 1974*
- *Water Management Act 2000.*
- *Local Land Services Act 2013*
- *Heritage Act 1977*
- *Protection of the Environment Operations Act 1997*

Have any applications for approval been lodged?

☒ No ☒ Yes If yes, please provide details.

No applications for approval of the project have been lodged to date.

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

The VMFRP is managed by a partnership team comprised of LMW, GMW, North Central CMA, Mallee CMA and Parks Victoria. Each of these agencies are represented on the VMFRP Program Control Group, but also have a separate regulatory approvals function for the VMFRP projects. DELWP Water is the Program Owner. DELWP also has a separate regulatory approvals function for the VMFRP projects.

As part of broad stakeholder engagement activities undertaken between 2012 and 2014 to support the SDL Adjustment Gunbower Floodplain Restoration Project Business Case, North Central CMA also consulted with Ganawarra Shire Council, Campaspe Shire Council, GMW, DELWP and Parks Victoria.

During 2015 to 2017, engagement activities were undertaken in the form of monthly Steering Committee meetings with Mallee CMA, Murray-Darling Basin Authority, Parks Victoria, GMW and DELWP.

The VMFRP has since established a Technical Advisory Group – Regulatory Approvals Committee (Approvals TAG) to advise on regulatory approval requirements through the planning and design of the

project. In addition to the partnership agencies, regulatory approval agencies currently represented on the Technical Advisory Group include:

- Aboriginal Victoria
- DELWP (Impact Assessment Unit, Planning, Regional)
- Department of Agriculture, Water and the Environment (DAWE).

An overview of the VMFRP projects was presented to the TAG at a meeting held on 8 August 2019.

In addition, a Design TAG operates concurrently which has representation from the following:

- DELWP
- GMW
- LMW
- Mallee CMA
- Murray-Darling Basin Authority
- North Central CMA
- Parks Victoria
- SA Water

Other agencies consulted:

See previous response.

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):

An assessment of the potential construction and operational impacts of the project has been undertaken and is detailed in Parts 12 – 16 of this Referral Form. Key potential effects and uncertainties are summarised below.

Impacts on native vegetation

Native vegetation within the proposed construction footprint has been subject to desktop and field assessment. Vegetation communities within the inundation area have been identified based on available EVC mapping (Bennetts, 2014a). Refer **Attachment 3 – Flora and Fauna Assessment.**

Construction

Efforts have been made to avoid and minimise impacts to native vegetation throughout the project planning and design process. Impact avoidance and minimisation measures include:

- Locating infrastructure (for example embankments) on top of existing vehicle tracks and other previously disturbed areas. The embankments would continue to be used as vehicle access tracks.
- Minimisation of bank height (freeboard) to the minimum height required to retain functionality, after considering wear and wave impacts.
- Minimisation of bank crest width to achieve the relevant track design speed.
- Adopting the steepest batter slope which still meets embankment stability and road safety requirements (3H:1V) in order to minimise the footprint of the structure.

Despite the measures taken to avoid and minimise impacts to native vegetation it is not feasible to construct the required infrastructure without removing native vegetation. As the design for the project progresses, there will be opportunity to further refine construction footprints around infrastructure. The current construction footprint does not include power supply and associated poles, stays or cables due to their location being currently unknown. Levees, which are subject to further risk assessment and therefore not confirmed, are also not included in the construction footprint. As such, requirements for vegetation removal would be further assessed and minimised through the design process.

The approach taken to the estimation of vegetation impacts involves two main components, (1) vegetation impacted for project infrastructure, and (2) vegetation impacted for access:

- Up to 12.83 hectares of native vegetation within the construction footprint would potentially require removal as a result of the construction of project infrastructure. This is based on a buffer around the project's development footprint to allow construction activities. The project's development footprint is approximately 6.9 hectares.
- Up to 6.74 hectares of native vegetation has been calculated within the project's access track which includes native vegetation surveyed (Bennets 2014 and R8, 2020a) within the 5 m buffer along the access track (i.e. 2.5 m from centreline of existing road). Part of this area would consist of the existing access tracks, which have been previously cleared. The scope and requirements for works along access tracks is still to be confirmed and would be designed to avoid and minimise native vegetation removal to the extent practicable. Given works are proposed to upgrade existing access tracks only, these works may be limited to minor maintenance and upgrades that required minimal, if any, vegetation clearance (i.e. lopping rather than removal).

- 58 large trees (i.e. canopy trees within patches with a DBH that meets the threshold to be considered large for a particular EVC) may be impacted by the proposed works (refer Appendix L in **Attachment 3 – Flora and Fauna Assessment**). No Scattered Trees will be impacted as a part of the project. This total only includes large trees mapped within the Upper Gunbower Forest (excluding Camerons Creek pump station and pipeline) and Middle Gunbower Forest (upstream Deep Creek) and does not include access tracks. This total will increase once large trees have been mapped within the buffer area of access tracks, Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower in spring 2020.

The combined estimate of impact on native vegetation is 19.57 hectares (12.83 + 6.74) including 58 large trees (refer to **Attachment 3**). This total does not include large tree clearance associated with works in Middle Gunbower (downstream of Deep Creek), power supply and levee works which are subject to further risk assessment. If levee works are required, this would involve works along between 1.5 and 3 kilometres of existing, previously disturbed, levee banks.

A total of 2.50 ha of one EPBC listed TEC was identified during surveys in the construction footprint in Upper Gunbower Forest (excluding Camerons Creek pump station and pipeline) and Middle Gunbower Forest (upstream of Deep Creek) and 1.68 ha is predicted to occur in Middle Gunbower Forest (downstream of Deep Creek) based on EVC Plains Woodland mapping (Bennetts 2014a). The predicted amount is a conservative estimate, given the mapped area of EVC 803 Plains Woodland may not meet the required criteria, but will be assessed during the field survey in spring 2020. The proposed works will likely result in the permanent loss of 1.71 ha (of which 1.34 ha is required to be confirmed through field assessment) of the TEC in the construction footprint. An estimated 2.47 ha along access tracks will be avoided by restricting vehicle access to tracks and limiting disturbance to lopping overhanging vegetation to allow access for larger vehicles.

It is noted that there are areas of the endangered EVC (Riverine Chenopod Woodland and Plains Woodland) (8.23 hectares) and vulnerable EVCs (Riverine Grassy Woodland and Riverine Swampy Woodland) (7.79 hectares) within the construction footprint. However, it is anticipated that any impacts to these Ecological Vegetation Classes (EVCs) associated with the proposed works, will be greatly outweighed by the long-term benefits and improvements that these same EVCs will achieve through environmental watering within the area of inundation. The area of benefit for the Riverine Chenopod Woodland and Plains Woodland is approximately 93.67 hectares and Riverine Grassy Woodland and Riverine Swampy Woodland (316.37 hectares). Future design will consider avoiding where possible, or minimising impacts on these EVC. The mitigation measures outlined in Part 2 (Environmental management) of this referral would therefore assist in minimising and avoiding impacts to these EVCs.

From a landscape perspective, the proposed construction footprint represents a comparatively small area within the 9,330 hectares of Gunbower National Park and the broader Gunbower Forest (approximately 20,000 hectares) in comparison to the 704 hectare inundation area.

Additional details on the potential vegetation impacts are provided in Section 12, including the vegetation communities proposed to be impacted.

Operation

The majority of EVCs mapped as present within the inundation area are swampy or riverine vegetation communities that require or are tolerant of inundation. The condition of these vegetation communities is expected to improve as a result of environmental water delivery that restores a more natural inundation regime, as demonstrated over 15-years of monitoring at the Gunbower Forest TLM site. A total of 0.98 hectares of terrestrial woodland (EVC 803 Plains Woodland mapping, Bennetts, 2014a) is within the inundation area. Over the long-term, the proposed forest floodplain inundation regime may cause the understorey species composition of some of these areas to become more aquatic. However, it is not considered that the level of inundation would result in any detrimental impact to the community that would

lead to identified areas of this community no longer meeting the classification criteria for the community. None of the identified communities are considered to be adversely impacted by the proposed inundation regime, having historically been exposed to a more frequent inundation regime. Vegetation communities within the inundation area have been identified based on mapping (Bennetts, 2014a) and field assessments (R8, 2020b) however, some areas have not been ground-truthed (because the concept design of infrastructure proposed in Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower was developed after the field assessments were undertaken in 2019) hence further assessments will be undertaken in spring 2020. These additional assessments and representative sample sites of EVCs within the inundation and construction areas will expand on the current desktop and field assessment data to inform the vegetation condition monitoring program (and offset strategy / conservation exemption).

Potential impacts on listed threatened species and communities

The proposed construction footprint has been subject to targeted flora and fauna surveys. Previous ecological studies (identified in Section 12.2, **Table 15**) were used to inform the additional targeted threatened flora and fauna surveys. Flora surveys were undertaken in September, October and December 2019 and targeted fauna surveys were undertaken in October and November 2019. A desktop assessment of potential impacts on listed threatened species and communities has been carried out for the inundation area. Refer **Attachment 3 – Flora and Fauna Assessment**.

Listed threatened communities

One EPBC listed Threatened Ecological Community (TEC) is consistent with vegetation mapped or modelled within the project area, and has been highlighted in previous assessments (North Central CMA, 2012) and also identified during R8 field surveys in 2019; Grey Box *(Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia. Approximately 1,300 hectares of this TEC is considered to occur within Gunbower Forest more broadly (North Central CMA, 2012). A total of 2.5 hectares of this TEC was located within the construction footprint (primarily along access tracks) within Upper and Middle Gunbower Forest (upstream Deep Creek) and 1.68 hectares is predicted to occur in Middle Gunbower Forest (downstream of Deep Creek) (R8, 2020b). Further assessment will be undertaken in spring 2020 to confirm the extent of disturbance to this TEC.

No FFG-listed vegetation communities were identified during the field assessment nor have they been considered to be present in previous desktop and field assessments within the Gunbower Forest project area. One FFG listed fauna community was identified in desktop and field assessments as being present in the project area, the Victorian Temperate Woodland Bird Community (VTWBC). Bird species of this FFG-listed fauna community are highly mobile and impacts as a result of the project are expected to be negligible in the short-term. This is due to the availability of significant River Red Gum open woodland and forest, with an abundance of tree hollows for nesting sites and fallen timber still being available within the forest. Seasonal restrictions will be implemented for removal of hollow-bearing trees to avoid breeding periods when these species are more vulnerable to impacts. In the long term, the community is likely to benefit from the project with improvements to its habitat expected from environmental watering.

There is also one FFG listed fish community identified in the desktop assessment as being present (Lowlands Riverine Fish Community of Southern Murray-Darling Basin). Impacts to this community are likely to be low due to mitigation measures proposed for construction works and operation. Managed inundation will adopt strategies to minimise the likelihood of fish entrainment and colonisation of floodplain environments during managed events (e.g. fish screens on pump stations). Managed drawdown of inflows will also provide opportunities for fish that do access the floodplain to return to the Murray River. Potential exposure to poor water quality from floodplain return flows will be managed through monitoring of potential hypoxic blackwater and drawdown strategies that maximise dilution potential.

There is one NSW endangered ecological community (Lower Murray River aquatic ecological community). The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, as well as all their tributaries and branches (NSW DPI, 2007). Impacts to the community relate to modification of natural flows and temperature regimes, introduction of pest fish species, decreased shelter and sedimentation, removal of large woody debris and water quality impacts. Risk of these impacts would be managed as part of the mitigation measures mentioned above (e.g. CEMP, aquatic fauna management plan).

Listed threatened fauna species

Desktop searches identified 56 listed FFG Act and EPBC Act terrestrial fauna species that have been recorded or have the potential to occur within 10 kilometres of the project area. Of these species, 45 are considered possible to occur or are known to be present within the project construction footprint or inundation area. These 45 species are provided in Table 16 (Section 12.2) and include 11 listed as threatened under the EPBC Act, 29 listed under the FFG Act, 41 DELWP advisory listed threatened species. Each of these species was then assessed for their likelihood of occurrence, taking into account factors such as the habitat requirements of each species and comparing those to the habitats encountered within the project area.

Nineteen of these threatened fauna species have been assessed as possibly being impacted by the project including:

- Bearded Dragon (*Pogona barbata*) – DELWP Advisory vulnerable
- Broad-shelled Turtle (*Chelodina expansa*) - FFG Act listed, DELWP Advisory endangered
- Carpet Python (*Morelia spilota metcalfei*) – FFG Act listed, DELWP Advisory endangered
- Freshwater Catfish (*Tandanus tandanus*) - FFG Act listed, DELWP Advisory endangered
- Golden Perch (*Macquaria ambigua*) - DELWP Advisory near threatened
- Growling Grass Frog (*Litoria reniformis*) – EPBC Act Vulnerable, FFG Act listed, DEWLP Advisory endangered
- Lace Monitor (*Varanus varius*) - DELWP Advisory endangered
- Murray Cod (*Maccullochella peelii peelii*) – EPBC Act Vulnerable, FFG Act listed, DELWP Advisory vulnerable
- Murray Crayfish (*Euastacus armatus*) - FFG Act listed
- Murray River Turtle (*Emydura macquarii*) – DELWP Advisory vulnerable
- Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*) – FFG Act listed, DELWP Advisory vulnerable
- Silver Perch (*Bidyanus bidyanus*) – EPBC Act Critically Endangered, FFG Act listed, DELWP Advisory vulnerable
- Sloane's Froglet (*Crinia sloanei*) – EPBC Act endangered
- South-eastern Long-eared Bat (*Nyctophilus corbeni*) - EPBC Act Vulnerable, FFG Act listed, DELWP Advisory endangered
- Southern Pygmy Perch (Murray-Darling lineage) (*Nannoperca australis*) - DELWP Advisory vulnerable
- Squirrel Glider (*Petaurus norfolkensis*) - FFG Act listed, DELWP Advisory endangered
- Trout Cod (*Maccullochella macquariensis*) - FFG Act listed, DELWP Advisory critically endangered

- Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*) – FFG Act listed
- Woodland Blind Snake (*Anilios proximus*) - DELWP Advisory near threatened

Possible impacts to these species are not expected to be significant during construction provided the recommended mitigation measures are implemented (refer to Section 12 – Proposed Mitigation). The operation of the project is expected to yield benefits to a number of these species through improved habitat conditions and resource availability.

Silver Perch, Murray Cod, Trout Cod and Golden Perch, were considered unlikely to be significantly impacted by construction and operation of the project. These species are considered as main-channel specialists with suitable habitat limited to the Murray River. Construction along the river is limited to a small area of the overall area of available habitat for the species and the use of partial coffer dams will ensure that fish passage is maintained within the River and water quality impacts can be managed. Any potential for sediment/ contaminant run-off into wet areas from construction footprint would be managed with consideration of these species. A construction specific aquatic fauna management plan (as part of the CEMP) would be developed and implemented to mitigate impacts for all works around waterways.

Potential operational impacts will also be managed to reduce risk to fish species. Pump stations will be constructed with fine fish screens that minimise entrainment of fish. Potential for poor water quality return flows will also be managed through monitoring of the return flows during drawdown, undertaking blackwater risk assessment prior to delivery (refer to Section 13 for further information), and adaptively managing release rates to ensure that suitable dilution occurs from passing flows within the Murray River if water quality of return flows is low. Return flow volumes are expected to be small (1,540 ML in total), at a low flow rate and will occur at a time of year when passing flows in the Murray River are typically high (i.e. during the irrigation season) therefore the risk is considered low. An inundation regime and operating plan to minimise the risk of stranding of fish that have entered the floodplain during hybrid inundation events during drawdown will be also adopted with potential fish exit cues provided for those fish that have entered the floodplain. This will be detailed in the project Operating Plan which is under development. Overall, mitigation measures included in the design, construction and operation of the project will manage potential impacts to fish species and reduce risks to low for both construction and operation of the project. The project is likely to have a benefit to fish, through restoration of floodplain and semi-permanent wetland habitat and increase in carbon returning to the Murray River, improving the productivity of the river which will benefit native fish species. Benefits are expected for both channel specialists (Murray Cod, Trout Cod, Golden Perch and Silver Perch) and wetland specialists (Unspecked Hardyhead, Murray-Darling Rainbow Fish, Southern Pygmy Perch and Freshwater Catfish) at the Camerons Creek site.

The South-eastern Long-eared Bat, Squirrel Glider, Bearded Dragon, Carpet Python and Lace Monitor, may also be impacted during the construction phase by large tree removal and ground disturbance impacts. Removal of large trees, which are more likely to provide hollows and other habitat for these species, would be avoided wherever possible and if required, salvage would be undertaken to minimise impacts to these native fauna species. This would include thorough inspection of all hollow-bearing trees proposed for removal prior to removal to identify any refuging wildlife, requirements around timing of surveys and clearing to avoid breeding season and requirements around clearing methods. Options to enhance surrounding habitat using removed vegetation (e.g. hollow bearing trees/ limbs) will also be included. An on-site ecologist with Management Authorisation under the *Wildlife Act 1975* would be present during large tree removal and construction works.

Similarly, the Broad-shelled Turtle, Murray River Turtle, Growling Grass Frog and Sloan's Froglet may also experience localised impacts as a result of habitat removal and construction works along river and creek banks during construction at Cameron's Creek, Baggott's Creek and Deep Creek. All works around waterways will aim to minimise impacts associated with coffer dam construction, dewatering works and any potential for sediment contaminant run-off. The works should be timed to where practicable avoid the

breeding season of turtles (spring to summer) where turtles may nest along river banks. In addition, indirect impacts from the proposed works may include the introduction or spread of Chytrid Fungus which impacts frogs. Transmission of the disease from vehicles transferring mud and water between water bodies is unlikely if vehicle hygiene protocols are undertaken. These species are not considered likely to be significantly impacted by the proposed construction activities or inundation. A construction specific aquatic fauna management plan (as part of the CEMP) would be developed and implemented to mitigate impacts for all works around waterways. The CEMP would also include hygiene protocols for Chytrid Fungus and any handling of frogs would be undertaken by a suitably qualified and experienced ecologist to employ protocols identified in Murray et al (2011).

The remaining EPBC Act and FFG Act listed species are birds that are highly mobile and wide ranging and they are therefore considered unlikely to be adversely impacted due to suitable habitat being surrounding and widespread. Specific to the Superb Parrot, assessments have determined that whilst suitable foraging and breeding habitat is present within the construction footprint (e.g. large River Red Gums with hollows), known important breeding populations are not present within the project area. The closest known breeding area is in an area east of Barmah and Millewah State Forest to Taylors Bridge in NSW / Victoria.

There is potential for the introduction of environmental water to lead to an increase in abundance of feral predators (cats, foxes, pigs) and resource competitors (goats, pigs) due to the associated increase in productivity of the floodplain. Some of the species such as feral cats could potentially prey on waterbirds, woodland birds, small mammals, reptiles and frogs that respond to the application of water to floodplains/wetlands. An accompanying pest animal management and control program would need to be implemented and funded targeting the inundation area, in consultation with DELWP and Parks Victoria, to expand current pest control programs within the area.

Listed threatened flora

Six EPBC Act listed flora species are known to occur or possibly occur in the project area. River Swamp Wallaby-grass was located during field assessments, and two others, Stiff Groundsel and Winged Peppercress are known to occur close to the project area in similar habitat. Slender Darling-pea is considered to possibly occur in the inundation area given presence of Black Box Woodland habitat. Suitable habitat for Ridged Water-milfoil and Floodplain Rustyhood is present within the inundation area.

Eight FFG Act listed flora species are known to occur or possibly occur in the project area. Umbrella Wattle and Buloke were recorded in recent field assessments. One species, Wavy Marshwort was previously recorded and the Winged Peppercress, Stiff Groundsel, Slender-Darling Pea, Ridged Water-milfoil and Floodplain Rustyhood (all also EPBC listed) have the potential to occur. Eighteen flora species listed on the DEWLP Advisory list are considered to possibly occur; with Umbrella Wattle (also FFG Act listed) and Long Eryngium (*Eryngium ovinum*) being recorded during recent field assessments.

Whilst impacts to all of the listed and protected flora species was considered possible, impacts are not expected to be significant at a local population or species level and are primarily associated with vegetation clearance within a relatively small and defined footprint. All of the flora species are likely to benefit from a return to a more natural inundation regime and increase their areas of potential occupancy.

Listed threatened migratory species

Fourteen EPBC Act listed migratory species are predicted to occur or have previously been recorded in the project area. However none of these species were considered likely to be adversely impacted by construction due to the absence of habitat within the construction footprint that would be considered important for these migratory species foraging or breeding activity or support an ecologically significant proportion of a population of migratory species. Power supply to the pump stations predominantly traverses private land outside of the forest, and any lengths within the forest will be underground within proposed

access tracks or levee banks. Many of these species are likely to be benefited by the proposed inundation regime that aims to improve ecological condition of riverine and floodplain habitats.

Impacts on aquatic ecosystems, surface water and groundwater quality

The project aims to reinstate a more natural inundation regime to the Gunbower National Park floodplain and is expected to deliver a range of ecological benefits to the floodplain and aquatic ecosystesm. The project is designed to have the operational flexibility to vary the timing, depth, duration and extent of inundation so that individual managed events can target specific ecological outcomes.

Potential adverse impacts on aquatic ecosystems and water environments could arise due to standard construction risks such as dewatering, sediment and erosion control, and management of chemicals and fuels. However, construction risks are well understood and would be managed through a CEMP containing detailed measures for managing works in or near waterway, spoil, sediment and erosion control chemicals and fuels.

Any upstream or downstream hydrological changes or impacts in the Murray River associated with the delivery of environmental water to the Gunbower National Park floodplain will be assessed and managed by the River Murray Operations Committee (RMOC) as part of their responsibility to oversee the operation of the river which is managed by the Murray-Darling Basin Authority on behalf of the relevant State and Commonwealth Governments. It is also proposed that the environmental water requirements for VMFRP sites will be added to the existing river flows and therefore managed to ensure minimal, if any, changes in flows experienced downstream of the project sites.

Due to the nature of environmental watering, risks to water environments could include water quality impacts (including saline discharge and low dissolved oxygen) within and downstream of project areas and spread of pest species (including carp). The spread of pest species such as carp (either onto the floodplain, or from the floodplain to the river) are not considered significant risks as the pumping of environmental water restricts carp movement, and the seasonal nature of watering means the numbers of carp on floodplains don't have the opportunity to build up. Water quality risks are considered low as the volume of return water (ML/day) is very small compared with the range of flows within the main channel. These risks would be adaptively managed through implementation of a monitoring and evaluation framework, the Operating Plan and EWMP and drawing on experience from previous environmental watering projects such as the TLM Program. Key measures relating to water quality would include implementing a monitoring program to measure inflows / outflows and water quality during events and releases, to facilitate timely identification of potential water quality issues, which would inform the adaptive management of such events to mitigate potential impacts on beneficial uses.

The nature and extent of changes to groundwater levels and quality during managed inundation would be identified through implementation of a monitoring bore network and adaptively managed through refinement of Operating Plans and EWMPs in consultation with MDBA, LMW, VEWH, CEWH, GMW, DELWP and Parks Victoria.

Impacts to Ecological Character of Ramsar Site

The project site is situated within the Gunbower National Park, which forms part of the greater Gunbower Forest, a listed Ramsar site. The Ramsar assessment (**Attachment 5**), included an assessment of impacts or exceedance of the Limits of Acceptable Change (LAC) identified in the Ecological Character Description for the Gunbower Forest Ramsar site. The assessment concluded that whilst the project is expected to have a positive impact on the ecological character of the Gunbower Forest Ramsar site, there will be highly localised negative impacts associated with construction. When considering the risk to the Gunbower site Ramsar listing in terms of possible causation of exceedances of LACs for the Ramsar site, it is not considered that the project causes a significant risk to ecological character of Gunbower Forest or will affect the site's listing as a Ramsar site. Refer **Attachment 5 – Ramsar Assessment** for further assessment of risks and measures to reduce risks.

Impacts on land use and amenity

Overall, the project supports both state and local planning policy, particularly in relation to the protection and enhancement of biodiversity, waterbodies and wetlands and significant landscapes of the area. The intention of improving on the health of these riverine environments will also support the economic development of the region where the Gannawarra and Campaspe Councils are encouraging development around nature-based tourism associated with the region's ecological values.

The project has the potential to generate traffic along local roads and park access tracks during construction of the project relating to haulage of fill/spoil, delivery and removal of plant and workers travelling daily to and from the site. This has the potential for disruptions to recreational access to the Murray River and other parts of Gunbower National Park.

Engagement would be undertaken with DELWP and Parks Victoria to manage access disruptions within both the River Murray Reserve and Gunbower National Park and prepared and implemented so that both DELWP and Parks Victoria is aware of the extent and timing of construction works, and can plan accordingly (e.g. signage, notification to park users). Construction traffic would be managed through standard controls contained in a CEMP and Traffic Management Plan to mitigate impacts.

During managed inundation events, some areas of Gunbower National Park may not be accessible due to water restricting access, or to manage public safety risks. The project provides opportunities to rethink access through the site for active and passive recreation, particularly given some tracks may be secondary or overgrown and alternate tracks may better highlight existing conserveration values. Environmental watering will typically occur in winter/spring and therefore avoid peak tourism periods and optimal track maintenance periods. Access related impacts on licensed apiary sites will also be considered. Further assessment will be undertaken in consultation with DELWP and Parks Victoria, to identify opportunities to maintain or provide alternative access, where practicable. It is also the intention to sequence the construction and operation of Gunbower National Park with proposed construction and operation in Guttrum and Benwell Forests to provide an alternative, nearby, location for active and passive recreation.

The nearest residential dwellings are located approximately 200 m from the construction footprint. Some of these dwellings may experience some additional noise, dust and traffic, these impacts would be managed through standard controls contained in a CEMP, including a site-specific traffic management plan and it is expected that construction would only be undertaken during the day time period, which would avoid night time construction noise impacts. Residents and businesses along the Murray Valley Highway, Gunbower Island Road, Island School Road, Bramley Road, Gamble Road, McPhail Road, Sternber Road, Norman Road, Dye Road, Frees Road, Tickells Road and other smaller public access roads that connect to the construction areas; Brereton Road, Camerons Creek Road, Steel Road, Torrumbarry Weir Road, Hall Road and Headworks Road, may experience some traffic during construction particularly during construction haulage of fill and spoil along the roads to and from the site. These effects would be temporary and limited to the construction period.

Noise modelling indicates that pumping activities during environmental watering will not exceed the relevant noise criteria for the rural landscape in which the project would operate with the implementation of proposed mitigations measures. The modelling indicates:

- Predicted noise levels from conservative scenarios where four pumps are running simultaneously during a pumped inundation event at the Brereton Road Pump Station indicate that noise levels will comply with the strictest noise criteria of 34 dB(A) at all sensitive receivers, as well as meeting the base noise levels of 32 dB(A) from the relevant "*Noise from Industry in Regional Victoria*" guideline.
- Noise levels from conservative scenarios where two pumps as well as a jockey pump are running simultaneously during a pumped inundation event at Camerons Creek Pump Station are predicted to comply with the strictest noise criteria of 34 dB(A) at all sensitive receivers with the exception of

the closest dwelling to the site where noise levels are predicted to be 36 dB(A) under this scenario. Following the placement of a 2.5m high earthen bund or noise wall to the south east of the pump station (between the pump station and the dwelling), the predicted noise level at the dwelling is expected to comply to the noise criteria with a noise level of 33 dB(A).

All pump stations will have external lighting fitted, however these lights would only be used during maintenance events if required. It will be uncommon for maintenance activity to occur at night and there will therefore not be any regular light impacts to resident dwellings located in close proximity to the pump stations or fauna in the area.

Impacts on landscape

The project would involve removal of some native vegetation and alteration of constructed landforms within areas supporting state and regional landscape values, specifically the Gunbower National Park. However, these areas of proposed native vegetation removal and landform alteration are mostly sited in areas already modified and degraded through construction of access tracks and embankments. Design of proposed structures would be sympathetic to the surrounding landscape and consistent with Parks Victoria infrastructure design guidelines.

The removal of native vegetation for the project would occur in discrete areas totalling a maximum of approximately 19.6 hectares in the context of a largely intact expanse of native vegetation within the Gunbower National Park floodplain. The areas of proposed vegetation clearing are considered minor when compared to the 704 hectares of native vegetation within the proposed inundation areas that would benefit from the project.

Impacts on heritage values

The project has potential to impact on both known and previously unregistered Aboriginal heritage places within the project area. The potential for these impacts is currently being assessed through preparation of a Cultural Heritage Management Plan in accordance with the *Aboriginal Heritage Act 2006*. This includes field survey and consultation with traditional owner (TO) groups. The draft CHMP will be finalised in consultation with the identified TO groups for approval by Aboriginal Victoria and is likely to include specific management conditions for a number of Aboriginal Places, along with general management recommendations relating to induction training, salvage methods and stakeholder engagement, and procedures for unexpected 'finds' of potential Aboriginal cultural material.

Hydrological modelling and geomorphological analysis would be carried out to inform an assessment of the potential impact to Aboriginal Ancestral Remains within the inundation area. The results of this assessment would be used to develop impact mitigation measures which will be included as management conditions in the CHMP. Development of management conditions will involve consultation with the Traditional Owners, Aboriginal Victoria, the Victorian Aboriginal Heritage Council, and the Ancestral Remains Unit within the Office of the Victorian Aboriginal Heritage Council.

No places listed on the Victorian Heritage Register (VHR), Victorian Heritage Inventory (VHI), Gannawarra or Campaspe Planning Scheme Heritage Overlay, World Heritage List, National Heritage List or Commonwealth Heritage List are located within or adjacent to area of investigation. Cohuna and Gannawarra Pumps have been nominated for the VHR as Cohuna Headworks but its heritage status has not yet been confirmed with HV. While not currently registered on any heritage register, this historical heritage place was nominated for listing on the VHR by Kaufman and Ballinger (2014), but its heritage status has not been confirmed with Heritage Victoria (HV) (refer Section 15.1 below for further detail).

The nearest historical heritage place to the area of investigation at Gunbower comprises Torrumbarry Weir Lock Chamber, Steam Boiler and Steam Winch Complex (H0993/Campaspe HO202/RNE 101506), which is situated on the Murray River. It is approximately 266 m to the north of the Upper Gunbower Forest area of investigation, and approximately 1 km east of the Upper Gunbower Forest inundation area.

There is also moderate-high potential for previously unidentified historical heritage items to be present within the project area, from the background history of the area. Site types most likely to be identified in the project area would be heritage places or archaeological sites associated with early agricultural or pastoral activities, logging, and water management practices. The presence of unregistered historic archaeological sites within the project area would be further assessed and managed in accordance with the *Heritage Act 2017*.

Borrow sites

VMFRP are currently progressing a site selection process to identify potential borrow pit locations from which to source fill material for the project, including consultation with local landowners. The nature and extent of potential impacts associated with establishment of borrow pits / quarry sites are yet to be assessed. Environment and heritage values would be evaluated as part of the site selection process to avoid and minimise impacts. Borrow pits would be located on private land, outside of Gunbower National Park, and where practicable within previously cleared areas.

12. Native vegetation, flora and fauna

12.1 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 review of relevant databases and previous studies was undertaken as part of the Flora and Fauna Assessment – Gunbower National Park (R8, 2020b) (refer to **Attachment 3 - Flora and Fauna Assessment)** to identify native vegetation and listed flora and fauna species with potential to occur in the construction footprint and inundation area, plus a 10 km buffer. The review considered previous records and predicted occurrences of vegetation communities.

The following databases and reports were used:

- Protected Matters Search Tool (PMST) for the EPBC Act, maintained by DAWE[2]
- Victorian Biodiversity Atlas (VBA), maintained by DELWP[3]
- NatureKit, spatial database for native vegetation (Ecological Vegetation Class) mapping throughout Victoria, maintained by DELWP[4]
- Native Vegetation Information Management tool (NVIM), maintained by DELWP[5].
- Weeds of National Significance (WoNS) database[6]
- Previous investigations and reports as identified in **Table 15**.

In addition to the desktop review, **Attachment 3 – Flora and Fauna Assessment** reports on the field assessments undertaken between October and December 2019 for the purpose of:

[2] http://www.environment.gov.au/epbc/protected-matters-search-tool (accessed on 06/07/2020)
[3] https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas (accessed on 30/03/2020)
[4] http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit (accessed on 30/03/2020)
[5] https://nvim.delwp.vic.gov.au/ (accessed on 30/03/2020)
[6] http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html (accessed 30/03/2020)

- Mapping the extent and condition of native vegetation present within the proposed construction footprint including:
    - Defining and mapping the relevant EVCs
    - Undertaking Habitat Hectare (HabHa) Assessments for each Habitat Zone (HZ) not previously assessed
    - Mapping and measuring Canopy Trees that meet the benchmark for Large trees not previously measured
- Recording the location of rare or threatened flora or fauna and protected flora where encountered.
- Collecting an inventory of incidental observations of both native and non-native flora and fauna encountered during the field assessment, together with their conservation status and origin.

A summary of the methods and key findings of the background studies and the recent R8 study is provided in **Table 15** below (Section 12.2).

Future surveys of Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower are planned in spring 2020.

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

☒ NYD Estimated area ……19.57(hectares)

As changes in the construction footprint have occurred since the 2019 survey, some areas of native vegetation proposed to be impacted have not yet been assessed in field, however vegetation mapping data (Bennetts, 2014) has been used to fill these gaps. Further design refinements may occur, but are expected to fall within the area of investigation. Once the design process is complete and the construction footprint has been finalised, a Vegetation Quality Assessment (Habitat Hectares) will be undertaken in these areas to confirm the condition and extent of native vegetation within these areas.

19.57 hectares is the current estimate of the maximum area of native vegetation needing to be cleared. This includes 58 large trees which have the potential to be impacted. This total only includes large trees mapped within the Upper Gunbower Forest (excluding Camerons Creek pump station and pipeline) and Middle Gunbower Forest (upstream Deep Creek). This total will increase once LOTs have been mapped within the Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower in spring 2020. This estimate also does not include native vegetation clearance associated with power supply or levee works which are subject to further risk assessment. If levee works are required, this would involve works along between 1.5 and 3 kilometres of existing, previously disturbed, levee banks.

The scope and requirement for works along access tracks is still to be confirmed and will be designed to avoid and minimise native vegetation removal to the extent practicable. In some instances these works may be limited to minor maintenance and upgrades that require minimal if any vegetation clearance. As such the current estimate of potential vegetation removal along tracks is potentially conservative, but would be confirmed should the final design be altered

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.

Construction footprints

Table 13 identifies the EVCs mapped within the current construction footprint and proposed access tracks that would be potentially impacted by the construction of infrastructure (all within the Murray Fans bioregion). This is a total of 19.57 hectares and includes EVCs mapped within the construction footprint associated with proposed infrastructure, proposed access tracks, as well as existing access tracks (where upgrades may be required and works may extend into the Tree Protection Zones. In addition, 58 large trees have the potential to be impacted by the construction activities proposed. However, this total will increase once large trees have been mapped within the Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower in spring 2020

Table 13: EVC areas potentially impacted by the works

EVC No.	EVC	Biodiversity Conservation Significance	Area (hectares)	
			Infrastructure	Tracks*
Upper Gunbower Forest				
56	Floodplain Riparian Woodland	Depleted		0.03
103	Riverine Chenopod Woodland	Endangered	1.53 *	0.71
803	Plains Woodland	Endangered	0.34 *	2.08
816	Sedgy Riverine Forest	Depleted	0.43	0.05
821	Tall Marsh	Least Concern	0.06	
	Sub-total		**2.35^**	**2.87**
Middle Gunbower Forest (upstream of Deep Creek)				
56	Floodplain Riparian Woodland	Depleted	0.07	
103	Riverine Chenopod Woodland	Endangered	0.64	0.41
803	Plains Woodland	Endangered	0.03	0.05
	Sub-total		**0.74**	**0.46**
Middle Gunbower Forest (downstream of Deep Creek) **				
56	Floodplain Riparian Woodland	Depleted		0.12
103	Riverine Chenopod Woodland	Endangered		0.75
106	Grassy Riverine Forest	Depleted	0.08	0.11
295	Riverine Grassy Woodland	Vulnerable	0.17	
803	Plains Woodland	Endangered	1.34	0.35
814	Riverine Swamp Forest	Depleted		0.73
815	Riverine Swampy Woodland	Vulnerable	6.64	0.98
816	Sedgy Riverine Forest	Depleted	1.52	0.37
		Sub-total	**9.74^**	**3.41**
		Total	**12.83^**	**6.74**

* EVC mapping completed by DELWP 2005, EVC mapping and aerial imagery. No ground truthing of this data has been completed

** EVC mapping for this area completed by Bennetts 2014a. No ground truthing of this data at Middle Gunbower Forest (downstream of Deep Creek) has been completed, but is scheduled for spring 2020.

^ Minor discrepancies with rounding, total impact area equals 19.57 hectares.

Appendix A and B in **Attachment 3 – Flora and Fauna Assessment** shows the location of the EVCs within the construction footprint and access tracks. The mitigation measures outlined in Part 2 (Environmental management) of this referral would therefore assist in minimising and avoiding impacts to these EVC's.

Inundation

Table 14 identifies the EVCs that are mapped to occur within the inundation areas. The environmental watering is proposed to deliver the preferred inundation regime for native vegetation communities within the proposed inundation areas. Accordingly, native vegetation within the proposed inundation areas is expected to benefit from the project rather than be adversely impacted.

Most of these EVCs are seasonal wetlands, River Red Gum forest and woodland, flood dependent understorey or Box woodland vegetation communities that require or are tolerant of inundation and therefore are expected to positively respond to the proposed inundation. A small area (0.98 hectares) of terrestrial box woodland is expected to be inundated during forest floodplain watering. Over the long-term, the understorey species composition of some of these areas may become more aquatic. However, it is not considered that the level of inundation would result in any detrimental impact to the community that would lead to identified areas of the community no longer meeting the classification criteria for the community.

Table 14: Modelled EVCs within inundation area

EVC	Ecological Vegetation Class	Biodiversity Conservation Significance	Inundation Area (hectares)
56	Floodplain Riparian Woodland	Depleted	
334	Billabong Wetland Aggregate (EVC 334)		12.84
168	Drainage Line Aggregate		9.17
812	Grassy Riverine Forest - Riverine Swamp Forest		85.95
815	Riverine Swampy Woodland	Vulnerable	10.77
821	Tall Marsh	Least Concern	12.58
954	Riverine Swamp Forest - Floodway Pond Herbland		1.26
1071	Sedgy Riverine Forest - Tall Marsh Complex		78.10
106	Grassy Riverine Forest	Depleted	56.75
295	Riverine Grassy Woodland	Vulnerable	
814	Riverine Swamp Forest	Depleted	5.95
815	Riverine Swampy Woodland	Vulnerable	316.37
816	Sedgy Riverine Forest	Depleted	3.94
103	Riverine Chenopod Woodland *	Endangered	92.69
823	Lignum Swampy Woodland ^	Vulnerable	8.92
803	Plains Woodland	Endangered	0.98

	No EVC Mapping		7.8
	Total		**704.1**

* Categorised as 'Box Woodland' in Bennetts 2014a mapping, this EVC has been assigned to flood-dependent woodlands to fit with the Water Regime Classes provided in Ecological Associates (2014).

^ Categorised as 'Red Gum Forest and Woodlands' in Bennetts 2014a mapping, this EVC has been assigned to Flood-dependent Woodlands to fit with the Water Regime Classes provided in Ecological Associates (2014)

Some mapping based on DELWP mapping as Bennetts 2014a mapping does not include all of the inundation area.

Have potential vegetation offsets been identified as yet?

☒ NYD ☒ Yes If yes, please briefly describe.

As described above, a total of approximately 19.57 hectares of native vegetation, including 58 large trees, is proposed to be removed within the construction footprint, and additional areas to be surveyed in spring 2020. **Attachment 3 – Flora and Fauna Assessment** contains a preliminary estimate of offset requirements.

Offsets would be sought in accordance with the requirements of the *Guidelines for removal, destruction or lopping of native vegetation* (DELWP 2017b) or through an alternate arrangement agreed with the Secretary to DELWP, such as a conservation exemption under Clause 52.17 of the Gannawarra planning scheme. The loss of native vegetation due to construction activities is proposed to be offset, at least in part, by the expected improvement in native vegetation quality in the inundation area resulting from environmental watering. The method for confirming this offset would be developed in consultation with DELWP. Any offset requirements that cannot be met through environmental watering would be purchased by the project.

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

NYD = not yet determined

12.2 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)

As described above, **Attachment 3 – Flora and Fauna Assessment** contains a review of previous ecological studies undertaken for the project and updated database and mapping searches to identify flora and fauna potentially occurring in the project area. A summary of the methods and findings of previous ecological studies is provided in **Table 15.**

Table 15: Summary methods and findings of previous ecological studies

Report	Methods	Key findings
ARI (2020b), *Upper Gunbower Creek Fish Management Plan.* Report to North Central CMA. Arthur Rylah Institute for Environmental Research, DELWP.	Review of existing information Desktop study of Hall Road Lagoon	The plan sets out the following objectives: • Clear ecological and management objectives for small-bodied native fish • Management actions for maintaining and improving small-bodied fish populations

		• Identifies fish passage and flow criteria/requirements for small bodied fish in Cameron's Creek, Black Charlie Lagoon and Hall Road Lagoon, including species, fishway depths/velocities/timing • Provides conceptual and specific design inputs for fishway design at Cameron's Creek • Considers vegetation objectives and provide brief recommendations for aquatic vegetation management at the sites, to support small-bodied native fish populations and ecological objectives. Also, briefly scopes the potential for Hall Road Lagoon to be used as a breeding or translocation site for small-bodied native fish.
Bennetts and Cook (2020) *Threatened Flora Monitoring Gunbower Forest Ramsar Site Spring 2019*. Report prepared for the North Central Catchment Management Authority.	Targeted field surveys for EPBC listed threatened flora at previously recorded locations and suitable habitat within Gunbower Forest Ramsar site (October 2019 to March 2020)	• River Swamp Wallaby-grass was present at 16 wetland and regularly inundating River Red Gum forest sites. All populations were observed with low cover, except for those protected from physical disturbance (e.g. wire cages). Within the Gunbower National Park project area, 6 locations were surveyd with two populations recorded, Dry Tree Lagoon and Dalley Bend (both outside of the construction and inundation areas) • Winged Peppercress was present at 6 previously recorded locations with populations ranging from 98 to over 1,000 individuals. Five of these locations are clustered in the Lower Gunbower Forest approximately 30 km downstream of the project area, however one population exists in the upper reaches of the Lower Gunbower Forest approximately 7 km from the project area. 13 other locations were surveyed within the project area that did not record the species. • Floodplain Rustyhood was present at one location with 70 individuals recorded. The species was only recorded in Gunbower Forest in 2015 and has declined from a total of 95 individuals. This population occurs on Spur Island, approximately 1.5 km north of the project area of Middle Gunbower Forest (downstream of Deep Creek).

		• The presence of the species suggest that they remained within the associated Limits of Acceptable Change drafted for the Ramsar site. Nonetheless, when surveyed in 2019, there was evidence of impacts such as grazing, low rainfall, altered hydrology, carp and off-road vehicles threatening the species. • Actions implemented to minimise these threats include regularly delivery of environmental water (to the River Swamp Wallaby-grass habitat) and physical protection (vehicle/herbivore barriers). The positive outcomes resulting from these actions suggest that they should be continued. • Assessment of the species' health and predicted trajectories in Gunbower Forest would benefit greatly from systematically collected monitoring data. Monitoring plans should be developed and implemented for each of the three species.
Seran BL&A (2018), *Screening of the potential impacts on threatened species and communities associated with the construction and operation of Victoria's nine Basin Plan environmental works projects.*	Desktop assessment (VBA / PMST search) Review of existing information	Listed ecological values identified as likely or potential to occur within Gunbower: **EPBC Act** Gunbower Forest Ramsar site Grey Box Grassy Woodland TEC Threatened fauna: Murray Cod, Flat-headed Galaxias, Superb Parrot, Growling Grass Frog and South-eastern Long-eared Bat Threatened flora: River Swamp Wallaby-grass, Winged Peppercress, Stiff Groundsel and Slender Darling-pea Migratory species: Glossy Ibis **FFG Act** Victorian Temperate Woodland Bird Community (VTWBC) 17 threatened fauna 6 Threatened flora Recommendation for a referral under the EPBC Act (potential impacts to the Grey Box Woodland TEC and the Gunbower Forest Ramsar site). In addition, a referral under the EE Act for the removal of >10 hectares of native vegetation from an endangered EVC.

GHD (2017), *Gunbower National Park Flora and Fauna Assessment.* Report prepared for the North Central Catchment Management Authority.	Review of existing information EVC mapping Habitat Hectare assessment Large trees (LOT) mapping Fauna surveys (February – March 2017) - Bird surveys - Bat surveys (Bat harp trapping and Anabat recording) - Active searching - Spotlight surveys - Remote sensing fauna cameras Recording of incidental observations	SDL Construction footprint (as at 2017) contained: ▪ 4 EVCs: Floodplain Riparian Woodland (EVC 56), Riverine Chenopod Woodland (EVC 106), Riverine Grassy Woodland (EVC 295) and Plains Woodland (EVC 803) ▪ One EPBC Act listed TEC, Grey Box Grassy Woodland and Derived Native Grasslands of South-eastern Australia ▪ 146 LOTs ▪ 86 flora species recorded (no listed threatened species) ▪ 52 terrestrial fauna species recorded ▪ 1 species of rare/threatened fauna: - Lace Monitor, DELWP Advisory listed endangered) ▪ Victorian Temperate Woodland bird Community (VTWBC). ▪ 30 weed species
NCCMA (2015), *Camerons Creek Vegetation survey, mapping and analysis.*	• Field surveys (August) along Cameron's Creek • EVC mapping using the Index of Wetland Condition methodology • Floristic surveys	11 vegetation classes were considered present • Floodplain Riparian Woodland (EVC 56), Riverine Chenopod Woodland (EVC 103), Billabong Wetland Aggregate (EVC 334), Aquatic Herbland (EVC 653), Plains Woodland (EVC 803), Riverine Swampy Woodland (EVC 815), Sedgy Riverine Forest (EVC 816), Spike-sedge Wetland (EVC 819), Tall Marsh (EVC 821), Submerged Aquatic Herbland (EVC 918), Dwarf Floating Aquatic Herbland (EVC 949) and open water In addition 3 DEWLP threatened flora species • Floodplain Fireweed • Leek Flax-lily • Long Eryngium
Sharpe (2015), *Autumn 2015 Fish surveys of Camerons Creek.* Sharpe (2014), *Fish surveys of Camerons Creek.*	• Fish surveys in Camerons Creek and Black Charlie Lagoon (spring 2014, autumn 2015) • Trapping, fyke netting and electrofishing	• 10 fish species (6 native and 4 exotic) recorded in both Camerons Creek (2014 and 2015) and Black Charlie Lagoon (2015 only) • 2 are FFG Act listed threatened species (Un-specked Hardyhead and Murray-Darling Rainbowfish)

		• Target species, Southern Pygmy Perch was not recorded during surveys
Biosis (2014a), *Flora and fauna assessment of the Gunbower National Park and Guttrum and Benwell State Forests.* Report prepared for the North Central Catchment Management Authority.	• Review of existing information • Field surveys of Gunbower NP and Guttrum and Benwell State Forests (July 2014) • EVC mapping • Habitat Hectare assessment • Large trees (LOT) mapping • Fauna surveys • Bird surveys • Active searching • Spotlight surveys including the use of call-playback • Recording of incidental observations	150 flora species and 70 fauna species recorded across all three Forests. The following ecological values were recorded at Gunbower National Park • 4 EVCs: Riverine Chenopod Woodland (EVC 103), Plains Woodland (EVC 803), Riverine Swampy Woodland (EVC 815) and Sedgy Riverine Forest (EVC 816) • 1 EPBC Act listed TEC, Grey Box Grassy Woodland and Derived Native Grasslands of South-eastern Australia • Potential habitat for EPBC-listed species: River Swamp Wallaby-grass, Winged Peppercress, Stiff Groundsel, Growling Grass Frog and Superb Parrot • Potential habitat for FFG-listed species: Wavy Marshwort, Squirrel Glider, White-bellied Sea-eagle, Grey-crowned Babbler, Diamond Firetail, Hooded Robin, Barking Owl, Bush-stone Curlew and Broad-shelled Turtle • 1 species of rare/threatened FFG Act listed fauna (Broad-shelled Turtle) • FFG listed threatened fauna community, VTWBC
Bennetts (2014a), *Vegetation Mapping in Upper Gunbower Forest. Report for the North Central Catchment Management Authority*	• Field vegetation (EVC) mapping • Delineates terrestrial woodland from woodland that tolerates periodic inundation in both Black Box and Grey Box vegetation in Upper Gunbower Forest • Establishes baseline understorey species and % cover across three transects	• Provides a complete GIS layer of EVC mapping across Upper and Middle Gunbower Forest to facilitate the evaluation of proposed water related works • Differentiates between Grey Box Woodland that resembles Plains Woodland (EVC 803) and is characteristic of the EPBC Act listed TEC Grey Box Grassy Woodland and Derived Native Grasslands of South-eastern Australia threatened community, and Riverine Swampy Woodland (EVC 815)
North Central Catchment Management Authority (2014), *Gunbower National Park: Ecological Objectives and Hydrological Requirements*	• Summarises the ecological values, objectives and targets of the Gunbower National Park Environmental Works Project	Reports on and summarises the findings of Ecological Associates (2014).

	• Provides justification for the corresponding hydrological requirements	
Ecological Associates (2014), *Ecological objectives and hydrological targets in Upper Gunbower Forest.* Report prepared for the North Central Catchment Management Authority	• Desktop hydrological analysis of Gunbower National Park • Flow analysis of the following scenarios: natural, benchmark and Basin Plan 2750	• Upper Gunbower Forest was classified into 5 different water regime classes: Scroll Bars and Riparian Billabongs, Seasonal Swamps, River Red Gum forest and woodland, flood dependent Box woodland, Terrestrial Box woodland. • These water regime classes were used to set ecological objectives and hydrological targets.
Bennetts and Jolly (2013), *Gunbower Forest Sentinel Wetland and Understorey Survey autumn 2013.* Unpublished Technical Report for the North Central Catchment Management Authority	• Field survey (April 2013) as part of annual understorey monitoring from 2005-2013 • 110 understorey quadrats and 15 wetland transects	• The results suggest a decline in floristic diversity (cover and richness of characteristic flora) and canopy condition as the Millennium drought intensified (2005 – 2010), with an interruption to this pattern brought about by above average rainfall and widespread natural inundation commencing in 2010. • Subsequent 2011 survey reported twice the diversity in understorey flora, improvement in canopy condition, and a flush of rare and threatened flora when compared to the 2010 results. • The 2013 results signify the end of the 2010 - 2012 flood peak and highlight the combined effect of climate and inundation on floodplain vegetation, with extreme summer conditions nearly negating the benefit of inundation.

North Central CMA (2012), *Mapping Grey Box (Eucalyptus microcarpa) Grassy Woodland within Gunbower Forest.* Unpublished report prepared for GMW	• Field survey (June 2012)
	• 30 surveyed quadrats used to determine the presence of Grey Box Grassy Woodland community
		• From the data collected, 3 broad zones of the presence of Grey Box Grassy Woodland were mapped:
		  ○ High detail mapping, Medium detail mapping, Low detail mapping
		  ○ In total, approximately 1300 hectares of Grey Box Grassy Woodland exists within Gunbower Forest, of that area 770 hectares has been mapped to either a high (170 hectares) or medium (600 hectares) level of detail.

Bennetts, Jolly and Osler (2012), *Targeted rare and threatened flora survey of Gunbower Forest summer 2011.* Report for the Department of	• Field survey (December 2011) • Targeted areas based on known or previous threatened species locations	52 populations of rare or threatened species were recorded in Gunbower Forest, from 19 rare or threatened species

Sustainability and Environment	• If rare or threatened species confirmed, a 200m radius around centrepoint was surveyed	• 2 EPBC Act listed species (River Swamp Wallaby-grass and Winged Peppercress) • 4 FFG Act listed species (Umbrella Wattle, Buloke, Winged Peppercress and Wavy Marshwort) • Species recorded within the Gunbower National Park include (Umbrella Wattle, Buloke, Blue Burr-daisy, Riverine Bitter-cress, Leek Flax-lily, Long Eryngium, Dwarf Brooklime, Smooth Minuria, Waterbush)
Bennetts and Jolly (2005-2020). *Wetland and Understorey Vegetation Condition Monitoring Gunbower Forest Autumn 2005-2019*. Technical Reports for the North Central CMA.	• Field survey in Autumn as part of annual understorey monitoring from 2005-2019 • 110 understorey quadrats and 15 wetland transects were sampled in accordance with the Manual of Field Procedures for Monitoring in Gunbower Forest (Crome 2004).	Results from the 2020 report: **Wetlands** • Wetlands monitored in 2019 were delivered eWater in 2018 after a dry phase at all sites, except at Reedy Lagoon and Black Swamp, which were also delivered eWater in 2017, and the Little Gunbower Creek, which retained water from the 2016 natural inudnation event. • The vegetation response to the eWater appears to be somewhat wetland-specific, however, there was evidence in the 2019 monitoring results to support the following previously reported patterns: • Low flora cover with successive dry years (e.g. as sampled in Autumn 2008) • Low aquatic flora cover after natural inundation event in 2010 (sampled Autumn 2011, particularly in wetlands connected to the Yarran Regulator) • High flora cover following inundation after a dry phase (in most instances in most wetlands) **Forests and Woodlands** • Twenty six of the 77 Red Gum monitoring sites and one Black Box site were inundated in the 2018 eWater event. When sampled in Autumn 2019, the River Red Gum and Box monitoring sites were all dry and observed with relatively low cover and richness of characteristic flora. • The River Red Gum canopy results provide evidence to suggest that eWater delivered to Gunbower Forest

		has potentially aided the recovery of the trees. • Flora cover continued to decline in the Box woodland monitoring sites after the peak recorded with natural inundation event in 2016. **Management recommendations**: • Time the delivery of environmental water based on positive climatic triggers (i.e. recorded or predicted higher than average rainfall). • Avoid delivering water to the wetlands if the subsequent summer is predicted with above average temperatures and below average rainfall. • Prioritise weed control works in areas unlikely to be inundated in the future, and in particular the Red Gum with flood-tolerant understorey WRC. **Monitoring recommendations**: • Develop and initiate a water quality monitoring plan that includes the wetland monitoring sites, in order to clarify water quality influences on aquatic flora. • Further investigate (through data analysis) patterns observed in wetland flora cover data (e.g. increased flora cover following inundation after a dry phase). • Investigate the potential causes for differences observed in the wetland site data based on water source (e.g. regulators).

The review of previous ecological studies and updated database searches was used to inform the additional targeted threatened flora and fauna surveys undertaken by R8 in September, October and December 2019 for which the results are described in **Attachment 3 – Flora and Fauna Assessment**. A summary of the results of updated desktop and field assessments undertaken for the project by R8, is provided in the following sections.

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.

Flora

VBA, PMST searches and recent studies identified 13 EPBC listed threatened flora species, and 13 FFG listed threatened flora species that have been recorded, or have a possible likelihood of occurrence within 10 kilometres of the area of investigation. A further 10 species listed as threatened in Victoria (DELWP Advisory) (DEPI, 2014) were also highlighted. A total of 26 listed threatened flora species were considered, with some species featuring on more than one list. A full list of the threatened species and assessment of their likelihood of occurrence is provided in **Attachment 3 – Flora and Fauna Assessment**.

Of the thirteen EPBC listed flora species (River Swamp Wallaby-grass *Amphibromus fluitans*, Stiff Groundsel *Senecio behrianus*, Winged Peppercress *Lepidium monoplocoides*, a Spear-grass *Austrostipa wakoolica,* Mueller Daisy *Brachyscome muelleroides,* Greencomb Spider-orchid *Caladenia tensa,* Chariot Wheels *Maireana cheelii,* Spiny Rice-flower *Pimelea spinescens* subsp*. Spinescens,* Turnip Copperburr *Sclerolaena napiformis,* Slender Darling-pea *Swainsona murrayana*, Ridged Water-milfoil *Myriophyllum porcatum*, Floodplain Rustyhood *Pterostylis cheraphila* and Red Swainson-pea *Swainsona plagiotropis* and), six were considered to have the potential to occur based on their habitat requirements and / or previous records in the field. River Swamp Wallaby-grass (Vulnerable) was located during the R8 field assessments, and three others, Stiff Groundsel and Winged Peppercress (both Endangered) and Slender Darling-pea (Vulnerable) are known to occur close to the project area in similar habitat. Suitable habitat for the Ridged Water-milfoil occurs within the inundation area. Floodplain Rustyhood was recorded on Spur Island in Gunbower Forest; recently recorded in 2015 on Spur Island in Gunbower Forest and has been monitored annually since (Bennetts and Cook 2020).

Two species listed as threatened under the FFG Act (as well as DELWP Advisory) were identified during the recent surveys in October 2019; Umbrella Wattle *(Acacia oswaldii*) (construction footprint), Buloke (*Allocasuarina luehmannii*) (area of investigation).

Six other FFG listed flora species have the potential to occur; Wavy Marshwort (*Nymphoides crenata*) was previously recorded (Bennetts 2014a, Biosis 2014), Floodplain Rustyhood has been recorded on Spur Island (Bennetts and Cook 2020) and the Winged Peppercress, Stiff Groundsel, Slender-Darling Pea, Ridged Water-milfoil (all also EPBC listed, and DELWP advisory) have the potential to occur, but have not been located in areas surveyed to date. Two species only listed on the DELWP Advisory list, were recorded within the project area; Leek Flax-lily (*Dianella porraceae*) (area of investigation), Long Eryngium (*Eryngium paludosum*) (construction footprint).

The above information was collected from areas accessible during the previous round of surveys, noting that areas of Middle Gunbower (downstream of Deep Creek) are yet to be surveyed. Additional survey work is anticipated to commence in Spring 2020.

Fauna

VBA and PMST searches highlighted 20 EPBC listed threatened fauna species, and 34 FFG listed threatened fauna species that have been recorded, or have a possible likelihood of occurrence, within 10 kilometres of the area of investigation. A further 16 species were identified which are listed as threatened in Victoria (DEWLP advisory) (DEPI, 2014), noting that some of these species have multiple listings. An additional EPBC listed species (Trout Cod) was highlighted in the desktop fish assessment. A total of 56 threatened fauna have been considered, with those considered known or possibly occur provided in

Table 16. A full list of threatened fauna species and assessment of their likelihood of occurrence is provided in **Attachment 3 – Flora and Fauna Assessment.**

Forty-five of these species (2 mammals, 26 birds, 6 reptiles, 2 amphibian, 8 fish and 1 invertebrate) are considered to have the potential to occur within the construction footprint and/or inundation area based on habitat requirements and/or nearby records. This includes 30 species listed under the EPBC Act and/or FFG Act and an additional 13 species only listed as DELWP Advisory species. A summary of the assessment is provided in

Table 16, and the full assessment is in **Attachment 3**.

Eleven EPBC Act listed as threatened fauna species were identified as either present or as possibly occurring within the construction and/or inundation areas included: South-eastern Long-eared Bat, Superb Parrot, Painted Honeyeater, White-throated Needletail, Growling Grass Frog, Sloan's Froglet, Murray Cod, Silver Perch, Trout Cod, Australian Painted Snipe and Australasian Bittern.

Silver Perch, Trout Cod and Murray Cod are three species listed under both the EPBC Act and FFG Act, and identified as possibly being present and impacted by in-stream construction works such as coffer dam construction and dewatering, and sediment or contaminants in runoff associated with construction of the project.

Three other EPBC Act and FFG Act listed species, the South-eastern Long-eared Bat, the Growling Grass Frog and Sloan's Froglet, were also identified as potentially impacted through habitat clearing for construction of the project.

There are also several DELWP Advisory fauna that have the potential to occur (refer summary in

Table 16) below.

Migratory species

Fourteen EPBC listed migratory species were highlighted as having potential to occur within the project area from a VBA and PMST search of area of investigation (10 km buffer from construction footprint and inundation area). Migratory species included aerial / terrestrial species and waterbird / shorebird species; Fork-tailed Swift, White-throated Needletail, Yellow Wagtail, Rufous Fantail, Common Greenshank, Common Sandpiper, Curlew Sandpiper, Latham's Snipe, Pectoral Sandpiper, Satin Flycatcher, Sharp-tailed Sandpiper, Eastern Curlew and Osprey. The Glossy Ibis, not highlighted by the PMST, but with previous records identified nearby, may also occur in the inundation footprint.

An assessment of the likelihood of occurrence of these species and potential for significant impacts was undertaken (refer **Attachment 3 – Flora and Fauna Assessment**). As such, most of these species are either highly unlikely to occur or would very rarely use airspace over these footprints, given the lack of core and non-core habitat available (waterbodies, wetlands etc.). The majority of these species do not breed in Australia. Hence significant impacts to these species are considered unlikely.

Ecological Communities

The PMST highlighted six EPBC Act-listed threatened ecological communities with potential to occur within 10 km of the project area.

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions - Endangered
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia – Endangered
- Natural Grasslands of the Murray Valley Plains – Critically Endangered
- Weeping Myall Woodlands – Endangered
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered
- Seasonal Herbaceous Wetlands of the Lowland Plains – Critically Endangered

Whilst none are listed as specifically occurring within the Gunbower Forest Ramsar Ecological Character Description, primarily given exclusion of some terrestrial areas and timing of listing (Hale and Butcher, 2011), one of these communities is consistent with vegetation mapped and / or modelled within either the construction footprint or inundation area, has been highlighted in previous assessments (North Central CMA, 2012), and was identified during recent field surveys; Grey Box Grassy Woodlands and Derived Native Grasslands of South-eastern Australia. Approximately 1,300 hectares of this TEC is considered to occur within Gunbower Forest more broadly (North Central CMA, 2012), and a total of 2.5 hectares of this TEC was located within the construction footprint (primarily along access tracks) within Upper and Middle

Gunbower Forest (upstream Deep Creek) and 1.68 hectares is predicted to occur in the inundation area, Middle Gunbower Forest (downstream of Deep Creek) (R8, 2020b).

No FFG-listed vegetation communities were identified during the field assessment or have been considered to be present in previous assessments within the Gunbower Forest project area.

One FFG-listed vegetation community, Grey Box – Buloke Grassy Woodland Community was considered to potentially occur within the Grey Box woodland present in the Gunbower National Park project area. However this community was not found to be present, given there was an insufficient number and density of Buloke occurring within Grey Box Woodlands at the site and the ground layer was dominated by plants from the *Maireana* and *Chenopodium* genus rather than native grasses which are representative of the TEC criteria.

Fauna Communities

One FFG Act listed fauna community is present (Victorian Temperate Woodland Bird Community, VTWBC) throughout the project area, due to the presence of significant River Red Gum Forest and Black Box woodland with an abundance of tree hollows for nesting sites and fallen timber.

This community is defined by a group of 24 woodland dependent bird species, characteristically found in a range of woodland types, and over a broad geographic area. The geographic area is defined as the slopes and plains inland of the Great Dividing Range within Victoria. Riverine floodplains associated with the Murray River are not specifically included or excluded from the VTWBC description. Six bird species characteristic of the community have previous records or are predicted to occur in the project area. Five of the 24 bird species were recorded during R8 field assessments (R8, 2020b); Brown Treecreeper (*Climacteris picumnus victoriae*) and Jacky Winter (*Microeca fascinans*) were observed in high abundance, Grey-crowned Babbler (*Pomatostomus temporalis*), Diamond Firetail (*Stagonopleura guttata*) and Red-capped Robin (*Petroica goodenovii*) were observed at lower densities. The non-listed Western Gerygone (*Gerygone fusca*) was not recorded during R8 field assessments, but is predicted to occur within the project area based on known habitat preferences.

There is also one FFG listed fish community identified in the desktop assessment as being present (Lowlands Riverine Fish Community of Southern Murray-Darling Basin). This community is characteristic of the geographical area that defines its distribution (broadly defined as lowland river reaches and associated floodplains of the Murray River tributaries in Victoria that drain the northern slopes of the Great Dividing Range, together with the lowland section and floodplain of the Murray River upstream of the South Australian border), and by a selected suite of native fish taxa that is typical of and largely restricted to the area (refer R8, 2020h for further detail).

There is one Lower Murray River aquatic ecological community (NSW endangered ecological community). The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, as well as all their tributaries and branches (NSW DPI, 2007).

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.

Potentially threatening processes are listed in accordance with Section 10 of the *Flora and Fauna Guarantee (FFG) Act 1988*. Threatening processes that have the potential to be exacerbated by construction and/ or operation of the project include:

Construction

- Degradation of native riparian vegetation along Victorian rivers and streams

- Loss of hollow-bearing trees from Victorian native forests
- The spread of *Phytophthora cinnamomi* from infected sites into parks and reserves, including roadsides, under the control of a state or local government authority
- Increase in sediment input into Victorian rivers and streams due to human activities
- Input of toxic substances into Victorian rivers and streams
- Alteration to the natural flow regimes of rivers and streams
- Prevention of passage of aquatic biota as a result of the presence of instream structures.
- Infection of amphibians with Chytrid Fungus, resulting in chytridiomycosis.
- Invasion of native vegetation by 'environmental weeds'
- Loss of coarse woody debris from Victorian native forests and woodlands (flooded or removed from site – re-purpose).

The construction footprint will be reduced and minimized during the various phases of the project (see Section 8) from earlier assessment footprints to the current construction footprint to minimize areas where possible and avoid hollow-bearing trees. A qualified ecologist will be on-site to manage the removal of any fauna habitat and capture and translocate fauna observed within the construction area. It is still possible that hollow-bearing trees will be removed as part of the project, however the broader objective to inundate 704 hectares of riverine forest and wetland vegetation is likely to contribute to the condition of existing hollow-bearing trees and the development of future hollow-bearing trees in the longer term.

An Environmental Management Framework will be prepared as part of the project that will include measures such as vehicle hygiene protocols to mitigate the potential spread of weeds and *Phytophthora cinnamomi* and measures to minimise sedimentation inputs or toxic substances (for example, fuel) to waterways and to minimise impacts associated with any works occurring within waterways.

Operation

- Predation of native wildlife by the introduced Cat, *Felis catus,* introduced Red Fox *Vulpes Vulpes* or Feral Pigs (*Sus scrofa*)
- Soil degradation and reduction of biodiversity through browsing and competition by Feral Goats (*Capra hircus*)
- Alteration to the natural flow regimes of rivers and streams.

There is potential for the introduction of environmental water to lead to an increase in abundance of pest animals due to the associated increase in productivity. Some of the species such as feral cats, foxes and pigs could potentially prey on migratory waterbirds, woodland birds, small mammals, reptiles and frogs that may respond to the application of water to floodplains/wetlands. An accompanying pest animal management and control program would need to be implemented within the inundation area. This could involve Parks Victoria applying or expanding current pest control programs within the park to target these areas during inundation events.

The project aims to implement inundation regimes across middle and upper Gunbower Forest which will benefit both riverine and wetland species. The current inundation regimes have been significantly altered by river regulation and are not sufficient to meet the needs of the Gunbower National Park floodplain ecosystem. This project aims to meet the flow requirements of ecological values across the site.

Measures to manage these impacts are outlined in the 'mitigation' section below and also Part 2, Section 18 (Environmental management).

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.

Flora

Twenty six flora species were identified by VBA, PMST and recent studies as previously recorded or having potential to occur within 10 km of the project area. Species for which habitat was present or that had previously been located within the Gunbower National Park floodplain complex were targeted during the threatened flora surveys (R8, 2020b).

Six EPBC Act listed flora species are known to occur, or considered to possibly occur, in the project area. River Swamp Wallaby-grass (*Amphibromus fluitans*) was located during field assessments, and four others, Slender Darling-pea (*Swainsona murrayana*), Stiff Groundsel (*Senecio behrianus*) and Winged Peppercress (*Lepidium monoplocoides*) and Floodplain Rustyhood (*Pterostylis cheraphila*) are known to occur close to the project area in similar habitat. Suitable habitat for Ridged Water-milfoil (*Myriophyllum porcatum*) is also present within the inundation area. These species are not considered to be significantly impacted by either the construction works or proposed inundation. As flood responders, the species are likely to benefit from the restoration of a more natural inundation cycle. Under good conditions, River Swamp Wallaby-grass could be relatively widespread within the specific habitat (elevation / inundation) area it is associated. Winged Peppercress is likely to occur in areas exposed to periodic inundation under large inundation events and is associated with Black Box chenopod shrubland, which is widespread throughout Gunbower National Park. Floodplain Rustyhood and Ridge Water-milfoil are also likely to respond to a more natural inundation regime.

Eight FFG Act listed flora species are known to occur, or considered to possibly occur, in the project area. Umbrella Wattle (*Acacia oswaldii*) and Buloke (*Allocasuarina luehmannii*) were recorded in recent field assessments. One species, Wavy Marshwort (*Nymphoides crenata*) was previously recorded (Bennetts, 2014b; Biosis, 2014) and the Winged Peppercress, Stiff Groundsel, Floodplain Rustyhood and Ridged Water-milfoil (both also EPBC listed) have the potential to occur, as above. There are also previous records for the Slender Darling-pea (Seran BL&A 2018).

Eighteen species listed under the DELWP Advisory list of rare or threatened plants identified in searches of the VBA and PMST were considered as Possible to occur within the construction footprint. Two of these species, Umbrella Wattle listed above also under the FFG Act, and Long Eryngium (*Eryngium paludosum*) were identified in the construction footprint.

Whilst impacts to all of the listed and protected species was considered possible, impacts are not expected to be significant at a local population or species level and are primarily associated with vegetation clearance within a relatively small and defined footprint. All of the flora species are likely to benefit from a return to a more natural inundation regime and increase their areas of potential occupancy.

In addition, nine (9) flora species listed as under the FFG Act (already discussed) and nineteen (19) considered rare or threatened in Victoria (DELWP Advisory) may also occur within the Middle Gunbower Forest (downstream of Deep Creek) based on previous assessments and modelling of habitat. Their presence/likelihood of occurrence will be confirmed after surveys are undertaken in Spring 2020, and assessment as to whether the final design can avoid or minimise impacts. A full assessment of the likelihood of 26 potential threatened or listed species within the project area is provided in Appendix D and Appendix E

of **Attachment 3 – Flora and Fauna Assessment**. The location of threatened species identified during surveys at the site are also shown in Appendix A of **Attachment 3 – Flora and Fauna Assessment**.

Fauna

Of the 56 fauna species identified by VBA, PMST and recent studies as previously recorded or having potential to occur within 10 kilometres of the project area, 45 are considered to possibly occur within the construction footprint and / or inundation area. A full assessment of the likelihood of threatened or protected species within the project area is provided in Appendix D to G of **Attachment 3 – Flora and Fauna Assessment.**

Of the 45 threatened fauna species considered to possibly occur in the project area during construction and / or inundation, possible impacts are expected for nineteen species (2 mammals, 6 reptiles, 2 frogs, 8 fish and 1 invertebrate (crayfish)) have been assessed as possibly being impacted by the project. These potential impacts are not expected to be significant at a population or species level, with highlevel justifications for this determination provided in

Table 16 below. Species that are considered known or may occasionally occur in the area, and therefore have possible localised impacts include: South-eastern Long-eared Bat, Squirrel Glider, Woodland Blind Snake, Lace Monitor, Murray River Turtle, Bearded Dragon, Carpet Python, Broad-shelled Turtle, Growling Grass Frog, Murray Cod, Silver Perch, Murray-Darling Rainbow Fish, Unspecked Hardyhead, Golden Perch, Trout Cod, Southern Pygmy Perch (Murray-Darling lineage), Freshwater Catfish and Murray Crayfish. These species are all less mobile and less able to move away from the area during construction and may be impacted by localised activities such as vegetation clearance when they are roosting / resting or are in aquatic environments that would be impacted during construction.

There were also historical records for three other fish within 10 km of the project area; Macquarie Perch, Murray Hardyhead and Flat-headed Galaxias. However, these fish were considered unlikely in the project area and therefore unlikely to be impacted by the project **Attachment 3 – Flora and Fauna Assessment**. Note, Macquarie Perch was considered highly unlikely to be present.

It is recognised that there is potential for construction activities to have a localised impact to a number of fauna species due to the potential loss of habitat through vegetation removal including the removal of large trees. However, in the context of the broader Gunbower Forest (20,218 hectares), the vegetation removal within the construction footprint (a combined area of 19.6 hectares) represents small, isolated and discreet areas of habitat within an extensive area of potentially suitable, but largely marginal habitat for these species. The vegetation removal will not likely reduce the area of occupancy of any important populations of threatened fauna species, nor is it likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the threatened fauna species are likely to decline. The Gunbower Forest area does not represent core habitat or important populations for any of the threatened species listed in Table 16.

As such, potential construction impacts are not expected to be significant for the reasons listed above, and summarised below in Table 16, assuming the recommended mitigation measures are implemented (refer to Section 12 – Proposed Mitigation). Significant impacts from the operation of the project have also been assessed as unlikely, as fauna species are likely to benefit from environmental water when present or the improvement in habitat as a result of the operation of the project over the longer term.

Table 16: Threatened Fauna considered possible or known to occur in the project area

Common name *Scientific Name*	EPBC Act	FFG Act	DELWP Advisory	Potential Impact / Justification
Mammals				
South-eastern Long-eared Bat *Nyctophilus corbeni*	VU	L	en	Not recorded during bat surveys (GHD 2017), and there has been limited survey effort across the landscape for this species. However likely to occur along the Murray River, given presence of suitable habitat, dry woodland and shrubland communities. Note core population occurs in the Piliga Scrub of NSW. **Construction** **Impact Possible.** Localised impacts possible during large tree removal in construction footprint. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under the *Wildlife Act 1975*. **Inundation Area** **Impact Unlikely.** Species roosts in trees during day and forages on insects near water at dusk, suitable surrounding habitat widespread. No tree removal is expected within inundation area. Species likely to benefit from improved habitat condition as a result of the project.
Squirrel Glider *Petaurus norfolcensis*		L	en	Species not recorded during targeted surveys but may still occur in dry woodland and shrubland communities of project area. **Construction** **Impact Possible.** Localised impacts possible during large tree removal in construction footprint. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under the *Wildlife Act 1975*. **Inundation Area** **Impact Unlikely.** Species roosts in trees during day and forages at dusk, night, suitable surrounding habitat widespread. No tree removal is expected within inundation area. Species likely to benefit from improved habitat condition as a result of the project.
Birds				
Brolga *Antigone rubicunda*		L	vu	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Great Egret *Ardea alba*		L	vu	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area**

				Impact Unlikely. Species likely to benefit from improved habitat condition as a result of the project.
Plumed Egret *Ardea intermedia plumifera*		L	en	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Hardhead *Aythya australis*			vu	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Australasian Bittern *Botaurus poiciloptilus*	EN	L	en	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. Unlikely to adversely affect habitat critical for the species or reduce the species area of occupancy. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved potential habitat condition, extent and quality as a result of the project, potentially extending their area of occupancy by utilising the site.
Azure Kingfisher *Ceyx azureus*			nt	Many records within 10 km and suitable swamp forest habitat available throughout project area. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat from proposed vegetation clearance in comparison with available habitat within forest and surrounding area. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Whiskered Tern *Chlidonias hybrida*			nt	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Brown Treecreeper			nt	Species observed during field assessments, suitable foraging habitat present and widespread across project area. **Construction**

Climacteris picumnus				**Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat from proposed vegetation clearance. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Emu *Dromaius novaehollandiae*			nt	Species observed during field assessments, suitable foraging habitat present and widespread across project area. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential breeding habitat from proposed vegetation clearance in comparison with available habitat within forest and surrounding area. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Little Egret *Egretta garzetta*		L	en	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project t.
Grey Falcon *Falco hypoleucos*		L	en	Species is known from area, though rare and highly mobile. Suitable foraging habitat present within project area. **Construction** **Impact Unlikely.** Species wide ranging and suitable surrounding habitat widespread. Losses to relatively small area of habitat in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species wide ranging and suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Black Falcon *Falco subniger*		L	vu	Species is known to occur within the area, though rare and highly mobile. Suitable foraging habitat present within project area. **Construction** **Impact Unlikely.** Species highly mobile and wide ranging and suitable surrounding habitat widespread. Losses to relatively small area of habitat in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Painted Honeyeater *Grantiella picta*	VU	L	vu	No records, but suitable woodland foraging habitat present within project area. **Construction** **Impact Unlikely.** Species highly mobile and wide ranging, suitable surrounding habitat widespread. Losses to relatively small area of

				habitat in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide ranging, suitable surrounding habitat widespread. Species likely to benefit from improved potential habitat condition, extent and quality as a result of the project.
White-bellied Sea-Eagle *Haliaeetus leucogaster*		L	vu	Recent records and suitable foraging habitat present within project area. Preferre habitat includes coastal areas and large rivers for catching fish. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
White-throated Needletail *Hirundapus caudacutus*	VU, Mi	L	vu	Recent records and suitable foraging habitat present within project area. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of habitat in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Square-tailed Kite *Lophoictinia isura*		L	vu	Suitable foraging habitat present within project area. **Construction** **Impact Unlikely**. Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of habitat in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely**. Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Hooded Robin *Melanodryas cucullata*		L		Many recent records and suitable foraging habitat present within project area. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat from proposed vegetation clearance, in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Barking Owl *Ninox connivens*		L	en	Recent records and suitable foraging habitat present within project area.

				Construction **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat proposed from the removal of trees, in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Nankeen Night-Heron *Nycticorax caledonicus*			nt	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Pied Cormorant *Phalacrocorax varius*			nt	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Royal Spoonbill *Platalea regia*			nt	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Glossy Ibis *Plegadis falcinellus*	Mi		nt	Records within 10 km of project area, recorded at nearby Guttrum-Benwell in 2019 surveys, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Superb Parrot *Polytelis swainsonii*	VU	L	en	One record within 10 km of project area. Suitable foraging and nesting habitat present within project area, however breeding is known to occur in three main areas (south west slopes of NSW, Murrumbidgee River NSW, east of Barmah and Millewa State Forest to Taylors Bridge NSW / Vic) in large River Red Gums. **Construction**

				Impact Unlikely. Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging habitat and potential nesting habitat from proposed removal of large trees, in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved potential habitat condition, quality and extent as a result of the project
Grey-crowned Babbler *Pomatostomus temporalis*		L	en	Species recorded during field assessment and suitable foraging habitat present within construction footprint. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat from proposed vegetation clearance, in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Australian Painted Snipe *Rostratula australis*	EN	L	cr	Records within 10 km of project area, and suitable wetland habitat present in the inundation area. **Construction** **Impact Unlikely.** Limited suitable wetland habitat present within construction footprint. Unlikely to adversely affect habitat critical for the species or reduce the species area of occupancy. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved potential habitat condition, quality and extent as a result of the project.
Diamond Firetail *Stagonopleura guttata*		L	nt	Species recorded during field assessment and suitable foraging habitat present within construction footprint. **Construction** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Losses to relatively small area of foraging and potential nesting habitat from proposed vegetation clearance, in comparison with available habitat within forest and surrounding areas. **Inundation Area** **Impact Unlikely.** Species highly mobile and wide-ranging, suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Reptiles				
Woodland Blind Snake *Anilios proximus*			nt	Records within 10 km and suitable Black Box/ Red Gum woodland habitat within the project area. **Construction** **Impact Possible.** Localised impacts possible during large tree removal and sub-surface impacts in construction footprint. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under the *Wildlife Act 1975*.

				Inundation Area **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Lace Monitor *Varanus varius*			en	Species recorded incidentally and on arboreal cameras in project area. **Construction** **Impact Possible.** Localised impacts possible during large tree removal and sub-surface impacts in construction footprint. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under the *Wildlife Act 1975*. **Inundation Area** **Impact Unlikely**. No tree removal is expected within inundation area. Species likely to benefit from improved habitat condition as a result of the project.
Murray River Turtle *Emydura macquarii*			vu	Species is known to reside in permanent, deep water limited to the Murray River and surrounding Gunbower Lagoons outside the project area (Howard et al. 2013). Species may utilise river banks for nesting. **Construction** **Impact Possible.** Localised impacts possible, consideration of coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. The plan would consider timing of works to avoid breeding season (spring to summer) where turtles may nest along river banks. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Bearded Dragon *Pogona barbata*			vu	Records within 10 km, wide ranging and suitable woodland habitat within the project area. **Construction** **Impact Possible.** Localised impacts possible during large tree removal and sub-surface impacts in construction footprint. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under the *Wildlife Act 1975*. **Inundation Area** **Impact Unlikely**. No tree removal is expected within inundation area. Species likely to benefit from improved habitat condition as a result of the project.
Carpet Python *Morelia spilota metcalfei*		L	en	No records, but suitable habitat (riparian forest, inland or coastal) in area. **Construction** **Impact Possible.** Localised impacts possible, consideration of finalised footprint required. Direct impacts, if present, through habitat clearance, removal of hollow-bearing trees will contribute to incremental loss of habitat, however suitable habitat is widespread. A fauna management plan (as part of the CEMP) would be developed for all large tree removal activities as required under *the Wildlife Act 1975.* **Inundation Area**

				Impact Unlikely. Suitable surrounding habitat widespread. Species likely to benefit from improved habitat condition as a result of the project.
Broad-shelled Turtle *Chelodina expansa*		L	en	Known to reside in permanent, deep water limited to the Murray River and surrounding Gunbower Lagoons outside the project area (Howard et al. 2013). Species may utilise river banks for nesting. **Construction** **Impact Possible.** Localised impacts possible, consideration of coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. The plan would consider timing of works to avoid breeding season (spring to summer) where turtles may nest along river banks. **Inundation Area** **Impact Unlikely.** Species likely to benefit from improved habitat condition as a result of the project.
Amphibian				
Sloane's Froglet *Crinia sloanei*	EN			Existing records in project area and suitable habitat present in Cameron's Creek and Deep Creek in construction footprint, and wetland habitat in inundation area. **Construction** **Impact Possible.** Localised impact possible in aquatic habitats. A construction specific aquatic fauna management plan would be developed for all works around waterways. Targeted surveys to be undertaken in winter/spring 2020. **Inundation Area** **Impact Unlikely**. Species almost certain to benefit directly from increasing the potential area of habitat when environmental water is present, and indirectly from improved habitat condition as a result of the project.
Growling Grass Frog *Litoria raniformis*	VU	L	en	No recent records exist in project area, but suitable habitat present in Cameron's Creek and Deep Creek in construction footprint, and suitable aquatic habitat along waterways. **Construction** **Impact Possible**. Localised impact possible in aquatic habitats. A construction specific aquatic fauna management plan would be developed for all works around waterways. Targeted surveys to be undertaken in winter/spring 2020, noting that the calling / breeding period is from August to February (DEWHA, 2010). **Inundation Area** **Impact Unlikely**. Species almost certain to benefit directly from increasing the potential area of habitat when environmental water is present, and indirectly from improved habitat condition as a result of the project.
Fish				
Murray Cod *Maccullochella peelii peelii*	VU	L	vu	Murray Cod is a main channel specialist that occurs naturally in the waterways of the Murray-Darling Basin. Suitable habitat within the project area is likely to be limited to the Murray River and Gunbower Creek where the species has been frequently recorded, including in

				the Torrumbarry Weir Pool (ARI, 2020b). Presence in the Murray River and National Channel at the project site should be assumed. **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets. A staged drawdown regime will likely be implemented to provide cues for native fish to exit the floodplain during a hybrid event and release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low.
Silver Perch *Bidyanus bidyanus*	CR	L	vu	The species is a main-channel specialist (ARI, 2020b) with suitable habitat limited to the Murray River. Species recorded in low abundances during annual monitoring between 2008-2018 of the Murray River in Gunbower Forest (Bloink et al. 2018). **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets. During floodplain drawdown following hybrid inundation events, fish will also be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Murray-Darling Rainbowfish *Melanotaenia fluviatilis*		L	vu	Species recorded during recent surveys of Cameron's Creek and Black Charlie Lagoon (Sharp 2014, 2015) and during annual monitoring across Gunbower Forest between 2008 - 2018 (Mallen-Cooper et al. 2014; Bloink et al. 2018). **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain

				due to fish screens being included on the pump inlets. During floodplain drawdown following hybrid inundation events, fish will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Unspecked Hardyhead *Craterocephalus stercusmuscarum fulvus*		L		Species recorded during recent surveys of Cameron's Creek and Black Charlie Lagoon (Sharp 2014, 2015) and during annual monitoring across Gunbower Forest between 2008-2018 (Bloink et al. 2018). Preferred habitat is margins of slow flowing rivers, backwaters and wetlands. **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets. During floodplain drawdown following hybrid inundation events, fish which have entered the floodplain will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Golden Perch *Macquaria ambigua*			nt	The species is a main-channel specialist with suitable habitat limited to Gunbower Creek (Mallen-Cooper et. al. 2014) and the Murray River, including the Torrumbarry Weir Pool (ARI 2020b). Has been frequently recorded from the Murray River upstream and downstream of the project area. May enter forest areas during inundation events, but forest wetlands do not provide suitable long term habitat. **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets. During floodplain drawdown following hybrid inundation events, fish which have entered the floodplain will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also

				be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Trout Cod *Maccullochella macquariensis*	EN	L	cr	A riverine species, inhabiting a variety of flowing waters in the mid to upper reaches of rivers and streams with cover in the form of woody debris or boulders. Has been detected in the Murray River downstream of Yarrawonga Weir, recorded in Gunbower Creek (Mallen-Cooper et. al. 2014) and in the Torrumbarry Weir Pool (ARI, 2020b). **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets. During floodplain drawdown following hybrid inundation events, fish which have entered the floodplain will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Freshwater Catfish *Tandanus tandanus*		L	en	Has been recorded in Gunbower Creek and Lagoons in the past 10 years (Mallen-Cooper et. al., 2014, Bloink et al. 2018). Preferred habitat is slow flowing rivers, backwaters and vegetated wetlands The Murray River in vicinity of project area has also been mapped as possible habitat by NSW Fisheries, but there are no records from annual TLM monitoring within the Murray River sites. **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets, and there are limited records for this species at the site in general. During floodplain drawdown following hybrid inundation events, fish which have entered the floodplain will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Southern Pygmy Perch			vu	Preferred habitat is slow flowing rivers, backwaters and vegetated wetlands. Has been recorded from Gunbower Creek wetlands in the

(Murray-Darling lineage) ***Nannoperca australis***				past 30 years, but not since 1997 (Mallen-Cooper et. al., 2014; Bloink et al. 2018) and is Considered locally extinct in the Gunbower region (Sharp 2015). **Construction** **Impact Possible.** Localised impacts possible, coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint must consider aquatic fauna. A construction specific aquatic fauna management plan would be developed for all works around waterways. **Inundation Area** **Impact Unlikely.** As the site will receive water via pumping during managed inundation, it is unlikely that operation of the project will impact the species as there is a low likelihood that large numbers of fish will enter the floodplain due to fish screens being included on the pump inlets, and there are limited records for this species at the site in general. During floodplain drawdown following hybrid inundation events, fish which have entered the floodplain will be able to exit the floodplain via outlet regulators, which will provide uninterrupted fish passage. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. If present, fish would also be able to retreat to permanent water bodies and waterways in Upper Gunbower.
Invertebrate				
Murray Crayfish *Euastacus armatus*		L		Species seems to be tolerant of a wide variety of habitats, including deep flowing water proximal to clay banks, wood or rock cover, as well as tributary streams and shallow riparian habitats (for smaller individuals) (Fisheries Scientific Committee 2013). The Murray River in vicinity of project area has been mapped as possible habitat by NSW Fisheries (NSW DPI (accessed 2020). It is possible that individuals are present in the Murray River within and adjacent to the Project Area. **Construction** **Impact Possible**. Localised impacts possible, consideration of coffer dam construction, dewatering works, and any potential for sediment/ contaminant run-off into wet areas from construction footprint will consider aquatic fauna. A construction specific aquatic fauna management plan will be developed for all works around waterways. **Inundation Area** **Impact Possible.** A staged and managed drawdown regime will be implemented to monitor water quality of return flows and provide cues for native fish and invertebrates to exit the wetlands to prevent stranding. Release rates of return flows enable suitable mixing to occur with the Murray River if water quality in return water is low. There is an overall assessment of low likelihood of impact to Murray Crayfish during the operation phase of the project.

Key: L – Listed under FFG Act; EN / en – Endangered under EPBC Act / DELWP Advisory List; VU / vu – Vulnerable under EPBC Act / DELWP Advisory List; CR / cr – Critically Endangered under EPBC Act / DELWP Advisory List; r – Rare under DELWP Advisory List; nt – Near Threatened under DELWP Advisory List.

No EPBC listed fauna species were recorded during targeted surveys in 2019 or in previous assessments of the project area (R8, 2020b).

Three fish species listed under both the EPBC Act and FFG Act, Silver Perch (*Bidyanus bidyanus*), Trout cod (*Maccullochella macquariensis*) and Murray Cod (*Maccullochella peelii*) and one fish species under the DELWP Advisory List for threatened flora, Golden Perch (*Macquaria ambigua*) have the potential to be

impacted by construction have the potential to be impacted by construction. These species are larger bodied fish and main channel specialists, preferring deeper water habitats such as the Murray River alongside the project area. Construction impacts to these threatened species include loss of habitat and barriers to movement during construction. The use of partial coffer dams that do not extend across the river will ensure fish passage is maintained, and sediment and water quality impacts associated with construction will be managed through a Construction Environmental Management Plan. Significant impacts to these species are considered unlikely provided the recommended mitigation measures are implemented (refer to Section 12 – Proposed Mitigation).

Other threatened small-bodied fish, Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*), Southern Pygmy Perch (Murray-Darling lineage) (*Nannoperca australis*), Murray-Darling rainbowfish (*Melanotaenia fluviatilis*) and Freshwater catfish (*Tandanus tandanus*) are wetland/floodplain specialists, given their preference for slow-flowing and still waters, and are unlikely to be impacted from construction as construction activities are limited to floodplain areas that are not critical fish habitat and will be undertaken during dry conditions when no aquatic biota would be present on the floodplain. There is still potential for mobilisation of sediments that may discharge into wetland habitats during rainfall events, however these will be managed under general sediment control measures in the Construction Environmental Management Plan. The Macquarie Perch, Murray Hardyhead and Flat-headed Galaxias are also unlikely to be impacted from construction due to the species not being recorded in the region for many decades.

There is the potential for threatened fish species to be impacted by operation of the project due to entrainment of fish in pump infrastructure, exposure to poor water quality during inundation events, stranding during managed drawdown events and exposure to poor water quality in return flows to the Murray River during managed drawdown, and changes to Murray River flows as a result of pump diversions. Mitigation measures are included in the design, construction and operation of the project to manage potential impacts to aquatic fauna. These are considered to reduce risks to low for the operation of the project. These measures include design of all pump stations with fish screens on screens on the pipe inlets with a 2 mm hole aperture to minimise likelihood of entrainment of fish, management of inundation and drawdown to minimise the likelihood of fish stranding on the floodplain during hybrid events by providing staged drawdown cues and opportunities for fish to exit the floodplain during managed drawdown, and management of the timing of inundation and drawdown to minimise risks of blackwater and enable entrainment of organic matter during natural inundation events and to enable ensure appropriate dilution of return flows if low dissolved oxygen is evident. These operational measures will be documented in the Operating Plan. The project also has the potential to improve the productivity of the Murray River which will benefit native fish species such as Murray Cod, Trout Cod, Golden Perch and Silver Perch. As the floodplain is inundated, the surface and immediate subsurface floodwaters accumulate carbon in various forms from organic matter and primary productivity within the floodplain. When that water is returned to the Murray River from the floodplain, it transports some volume of carbon with it (ARI, 2020).

Two EPBC Act listed species, Sloane's Froglet (*Crinia sloanei*) and Growling Grass Frog (*Litoria raniformis*) have not been recently recorded in the project area. The Growling Grass Frog was last recorded within Gunbower National Park in 1961 and has not been recorded during previous surveys of the project area (Biosis, 2014; GHD, 2017). Sloane's Froglet has not been recorded since 1993, but was only listed in 2019. Given the potential habitat and lack of species-specific survey effort, targeted surveys in late winter (Sloane's Froglet) and early summer (Growling Grass Frog) in 2020 are proposed to assess habitat quality and determine presence/absence for the species within areas of the construction footprint. Despite the long absence of records of the Growling Grass Frog and Sloane's Froglet, the presence of seasonally-suitable habitat, and the ability of these species to recolonise areas suggest that they have potential to occur in the area, and a reintroduction of more suitable inundation regimes may help facilitate this. Impacts to Growling Grass Frog and Sloane's Froglet are unlikely for the majority of the construction footprint, but localised impacts are possible at Cameron's Creek, Baggott's Creek and Deep Creek. Based on assessment against the EPBC significant impact criteria, significant populations are not expected to be impacted, and suitable habitat is surrounding and widespread. Coffer dam construction, dewatering works, and any potential for

sediment/ contaminant run-off into wet areas from construction footprint will be considered in development of CEMPs. Measures such as pre-clearance fauna surveys would be implemented to further reduce impacts. A construction specific aquatic fauna management plan would be developed for all works around waterways.

Whilst direct impacts from works are not likely for the Growling Grass Frog and Sloane's Froglet, indirect impacts from the proposed works may include the introduction or spread of Chytrid Fungus Transmission of the disease from vehicle is unlikely, if vehicles traverse between sites and result in water and mud being transferred to/from other water bodies, hygiene protocols for Chytrid Fungus will be included in a site specific EMP (Murray et al 2011). Additionally, if the handling of frogs is required during the proposed works (i.e. during salvage), a suitably qualified and experienced ecologist will be engaged, and employ hygiene protocols identified in Murray et al (2011). These species are not considered likely to be significantly impacted by the proposed construction activities or inundation and reinstatement of a more natural inundation regime is likely to benefit these species.

The EPBC listed South-eastern Long-eared Bat (*Nyctophilus corbeni*) has the potential to occur within the Gunbower National Park. The species roosts in large, hollow-bearing trees with deep fissures, but has not been recorded in the project area including during bat surveys in the construction footprint in 2017 (GHD 2017). No significant impacts are expected for South-eastern Long-eared Bat, as a vulnerable listed species, particularly given the core 'important population' for the species occurs in the Piliga Scrub in NSW. Large hollow bearing trees within the project area provide potential habitat for this species as well as other species (FFG listed and / or DEWLP advisory) such as the Squirrel Glider, Carpet Python, Lace Monitor and Bearded Dragon. These species may therefore be impacted during the construction phase by large tree removal and ground disturbance. To minimise impacts to these species the removal of very large trees (DBH > 150), which are more likely to provide habitat for these species, will be avoided wherever possible. During the removal of large hollow-bearing trees, hollow-salvage will be retained as potential habitat for these species and provide some mitigation against the loss of hollow-bearing trees. A fauna management plan (as part of the CEMP) will be developed for all large tree removal activities. An on-site ecologist with Management Authorisation under the *Wildlife Act 1975* will be present during large tree removal and construction works. No Significant impacts are expected for South-eastern Long-eared Bat, particularly given the core 'important population' for the species occurs in the western slopes and plains in NSW.

Two EPBC listed threatened wetland birds, the Australasian Bittern (*Botaurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*), are considered to have the potential to utilise wetland habitats within the Gunbower National Park. The Bittern has not been recorded since 1993 and the Painted Snipe has not been recorded within the last 50 years (Hale and Butcher 2011). Both species are likely to benefit from environmental watering and a return to natural inundation within the project area. Significant impacts to these species are considered unlikely, given there are limited records, no known important populations at the site and impacts to the associated aquatic EVCs are expected to be negligible. In addition, the species are highly mobile and would be able to move away from the area during construction.

Three other EPBC listed threatened terrestrial bird species, Painted Honeyeater (*Grantiella picta*), White-throated Needletail (*Hirundapus caudacutus*) and the Superb Parrot (*Polytelis swainsonii*) are not considered to frequently visit the Gunbower National Park, with the latter the only one with a single VBA record from 1996. Significant impacts to these species are considered unlikely, with limited records and core populations not known from the site. Where they may infrequently utilise the project area, they are highly mobile species and able to move away from the site during construction. These species are expected to benefit from environmental watering via increased availability of potential habitat condition and extent.

Impacts on the remaining EPBC Act listed species identified as possibly occurring within the construction or inundation area were either considered to be unlikely or the species are expected to benefit indirectly from improved habitat condition following environmental watering.

Sixteen FFG Act listed species (not listed under the EPBC Act), are identified in

Table 16 as potentially occurring at the site. However, impacts to these species are likely to be localised and generally the species are highly mobile wide ranging species and suitable habitat is widespread. Improvements to habitat condition and extent as a result of the project are also likely to benefit these species. In addition, impacts to the FFG listed Murray Crayfish are possible, however it is considered that any potential impacts will migitated with the Aquatic Fauna Management Plan (refer Section 12 – Proposed Mitigation Plan).

The Broad-shelled Turtle and Murray River Turtle (both DEWLP advisory species) may be impacted from localised impacts as a result of habitat removal and construction works along river banks. Potential nesting habitat is unlikely to be impacted, as both species of turtle prefer open, sandy environments with lower canopy cover, which have not been identified within the construction footprint. Significant impacts to these species are considered unlikely due to the limited construction areas along the Murray River and provided the recommended mitigation measures are implemented (refer to Section 12 – Proposed Mitigation). A construction specific aquatic fauna management plan will be developed (as part of a CEMP) for all works around waterways, which would consider coffer dam construction, dewatering works and any potential for sediment contaminant run-off. It would also consider the timing of works to where practicable avoid the breeding season of turtles (spring to summer) where turtles may nest along river banks.

Further discussion of potential impacts on listed threatened species identified as known to occur or possibly occurring in the project area is provided in **Attachment 3 – Flora and fauna Assessment**. This includes an assessment against the EPBC Act significant impact criteria for each of the EPBC Act listed species identified in

Table 16.

Migratory species

Thirteen migratory species were identified as having the potential to occur within 10 km of the project area. One additional species (Glossy Ibis) not highlighted by the PMST, but had previous records, and was recorded as present during the recent field surveys of nearby Guttrum and Benwell Forest. Most of these species are considered either highly unlikely to occur (e.g. Eastern Curlew) or would very rarely use airspace over the project area (e.g. Fork-tailed Swift, White-throated Needletail), as evidenced by a lack of recent records and / or lack of suitable core habitat within the project area. It is considered highly unlikely that the construction footprint supports habitat that would be considered important for migratory species foraging or breeding activity, particularly given most breed overseas or support an ecologically significant proportion of a population of migratory species. An assessment of the EPBC Act significant impact criteria for the fourteen listed Migratory species in relation to potential impacts from the proposed works on these species is provided in Appendix R of **Attachment 3 - Flora and Fauna Assessment** and found that it is highly unlikely that the construction footprint supports habitat that would be considered important for migratory species foraging or breeding activity or support an ecologically significant proportion of a population of migratory species, hence no significant impacts to any of these species are anticipated.

Reinstating historical environmental flows within the Gunbower National Park floodplain complex will improve the quality of habitat present, and the frequency of wetland habitat available. Such enhancements correspond to increased productivity of floodplain vegetation communities, increased vegetation diversity and structure from more dominant drought-tolerant species and increase the overall health and integrity of the area. This will likely improve breeding, foraging and refuge resources for highly mobile listed Migratory species, that have potential to utilise habitat in the area (for example, Glossy Ibis, Curlew Sandpiper, Sharp-tailed Sandpiper, Common Sandpiper, Common Greenshank, Pectoral Sandpiper, Latham's Snipe and Osprey) (R8, 2020b) and other resident wetland-dependant bird species. Noting that most of the shorebird species breed internationally, also use coastal habitats and only use inland freshwater refuge areas for short periods of the year, when water is present.

Ecological communities

One EPBC Act listed Threatened Ecological Community (TEC), Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia was identified within the construction footprint (primarily along access tracks) within Upper and Middle Gunbower Forest (upstream Deep Creek). Approximately 1,300 hectares of this TEC is estimated to occur within the Gunbower Forest (North Central CMA, 2012), while a total of 2.50 hectares of this TEC was identified during surveys in the construction footprint in Upper and Middle Gunbower Forest (upstream) and an additional 1.68 hectares is predicted to occur in Middle Gunbower Forest (downstream of Deep Creek) based on EVC Plains Woodland mapping (Bennetts 2014a). The proposed works will likely result in the permanent loss of 1.71 hectares of this TEC in the development footprint (of which 1.34 hectares is required to be confirmed through field assessment). Approximately 2.47 hectares identified along access tracks will be avoided by restricting vehicle access to tracks and limiting disturbance to lopping overhanging vegetation to allow access for larger vehicles. Though the project will result in the reduction of extent this TEC, given the minimal area of physical removal of the community in the context of broader Gunbower Forest that supports significant intact areas of the TEC it is not considered that the loss 1.71 ha of Grey Box Grassy Woodland is notable in extent of the community or will have a long term impact on the survival of the community.

No FFG Act listed flora communities have been identified in the project area or are likely to be impacted by the construction or operation of the project.

One FFG Act listed fauna community (Victorian Temperate Woodland Bird Community (VTWBC) is present in project area. Six bird species characteristic of the VTWBC have been identified as potentially occurring in the project area in the Flora and Fauna Assessment (R8, 2020b). Bird species of this FFG-listed fauna community are highly mobile and impacts as a result of the project are expected to be negligible in the short-term to species of these communities given the large expanse of surrounding intact habitat. The project is unlikely to impact habitat connectivity or remove important components of the community. In the long-term, the proposed inundation of floodplain and wetland habitats however, is likely to provide important future benefits to the community particularly under climate change scenarios of longer, dryer conditions.

Is mitigation of potential effects on indigenous flora and fauna proposed?

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

Efforts have been made throughout the planning and design phases for the project to avoid and minimise impacts to ecological values, including native vegetation and fauna habitat, threatened flora, fauna and communities. All areas of native vegetation that are proposed to be impacted are adjacent to existing access tracks and other areas of previous disturbance, and represent inferior areas of habitat to those which surround them. Previous disturbance in these areas have resulted in soil compaction, weed invasion (particularly at the outer edges of the forest near surrounding agriculture land), which has reduced the understorey quality and habitat for threatened flora. From a landscape perspective, the proposed construction footprints represent a small area within a much larger intact area of high quality native vegetation outside the construction footprint.

The following measures are proposed to be implemented during the further design, construction and operation of the project:

Design

The following mitigation measures have been implemented during the design phase to minimise and mitigate impacts to threatened flora and fauna identified in previous ecological surveys within the construction footprint (Biosis, 2014; Sharpe, 2014, 2015; GHD, 2017; R8, 2020b):

- Prioritise the avoidance of areas mapped as the EPBC listed threatened ecological community Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (Appendix M of **Attachment 3 – Flora and Fauna Assessment**, and following

field assessment of Middle Gunbower Forest (downstream Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower in spring 2020).

- Siting of proposed structures primarily along or immediately adjacent to existing access tracks and other previously disturbed areas.
- Design project infrastructure to enable fish migration and manipulation to provide fish exit cues.
- Design of pump stations to provide appropriately sized fish screens on inlet pipes.
- Avoid where possible mapped rare and threatened flora species.
- Micro-aligning construction footprint to avoid impacting hollow-bearing trees to reduce impacts to hollow-dependent fauna (including threatened species and species within the FFG Act Listed community, VTWBC).
- Refinement of the design and construction methods to minimise the construction footprint (including access track and laydown areas).
- Specific recommendations to further avoid and minimise impacts to EPBC and / or FFG Act-listed flora species identified within the Gunbower National Park project area are outlined below:
    - River Swamp Wallaby-grass (*Amphibromus fluitans*) (EPBC / FFG listed) was recorded in the area of investigation in the far western extent of the Baggot's creek overflow in Upper Gunbower Forest, approximately 1.75 km from the nearest construction area. As the individuals recorded during field assessment in 2019 were not located close to the revised construction footprint, the project is not expected to result in a significant impact to this species. Further surveys are proposed for Middle Gunbower (downstream of Deep Creek) to confirm the presence or absence of this species and three other potential EPBC listed species Winged Peppercress (*Lepidium monoplocoides*), Slender Darling-pea (*Swainsona murrayana*) and Stiff Groundsel (*Senecio behrianus*).
    - Umbrella Wattle (*Acacia oswaldii*) (FFG listed) individuals were recorded within the construction footprint, in area of investigation. Two individuals recorded along the access track close to the Cameron's Creek Mid Creek regulator. It should be possible to avoid their removal during construction with individual no-go flagging.
    - Buloke (*Allocasuarina luehmannii*) (FFG listed) was located within the area of investigation, but not within the construction footprint. Wavy Marshwort (*Nymphoides crenata*) also has potential to occur.

Construction

The following mitigation measures would be implemented to minimise and avoid impacts upon the identified threatened flora, fauna and community values:

- Follow the avoid, minimise and offset protocol in Guidelines for the removal, destruction or lopping of native vegetation (DELWP 2017) for determining the construction works footprint at each site (i.e. make every effort to avoid threatened flora species loss as a high priority).
- Areas of remnant native vegetation to be retained are to be delineated (temporary) from those areas to be removed as 'no-go zones', to avoid encroachment into areas of retained vegetation.
- Use existing disturbed areas or areas of non-native vegetation for lay-downs and stockpiling where possible.
- All vehicles and plant must only operate on existing tracks and in areas marked as parking areas or construction zones.
- Manage potential impacts to tree root zones during construction.

- For the protection of threatened flora:
  - Species listed under the FFG Act and EPBC Act are not permitted to be removed, are to be fenced off as no-go zones prior to construction commencing
  - Fencing is to be checked on a weekly basis and the population monitored on a monthly basis
  - All staff onsite will be made aware through inductions and/ or signage of the presence of threatened species and how to identify the species.
- If any threatened flora species additional to those already identified in site plans (i.e. listed as threatened under the EPBC Act or the FFG Act) are found within the construction area, the project Ecologist is to be notified. The number and location of individuals is to be recorded and DELWP is to be advised.
- Manage the removal of hollow-bearing trees within the construction footprint (if required, based on final footprints and potential impacts to tree root zones from track establishment, set down areas) where construction may impact habitat trees of native fauna, particularly EPBC Act and/or FFG Act listed fauna species and communities:
  - Avoiding the breeding season of hollow-dependant species is recommended, however where this is not practical an assessment must include surveys undertaken by a suitably qualified ecologist of the hollow-bearing trees being removed during the breeding season. The survey should also include other native hollow-dependent fauna. A protocol will be developed prior to/during construction.
  - Where clearing is proposed outside the breeding season, complete pre-clearance surveys for any remnant hollow-bearing trees to be removed. These trees could harbour one or more species of native hollow-dependent fauna. Pre-clearance surveys will be conducted prior to (within 24 hours) of the hollow-bearing trees being removed. In some instances, DELWP will need to be contacted. Where nocturnal wildlife can be removed, they will be kept in cages and released at dusk. If fauna are located within hollows, or are nesting in a tree the onsite ecologist will follow the Flora and Fauna Management Plan.
- For the protection of fish species:
  - Use only partial coffer dams to isolate small areas of back from construction works
  - Relocate any habitat within works areas to the same river reach and adoption of sediment control and accidental spill measures.
  - If the capture, handling or translocation of fish is required during construction (e.g. dewatering work sites) or operation of the project, persons undertaking these activities will need to hold the appropriate permit or licence under the *Fisheries Act 1995*. Any capture of fish must be carried out by a qualified aquatic ecologist.
- An initial briefing of construction works crews by a qualified ecologist and subsequent planning of safe work distances and establishment of each site.
- Manage the impact of noise and light pollution for fauna during construction. Where night-time works are unavoidable, measures would be implemented to limit the impact to nocturnal fauna. Measure would include:
  - Directional lights to avoid unnecessary light split across a broader area than required.
  - Light wavelengths selected (yellow/orange LED) to avoid insect attraction, and therefore reducing indirect impacts to bat and nocturnal bird behaviour.
  - Easing of start-ups, where possible, to prevent animal startle.
  - Works undertaken away from known nesting areas or undertaken outside of breeding season.

- Allotting periods of reprieve where noise is shutdown for an allotted timeframe.
- Avoiding periods of high insect/bird/bat activity so as to minimise disturbance to faunal communication
- Fencing areas to provide exclusion zones.
- Ensure areas of quiet remain in connected/adjacent habitat that can act as a refuge while other areas are subject to higher temporary noise levels.
- Avoid where possible equipment which emit noise at known animal communication frequencies (generally higher frequencies above 500Hz).

- If the capture, handling or translocation of fish is required during construction (e.g. dewatering work sites) or operation of the project, persons undertaking these activities will need to hold the appropriate permit or license under the *Fisheries Act 1995*. Any capture of fish must be carried out by a qualified aquatic ecologist.
- Standard vehicle hygiene measures are to be implemented to prevent the spread and introduction of weed species, particularly the weeds of national significance and noxious weeds listed under the Catchment and Land Protection Act 1994 (CaLP Act), and to prevent the spread or transmission of Chytrid Fungus as per Murray et al (2011).
- Develop and implement a Construction Environmental Management Plan (CEMP) for the construction phase. This CEMP should provide appropriate measures to avoid or minimise indirect impacts such as erosion, sedimentation and the accidental spill of oils or other chemicals. It would also provide a protocol for minimising impacts in ecologically sensitive areas. The CEMP should be audited during and following the construction process to check that works have been conducted appropriately.
- Develop and implement a Flora and Fauna Management Plan as part of the CEMP that contains requirements, including those listed in this section of the referral, to avoid, mitigate and manage impacts to flora and fauna values and particularly threatened species and describing the habitat preclearance and clearance process.
- Develop and implement an Aquatic Fauna Management Plan as part of the CEMP to manage impacts to aquatic values – with emphasis on threatened fish species that may be present in vicinity of construction sites. Any construction activities that could lead to entrapment of fauna or temporary loss of habitat (e.g. due to the use of coffer dams and dewatering) will be considered.
- On completion of works, temporary construction areas are to be rehabilitated to the satisfaction of Parks Victoria or the relevant landowner/manager. Site rehabilitation measures may include:
  - Setting aside topsoil to reinstate when works are complete and compacting to original levels
  - If native vegetation must be removed, re-spreading of stored topsoil should occur, followed by monitoring to assess germination in the following year
  - Appropriate weed control measures at the site following the works
  - If the site is not naturally recolonised by locally indigenous species, planting of locally indigenous species appropriate to that particular position in the landscape may be undertaken in the following year
  - Ground debris that is temporarily removed to allow construction activities, is to be reinstated

Operation

The following mitigation measures are recommended to minimise and avoid impacts upon the identified threatened flora, fauna and community values. These measures are general across the inundation area and are not site specific.

- Implement complementary measures to maximise the ecological benefits of environmental watering and assist in achieving project objectives. Measures will include pest animal and plant management and active regeneration and are further discussed in Section 18 Environmental Management. This will require collaboration with DELWP and Parks Victoria and the expansion of current programs (e.g. pest control programs) within the forests and consistent with Parks Victoria River Red Gum Conservation Action Plan.
- Timing water delivery to promote native flora species, and to minimise growth, germination and seed set (e.g. drown seedlings) of pest flora species.
- Management of inundation and drawdown to minimise the likelihood of fish stranding on the floodplain by providing opportunities for fish movement during managed drawdown (e.g. development of fish exit strategy, maintenance of fish screens).
- Implement inundation regimes and mitigation measures with consideration to the recommendations of the Fish Management Plan for Upper Gunbower Forest (ARI, 2020b) to enhance outcomes for threatened fish species.
- Timing of inundation and drawdown to minimise risks of the blackwater and to provide appropriate dilution of return flows if hypoxic blackwater is evident.

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 Gunbower National Park Floodplain Restoration Project would inundate 704 hectares (247 hectares at Upper Forrest and 457 hectares at Middle Forest) of floodplain at a design water level of between 83.0m AHD and 85.0 m AHD across the three different areas of the forest; Upper Gunbower Forest, Middle Gunbower Forest (upstream Deep Creek) and Middle Gunbower Forest (downstream Deep Creek).

Water would be sourced from existing environmental water entitlements via the Victorian Environmental Water Holder (VEWH). Water use is expected to vary from year to year depending on the environmental water requirements, inundation history and water availability. The volumes of water required to fill Gunbower Forest National Park floodplains, returned flows to the River and total net volume of water used is summarised by **Table 17**.

Table 17: Estimated water use under the proposed operating scenarios – fill and maintenance flows (source: VMFRP, June 2020b)

Scenario	Pumped volume (ML) under the proposed operating scenarios	Gravity volume (ML)	Return flow to Murray River (ML)	Net volume used (ML)
Upper Gunbower Forest				
Forest floodplain watering	205	333	NA	538
Semi-permanent wetland watering	155	183	NA	337
Middle Gunbower Forest				

Forest floodplain watering	6,215	NA	1,540	4,675
Semi-permanent wetland watering	500	NA	0	500

Inflows and outflows to the Gunbower National Park would be measured during managed inundation events when the proposed works are operated. This would be achieved using flow sensors installed at each of the regulators to measure natural inflows and outflows. These measurements are important to inform calculation of the volume of environmental water used in each event and enable accuracy of water accounting.

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

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

Through the construction of new infrastructure the project aims to provide pumped inflows from 10 ML/d to 125 ML/d of water from the Murray River at the Brereton Road Pump Station and from less than 1 ML/d to 20 ML/day from the Camerons Creek Pump Stations into the forests. The pumping will result in inundation of approximately 457 hectares of Middle Gunbower Forest. The inundation of the 247 hectares of Upper Gunbower Forest will occur via a combination of pumping and gravity fed inflows.

Flows will be diverted from the River, pumped on to the floodplain and a number of swamps across the Middle Gunbower forest, through the selective operation of nine regulators, two pipelines, drop structures, two pump stations, and a series of containment banks to divert, retain and release water. Allowing for floodplain losses, it is estimated that approximately 1,540 ML (detailed in **Table 17**) of flows entering the Middle Gunbower Forest are estimated to return to the Murray River throughout a watering event. Any water quality impacts associated with return flows will be managed under the MDBA Basin Plan statutory water quality requirements including compliance with the State Environment Protection Policy (Waters) (DELWP, 2018) and the Basin Salinity Management 2030 – BSM2030 (Murray-Darling Basin Ministerial Council, 2015). It is also noted that return water events occur under natural inundation events also. Return flows to the Murray River would be managed as part of the Operating Plan and measures to reduce water quality impacts will be included in the Environmental Water Management Plan including monitoring water quality and water temperature and dilution flows.

Construction works would be managed in accordance with a CEMP including controls for managing sediment, erosion, and rainfall runoff and management of activities such as works in waterways and dewatering, where required.

Potential impacts to water environments, including those associated with wastewater or runoff are described in the response below.

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.

Waterways likely to be affected by the project include Murray River, Gunbower Creek (National Channel), Camerons Creek, Deep Creek, Baggots Creek, Dry Tree Creek, Broken Axle Creek and Spur Creek. The Murray River forms the northern border of the Gunbower Forests with construction of two pump stations and one drop structure proposed on the banks of the Murray River (noting that construction within the river is deemed to be within NSW, and will be approved in that state).

Attachment 5 – Ramsar Assessment provides a detailed assessment regarding potential impacts to wetlands and waterways in the vicinity of the project, including mapping. Two significant wetlands are within the construction footprint and inundation areas for the project:

- Gunbower Forest Ramsar site

- Gunbower Island – DIWA (Directory of Important Wetlands in Australia) listed wetland

Eleven Victorian Wetland Inventory Wetlands have potential to be affected by the project area. Four are within the inundation area, seven overlap with the area of investigation and four of these are in the construction footprint and development footprint. Given the nature of the project, all of these wetlands are anticipated to benefit from environmental water delivery during operation of the project, with mitigation measures in place to manage risks during construction.

Those wetlands partially within the construction footprint for the project, may be temporarily affected by works and use of access tracks. Those wetlands also partially within the development footprint may experience long term impacts due to construction of permanent infrastructure within the wetland area, though areas affected are small in relation to wetland size and design will take into consideration avoiding and minimising impacts to the wetlands. Unavoidable impacts will be minimised through the implementation of a rigorous environmental management framework during construction (North Central CMA, 2014a).

Significant listed wetlands (Ramsar and DIWA) downstream of the project areas and therefore potentially affected by water quality or hydrology changes associated with managed inundation of Gunbower National Park and their approximate downstream distances from the project area are shown in **Table 18**below.

Table 18: Significant wetlands downstream of the project

Ramsar title	DIWA title	Distance downstream*
NSW Central Murray Forests	Koondrook and Perricoota Forests	Adjacent to the project area on the opposite bank of the Murray River
	Beveridge Island	>100 km
	Major Mitchell Lagoon	>200 km
	Belsar Island	>200 km
Hattah-Kulkyne Lakes	Hattah Lakes	>300 km
	Kings Billabong Wetlands	>400 km
	Lake Ranfurly	>500 km

*Distances are approximate only and are likely to be greater than these values due to the sinuosity of the Murray River

Potential impact pathways of the project during construction and operation are listed below. These potential impact pathways will be monitored and managed to reduce and avoid impacts under the project's environmental management documentation (Section 18 Environmental Management) including Environmental Management Framework, Construction Environmental Management Plan, Operating Plan and Environmental Water Management Plan:

Potential impacts of the project during construction

Construction impacts are temporary and generally localised in nature. The implementation of appropriate construction methodologies and measures documented within a project CEMP would address the following identified risks:

- Physical disturbance within wetlands where construction works and upgrades of existing roads are required, including vegetation disturbance or removal or water quality impacts
- Entrapment or temporary loss of habitat from cofferdam construction
- Introduction or transport of invasive weeds
- Temporary drawdown of groundwater levels during construction (dewatering excavations) causing minor impact to groundwater dependent ecosystems and adjacent vegetation
- Erosion and loss of topsoil causing water quality impacts
- Construction works and structures causing bed and bank erosion and instability
- Rainfall and flood events causing a pollution event and runoff
- Discharging/dewatering poor quality water into receiving water waters (high turbidity, EC)
- Spills, leaks, poor handling of fuels, oils and other chemicals causing soil/water contamination

Potential impacts of the project during operation

An Operating Plan will be drafted for the project. This document, together with the Environmental Water Management Plans for the Gunbower National Park would be updated on an ongoing basis in order to assist with the management of the operational risks to water quality associated with watering events. Identified water quality related risks are:

- Hypoxic blackwater in the floodplain that can eventuate from environmental water after a dry period or warm water and high loads of organic matter, which impacts on the health of aquatic species and communities through compromising foraging habitat and causing wetland biota deaths.
- Suspended solids, turbidity, organic matter may cause poor water quality (including groundwater) impacting the health of aquatic species and communities, and indirectly waterbird species (through reduced food availability)
- The release of poor quality water into the Murray River may impact water quality downstream
- Inability to release poor quality water back to the Murray River may impact floodplain health and vegetation
- Carp may breed in response to inundation of the forest, excessive numbers of carp can adversely affect aquatic ecosystems, impacting aquatic macrophytes through disturbance and increasing turbidity. This is only considered a real risk after natural inundation / hybrid events.

Measures to manage the construction related impacts are outlined in the ‘mitigation’ section below and also Section 18 (Environmental management). In particular a CEMP would be developed containing measures to avoid and mitigate impacts associated with construction works.

Potential impacts to DELWP mapped wetlands are predominately associated with vegetation removal associated with construction, however noting that the construction of works allows for the restoration of the wetland hydrology. Reinstating a more natural inundation regime to these wetlands will provide significant ecological benefits to the whole wetland area, particularly to wetland vegetation, therefore

benefits to native vegetation will be much larger compared to the small area of impact associated with construction. More detail about Ramsar sites is provided below.

Any upstream or downstream hydrological changes or impacts in the Murray River associated with the delivery of environmental water to the Gunbower National Park floodplain will be assessed and managed by the RMOC as part of their responsibility to oversee the operation of the river which is managed by the Murray Darling Basin Authority on behalf of the relevant State and Commonwealth Governments. It is also proposed that the environmental water requirements for VMFRP sites will be added to the existing river flows and therefore managed to ensure minimal, if any, changes in flows experienced downstream of the project sites.

Delivery of environmental water in the Murray River system is undertaken by the RMOC in accordance with a risk based approach to minimise impact to river users and the Commonwealth Environmental Water Holder's Framework for Determining Commonwealth Environmental Water Use (CEWO 2013) which requires environmental watering to consider the potential environmental risk, including downstream environmental risk, which may result from applying environmental water; and measures that may be taken to minimise those risks. The waterway mangers and water authority will also work with the RMOC to ensure that the planning and delivery of environment water delivery is undertaken to achieve ecological objectives and minimise adverse impacts on river hydrology and incorporate which will be informed by a monitoring program.

Further modelling of the cumulative change to flows in the Murray River as a result of the VMFRP (all sites) will be undertaken by the RMOC once all VMFRP projects are confirmed to either proceed or not based on the outcomes of the approvals process.

A draft Environmental Watering Management Plan and Operating Plan will be refined and contain measures to manage and mitigate water quality risks associated with environmental watering events. This would include monitoring of ground and surface water quality before, during and after watering events to inform management and measures which may include: diluting return flows with sufficient river flows; diluting poor quality water on the floodplain by delivering more fresh water to these areas; or reducing the frequency and/or extent of planned watering events if sufficient volumes not available. An Environmental Watering Management Plan has been developed for Gunbower Forest (MDBA, 2012) and will be updated to incorporate the project once the project has been fully approved. An Operating Plan will be developed as part of the project.

A blackwater risk assessment (i.e. using the blackwater risk assessment tool developed for Gunbower Forest) would also be undertaken prior to environmental water deliveries. If there is a large build up of carbon on the floodplain (i.e. long time period between inundation events) and a significant risk of hypoxic blackwater developing, then water deliveries will be managed to target the release of return flows to the Murray River during cooler conditions when the risk of hypoxic blackwater is lower. The volume and quality of return water would be monitored during the event and the release of anoxic blackwater from the floodplain only allowed if the volume of fresh passing flows in the Murray River is sufficient to dilute the hypoxic return flows. This approach is similar to risk assessment and management undertaken for the Gunbower TLM Icon Site. In 2018, a return flow trial was undertaken during a large-scale environmental water managed event at Gunbower Forest (approx. 4,500 ha inundation extent and 18,000 ML return flows). As part of the trial, the water quality risk to Gunbower Creek was assessed, and showed that the DO of return flows did not fall below 4 mg/L at any time and mixing occurred quickly with passing flows, causing a rapid increase in DO within the Gunbower Creek channel (Baldwin 2019).

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

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

The Murray River, Gunbower National Park Floodplain and surrounding floodplain communities of Gunbower Forest Ramsar site are likely to at least intermittently support listed threatened and migratory species. These species are generally expected to benefit from the anticipated improvements in ecological condition of floodplain vegetation and associated habitats that the project aims to deliver through the proposed reinstatement of a more natural inundation regime. Further discussion of listed threatened species and migratory species identified as possibly or likely to occur in the project area is provided in Part 2, Section 12 (Native vegetation, flora and fauna) and **Attachment 3 – Fauna and Flora Assessment** of this referral.

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

☐ NYD ☐ No ☒ Yes If yes, pleas e specify.

The project is located within a site listed under the Ramsar Convention and the Directory of Important Wetlands in Australia; Gunbower Forest. The site maintains the ecological diversity of the bioregion by supporting a vegetation communities representative of the Victorian Murray Fans Bioregion, which is a component of the Riverina IBRA Bioregion (DSE 2006, cited in RIS, 2006).

The project site occurs within the Gunbower National Park, located within the greater Gunbower Forest, which is listed as a Ramsar site (20,218 hectares, DEPI 2013). The Gunbower Forest Ramsar site includes Gunbower State Forest, Gunbower National Park and Murray River Park (Hale and Butcher 2011). The Gunbower Forest Ramsar site also overlaps with distinct wetlands referred to as 'Gunbower Island' (19,500 hectares) listed in the Directory of Important Wetlands in Australia.

The Ramsar assessment (**Attachment 5)**, included an assessment of impacts or exceedance of the Limits of Acceptable Change (LAC) identified in the Ecological Character Description for the Gunbower Forest Ramsar site. The assessment concluded that whilst the project is expected to have a positive impact on the ecological character of the Gunbower Forest Ramsar site, there will be highly localised negative impacts associated with construction. When considering the risk to the Gunbower site Ramsar listing in terms of possible causation of exceedances of LACs for the Ramsar site, it is not considered that the project will cause a significant risk to ecological character of Gunbower Forest or will affect the site's listing as a Ramsar site. Refer **Attachment 5 – Ramsar Assessment** for further assessment of risks and measures to reduce risks.

The NSW Central Murray Forests Ramsar site is directly adjacent to the project area and could potentially be affected by hydrological or water quality changes due to the project. It is unlikely that changes would be substantial or measurable due to the relatively small volumes of return flows to the Murray River cpmared with flows within the main channel.

The Hattah-Kulkyne Lakes Ramsar site is located more than 300 km downstream from the project. It is unlikely that changes would be substantial or measurable due to the relatively small volumes of return flows to the Murray River.

Table 19: Ramsar and DIWA listed wetlands downstream of Gunbower National Park

Ramsar site	DIWA site	Distance downstream*
NSW Central Murray Forests	Koondrook and Perricoota Forests	Adjacent to the project area, on the opposite bank of the Murray River
-	Beveridge Island	>100 km
-	Major Mitchell Lagoon	>200 km
-	Belsar Island	>200 km

Hattah-kulkyne Lakes	Hattah Lakes	>300 km
-	Kings Billabong Wetlands	>400 km
-	Lake Ranfurly	>500 km

**Distances are approximate only and are likely to be greater than these values due to the sinuosity of the Murray River*

The potential impacts to the Ramsar and DIWA listed sites downstream of the project site include hydrological and/or water quality impacts to floodplain wetlands as a result of return flows to the river from Gunbower National Park Floodplain during and following a managed inundation event.

If the volume of change in Murray River flows as a result of return flows was significant, unseasonal or excessive inundation of downstream wetland could occur. Return flows may also change the water quality (e.g. increased salinity and low Dissolved Oxygen levels) in the river resulting in an impact to biota in downstream wetlands.

Early estimates of return flow rates from the Middle Gunbower Forest are in the order of 20 ML/ d (based on 1,540 flow over 77 days which is the maintenance period for RRG and forest watering events) and would only occur in Middle Gunbower Forest during the River Red Gum and full forest watering events. There is good operational flexibility with the proposed infrastructure to be able to adjust the volume of return flows by adjusting the pump station flow rate. The volume of return flows is small in relation to daily passing flows in the Murray River, which have ranged between 1,300 – 59,905 ML/d downstream of the Torrumbarry weir during the period 1974 – 2020 (MDBA 2020). Therefore, downstream impacts from the Gunbower National Park Floodplain Restoration Project in isolation are expected to be small.

Any potential impacts to downstream wetlands would be adaptively managed through implementation of a monitoring and evaluation framework, the Operating Plan and EWMP and drawing on experience from previous environmental watering projects such as the TLM Program.

The project is not likely to adversely impact on the ecological character of any of these wetlands provided the mitigation measures described in **Attachment 8 – Draft Environmental Management Framework** are implemented, particularly those relating to potential risks to water quality (including saline discharge), spread of pest species (including carp), and erosion and sedimentation.

Could the project affect streamflows?

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

The purpose of the project is to reinstate a more natural inundation regime to Murray River floodplains within Gunbower National Park, in part through pumping from the Murray River. On completion of a managed inundation event, the project would release managed floodwaters back to the Murray River via Cameron's Creek, except for water losses due to infiltration and evaporative processes during retention on the floodplain. As detailed in **Table 17**, approximately 1,540 ML will be returned to the Murray River under the proposed operating scenarios at Middle Gunbower Forest. These return flows will only occur during floodplain watering scenarios, with all water delivered during semi-permanent wetland watering events being retained with the wetland areas.

Potential effects on Murray River flows would be assessed and managed through existing environmental water accounting frameworks under the Basin Plan, with which the current project would need to comply. These frameworks require that any water extracted from the Murray River is debited against environmental watering accounts, along with any additional evaporation and seepage losses caused by impounding natural inflows on the floodplain beyond the peak of floodwaters passing. To minimise potential effects, the project is designed to utilise natural flood inflows rather than additional pumping of water directly from the Murray River.

Could regional groundwater resources be affected by the project?

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

The groundwater environment of the project area is described in Section 7 of this referral. A desktop groundwater assessment has been prepared and is provided in **Attachment 6 –Groundwater Assessment**.

The potential groundwater effects of the proposed construction and operation of the works are:

- Temporary and limited drawdown of groundwater levels during construction
- Increased groundwater level as a result of inundation recharge
- Reduced groundwater salinity immediately following inundation events
- Modified groundwater quality of the watertable during and after inundation events
- Mobilisation of salt from either the soil surface or from shallow groundwater to return to the Murray River (noting that current salinity levels are low)

Construction of the project may require groundwater dewatering and subsequent disposal of pumped groundwater (for example, Brereton Rd and Irrigators Pump Stations, Camerons River Track Regulator coffer dam and potentially Camerons Mid Creek Regulator coffer dam). If this is the case, then minor impacts on adjacent vegetation and ecosystems are possible. These impacts can be mitigated by planning construction to minimise dewatering (for example, by avoiding high river or rainfall events) and to provide watering for any ecosystems that may experience an extended period of lowered groundwater levels.

Operation of the proposed works will result in elevated groundwater levels, wetting of soils and potentially mobilised salt from the unsaturated soil store. This could potentially result in the displacement of salt to the Murray River and increased evapotranspiration of water from the floodplain, potentially concentrating salts in the soil. Given the low soil salt store, the risk of salt mobilisation from the project area to the Murray River is considered to be low. A semi-quantitative assessment of the potential salinity impacts of environmental watering activities at Gunbower National Park was undertaken and the estimated salinity impact at Morgan under the operating scenarios was found to be negligible (<0.01 µS/cm EC) (Jacobs 2014). However, this may be become more of an issue if the cumulative impact of groundwater mound rise under the inundation area raises groundwater levels to above the Murray River water level pushing more groundwater, and therefore salt, into the River. This has the potential to increase the salinity in the Murray River and impact on downstream users of the River (R8, 2020a).

There is risk of a cumulative effect on groundwater levels over time from a change in inundation regime (i.e. increase in frequency and duration of inundation resulting in increased recharge to groundwater), however this is not expected to impact to any significant level on groundwater receptors (forest ecosystems or local groundwater users) because of the capacity of the Gunbower Forest (terrestrial vegetation) to then re-use the stored floodwater from groundwater via evapotranspiration. The exception to this is in the Upper Gunbower project area where current groundwater levels are < 5m in places and therefore water levels may increase to a level that may impact groundwater receptors (forest ecosystems or local groundwater users). The development of groundwater mounds under the inundation area will be monitored, especially in the Upper Gunbower area, to ensure groundwater levels are not being raised to levels that may impact on groundwater receptors outside the inundation area. These impacts may include near-surface salinisation from shallow saline groundwater or waterlogging in the area adjacent to the inundation area. Management of the watering program should be adapted as required to support the identified ecological objectives for the wider area if these issues arise.

To assist in the monitoring of salinity impacts, VMFRP has proposed new monitoring bores within the proposed inundation area. These monitoring bores would be integrated into the existing North Central CMA monitoring network and monitoring program, with monitoring and ongoing assessment of risks to

occur consistent with the Basin Salinity Management Strategy 2030 (Murray Darling Basin Ministerial Council, 2015).

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)

The waterways and water bodies within the project area are located within the State Environment Protection Policy (Waters) (SEPP (Waters)) Murray and Western Plains surface water segment. Wetlands within the project area are located within the SEPP (Waters) Lakes and Swamps surface water segment. In addition to these segments, surface waters within the River Murray Reserve and other natural features reserves are included in the Aquatic Reserves segment. Schedule 2, Table 3 of SEPP (Waters) identifies beneficial uses of inland waters within the Murray and Western Plains and the Lakes and Swamps segments as including:

- Water dependent ecosystems and species that are slightly to moderately modified (or largely unmodified in Aquatic Reserves)
- Human consumption after appropriate treatment where water is sourced for supply in accordance with the special water supply catchments area set out in Schedule 5 of the *Catchment and Land Protection Act 1994* or the *Safe Drinking Water Act 2003*
- Agriculture and irrigation (not in Aquatic Reserves)
- Human consumption of aquatic foods
- Aquaculture where the environmental quality is suitable and an aquaculture licence has been approved in accordance with the *Fisheries Act 1995*
- Industrial and commercial (applies to the Murray and Western Plains segment only, and not in Aquatic Reserves)
- Water-based recreation (primary, secondary contact and aesthetic enjoyment)
- Traditional Owner cultural values
- Cultural and spiritual values.

The SEPP(Waters) identifies beneficial uses of groundwater based on Total Dissolved Solids concentrations. The interpreted groundwater salinity at the project area indicates that the following groundwater beneficial uses are protected in the project area under the SEPP(Waters):

- Water dependent ecosystems and species
- Potable mineral water supply
- Agriculture and irrigation (stock watering)
- Water-based recreation (primary contact recreation)
- Traditional Owner cultural values
- Cultural and spiritual values

- Buildings and structures
- Geothermal properties.

Due to the generally saline nature of the deeper regional aquifer, the proximity to fresh water from the Murray River and limited access to floodplain aquifers by private landowners, there are no licenced groundwater users in vicinity of the project area (FedUni, 2015 cited in R8, 2020a). There are also no registered stock and domestic bores in the vicinity. The groundwater bores in the area are predominantly groundwater observation bores and a number of recently installed irrigation bores. The primary use of groundwater at the project area is environmental use associated with floodplain vegetation and terrestrial groundwater dependent ecosystems (GDEs). There are no aquatic GDEs mapped within the project area. It is anticipated that the project will have a beneficial impact on potential GDEs within the inundated areas (R8, 2020a).

Potential effects on beneficial uses of groundwater are expected to be either beneficial or negligible (see Table 1 of **Attachment 6 – Groundwater Assessment**).

Groundwater Dependant Ecosystems

Groundwater plays an important role in sustaining aquatic and terrestrial ecosystems including wetlands and rivers. For example, groundwater can contribute to river baseflow during low rainfall periods. A number of Ecological Vegetation Classes (EVCs) are mapped across the project area, some of which contain species which are at least partially reliant on groundwater (see **Attachment 3 – Fauna and Flora Assessment**).

The Fauna and Flora Assessment (**Attachment 3**) for the project identified several EVCs during recent field assessments that are considered to be flood-dependent or flood-tolerant vegetation communities. The ecosystems identified include EVCs associated with Riverine Swamp Forest, Riverine Chenopod Woodland, Plains Woodland and Spike-sedge Wetland, which are likely to benefit from the propsed inundation regime

Could aquatic, estuarine or marine ecosystems be affected by the project?

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

The project aims to reinstate a more natural inundation regime to the Gunbower National Park floodplain, which is expected to deliver a range of ecological benefits to floodplain and wetland communities. The project is designed to have the operational flexibility to vary the timing, depth, duration and extent of inundation so that individual managed events are able to target specific ecological outcomes.

A risk assessment was completed to inform project development (North Central CMA, 2014e). This involved identifying potential undesirable outcomes, determining their root causes, assessing likely consequences and significance; and developing relevant mitigation measures to reduce any residual risk to an acceptable level (very low to moderate). Experience gained from previous works and measures, and environmental watering projects of similar scale and complexity, including The Living Murray Program, informed this process.

The risk assessment (North Central CMA, 2014e) identified the following potential threats to aquatic ecosystems:

- If the inundation regime provides water (<1m deep) in some areas for 6-11 months from winter to spring, Giant Rush (*Juncus ingens*) may colonise these wetlands and flood runners, causing wetland plant diversity to be suppressed, loss of open water and the habitat value for fish and waterbirds to be altered. The risk of Giant Rush invasion in the Gunbower Forests is relevant to the wetlands which will have inudnation over summer, to be maintained as aquatic fauna refuges

(i.e. Black Charlie Lagoon), though it is noted that water is already maintained in these areas over summer so the project does not represent additional risk.

- If environmental water delivery transports pest fish (particularly carp) into the forest, this may increase the abundance of these species and impact on aquatic vegetation and still water habitats, thereby reducing the ecological value of the forest. At least six pest fish species already occur in Gunbower Creek, and associated lagoons, and are expected to occur in the Torrumbarry Irrigation System channels / Torrumbarry Weir Pool. Outside Black Charlie Lagoon (permanent wetland), the project will only provide temporarily inundated areas where pest fish species can potentially impact aquatic habitats, though given the water is pumped to the wetlands during managed inundation events, very few numbers of any fish would be transported, and if small fish, eggs or larvae are transported to the wetlands, they would not have time to grow and reproduce due to the seasonal nature of the inundation. Whilst there will be opportunity for main channel specialists to enter the floodplain during natural or hybrid inundation events, the seasonal nature of inundation will again limit their ability to build up in numbers on the floodplain. Staged drawdown strategies will be implemented to cue fish to return to the main channel as water recedes. Camerons Creek will receive water in the same way as it does currently, and carp already exist in this channel.

- If environmental water carries reproductive parts of Lippia and Arrowhead (e.g. seed, roots) into the forest wetlands, the weed may establish and expand, causing wetland plant species to be outcompeted, reduced plant diversity and degraded fauna habitat.

- If the forest drains quickly after watering, native fish may not have adequate cues or time to leave the floodplain and may become stranded, resulting in lowered recruitment and population decline for some species (e.g. channel specialists). This would only present as a risk during a hybrid or natural inundation event where fish can access the floodplain from the Murray River. Small-bodied fish delivered through Camerons Creek will likely be retained in Black Charlie Lagoon. It is also recognised that opportunistic use of the floodplain by native fish has many benefits regarding access to food and habitat resources (Mallen Cooper et al. 2014).

- If warm water and high litter levels create high organic and microbial load, blackwater with low dissolved oxygen and pH (and possibly toxic solutes) may result and could kill wetland biota, reduce food sources, cause toxic algal blooms and may threaten wetland community health, threatened species, fish and other aquatic fauna communities and waterbird communities. Blackwater develops in waterbodies with high organic loads, little circulation and in warm water. Whilst there is potential for blackwater impacts to occur, it is expected that the project will reduce the risk of blackwater over time as the time between inundation events will be reduced, thereby reducing the organic load build-up on the floodplain. Potential impacts from return flows of low quality water to the main river channel are not expected to be significant given the small volume of return water (approx. 20ML/day) compared with the volume of water in the main channel. Return flow water will be managed in response to water quality monitoring and significant water quality risks or aquatic environment risks from blackwater are therefore not expected to arise from the project).

In addition to these operational risks, construction of the project has the potential to affect aquatic ecosystems through:

- Erosion and loss of topsoil causing water quality impacts
- Construction works and structures causing bed and bank erosion and instability
- Rainfall and flood events causing a pollution event and runoff
- Discharging/dewatering poor quality water into receiving water waters
- Spills, leaks, poor handling of fuels, oils and other chemicals causing soil/water contamination

- Installation of temporary coffer dams in-stream during construction may interfere with through flows and fish passage.

The Ramsar assessment (**Attachment 5**), included an assessment of impacts or exceedance of the Limits of Acceptable Change (LAC) identified in the Ecological Character Description. The assessment concluded that whilst the project is expected to have a positive impact on the ecological character of the Gunbower Forest Ramsar site, there will be highly localised negative impacts associated with construction. When considering the risk to the Gunbower site Ramsar listing in terms of possible causation of exceedances of LACs for the Ramsar site, it is not considered that the project causes a significant risk to ecological character of Gunbower Forest or will affect the site's listing as a Ramsar site. Refer **Attachment 5 – Ramsar Assessment** for further assessment of risks and measures to reduce risks.

Planning and design of the project continues to address these identified risks, including design of pump stations to reduce pest fish entering the floodplain and design of regulating structures to satisfy fish passage requirements and to mitigate the potential effects of creating barriers to fish movement. Other measures to reduce the potential impacts identified above are outlined in the 'mitigation' section below and also in **Attachment 8 – Draft Environmental Management Framework**.

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.

Major and long-term effects on the health and biodiversity of aquatic ecosystems associated with the project are expected to be positive as defined through the specific ecological objectives and targets for the project set out in Section 2 of this referral. The project is designed to have the operational flexibility to vary the timing, depth, duration and extent of inundation so that individual managed events are able to target specific ecological outcomes. The project has received funding on the basis that other environmental watering programs across the Murray-Darling Basin have demonstrated positive environmental benefits.

As mentioned above, the Ramsar assessment (**Attachment 5**) considered the potential impacts to critical components, processes and services underpinning the Ecological Character Description of Gunbower Forest Ramsar site in term of Limits of Acceptable Change (LAC). Aspects that were assessed for impacts to LAC included hydrology, floodplain forest vegetation, floodplain marsh vegetation, native fish (species richness, threatened species), wetland bird abundance, and threatened wetland bird species. The assessment concluded that significant changes were unlikely for all of the LACs, with the exception of native fish species richness, and the project would enable more frequent inundation of the floodplain which would enhance the ecological values aligned with the intent of the LACs underpinning the Ecological Character Description and Ramsar listing. Some localised impacts to the six native fish species relevant to the LAC are possible due to construction. Mitigations are proposed for these construction impacts and these species are likely to benefit from improved habitat conditions following environmental watering within the inundation area. The six species relevant to the LAC include common and threatened species (Australian Smelt, Carp Gudgeons, Dwarf Flat-headed Gudgeon, Flat-headed Gudgeon, Fly-specked Hardyhead and Murray-Darling Rainbowfish). Refer **Attachment 5 – Ramsar Assessment** for further detail.

Is mitigation of potential effects on water environments proposed?

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

Construction

The following mitigation measures are proposed to minimise and avoid impacts on water environments during construction of the project:

- Develop and implement a CEMP, including erosion and sediment control plans, dewatering and water quality management plans, weed and pest hygiene protocols to minimise potential impacts on wetlands and other aquatic ecosystems
- Rehabilitate construction areas following completion of works to the satisfaction of Parks Victoria and DELWP
- Minimise the total volume and rate of groundwater extracted for construction purposes - plan construction to minimise dewatering, provide make-up of offset water for affected vegetation during construction.
- Do not dispose of groundwater from construction activities to land.
- Disposal of groundwater to waterways should be managed so as to not significantly impact water quality.

Operation

The following mitigation measures are proposed to minimise and avoid impacts on water environments during operation of the project:

- Continue to undertake water quality monitoring before, during and after watering events to inform adaptive management strategies and real-time operational decision making.
- Commence watering as early in the season as possible to move organic matter off the floodplain while temperatures are low. Maintain a through-flow where possible in other areas to maximise exchange rates and movement of organic material. Monitor dissolved oxygen and water temperature to identify hypoxic areas to inform consequence management.
- Planning and monitoring of inundation events to avoid prolonged periods of inundation that could lead to waterlogging (to avoid vegetation impacts). Avoid extended periods of shallow watertable < 3m below surface to avoid waterlogging of vegetation.
- Integrate water management with other sites in seasonal water planning process. Maintain good relationships with other water managers.
- Tailor inundation regimes to provide competitive advantage for native fish over carp. Dry wetlands that contain carp. Manage drawdown during managed events to provide triggers for native fish to move off the floodplain, and where possible, strand carp.
- Monitor ground and surface water quality before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as:
    - Diluting poor quality return flows with sufficient river flows
    - Diluting poor quality water on the floodplain by delivering more fresh water to these areas
    - Schedule watering events to make use of dilution flows where possible and optimise timing of releases
    - Reduce the frequency and/or extent of planned watering events if sufficient volumes not available
- Specific groundwater level and quality information is required for the area to form a baseline for the potential construction and operation impacts, as well as to monitor the effects of inundation outside of the inundated area. A number of monitoring bores were established across the project

area in 2014 as part of investigations by North Central CMA. These bores would be monitored to establish baseline conditions and continue to be monitored during operations to enable the groundwater effects to be verified.

- Monitoring the development of potential groundwater mounds under the inundation areas, focused on the south section of the Upper Gunbower Forest project area. Implement adaptive management of environmental water delivery to mitigate impacts if identified.

Mitigation measures would be implemented to minimise risks associated with pest plants, including:

- Timing water delivery to drown seedlings, minimise growth, germination and seed set. Time water delivery to promote native species.
- Controlling current populations and eradicate/control new infestations via existing management strategies (e.g. Parks Victoria pest management action plans/strategies). Support partner agencies to seek further funding for targeted weed control programs if necessary.

Mitigation measures would be implemented to minimise risks associated with barriers to fish passage, including:

- Design of regulating structures to satisfy fish passage requirements including those suggested in the Upper Gunbower Fish Management Plan (ARI, 2020b).
- Continuing to build on knowledge and understanding through current studies relating to fish movement in response to environmental watering and cues to further develop and refine strategies to trigger fish to leave the floodplain following managed inundation.

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

14. Landscape and soils

14.1 Landscape

Has a preliminary landscape assessment been prepared?

☒ No ☐ Yes If yes, please attach.

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 area of the project adjacent to the Murray River is located within an Environmental Significance Overlay (Schedule 1 – Waterway, Wetlands and Lakes Environs) (ESO1) (Refer **Attachment 7 – Land Use Planning Assessment).**

The ESO1 affects public and private land in non-urban areas and covers the length of the Murray River on land immediately adjoining the river. Project components that occur within the ESO1 include:

- Buffer to the Deep Creek Regulator (roads and tracks)

The ESO1 recognises *the importance of the Murray River and its environs, being of local, regional, state, national and international significance and notes that the Murray River is an important water supply, tourism, recreation, landscape, cultural and environmental asset*.

The environmental objectives of the ESO1 seek to, amongst other things, *protect the visual and environmental qualities of waterways, wetlands and lakes, restricting the use and development of land in these areas to maintain these qualities.*

The project area is not subject to a Significant Landscape Overlay.

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

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

As noted in the response above, the project area is located within the ESO1 which identifies the Murray River and its environs as being of local, regional, state, national and potentially international significance.

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

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

The project is located within and adjoining land reserved under the *Crown Land (Reserves) Act 1978*. This includes the Gunbower National Park which is owned and managed by Parks Victoria in accordance with the objectives 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.

As identified in **Attachment 7 – Land Use Planning Assessment**, the Murray River Reserve runs along the northern boundary of the Gunbower National Park floodplain, within Gunbower National Park and is used for a range of recreational activities such as fishing, camping, boating, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving. Part 2, Section 15 (Social environments) provides further details of the recreational activities undertaken within this area.

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

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

The project would involve the removal of 19.57 hectares of native vegetation as described in Section 12 (Native vegetation, flora and fauna) and **Attachment 3 – Fauna and Flora Assessment**, to raise / maintain existing access tracks, and to create new infrastructure (regulators, drop structures, pump stations, containment banks) in order to retain water during managed inundation events. In addition, approximately 58 large trees will be impacted either directly (tree removal) or indirectly (through encroachment of their TPZs). This total will increase once large trees have been mapped within the Middle Gunbower Forest (downstream of Deep Creek) and Camerons Creek pump station and pipeline in Upper Gunbower in spring 2020. Further context for these impacts, which would be reduced and minimised through detailed design, is provided below.

Upper Gunbower

The Camerons Creek Pump Station is located on the GMW National Channel, on Headworks Road just east of the Torrumbarry Weir Road. The surrounding land is heavily modified with the primary land use being agriculture (irrigation and dryland cropping and dairy farming).

The Camerons Creek Pump Station has two nearby sensitive receivers, within between 200 m to 330 m from the pumping facility to the east and south east of the site, and another two to the west and north west around 500 m away. The pump station location is not visible to any of these receivers as the line of sight is blocked by the bank and vegetation which will be retained.

The Camerons Creek River Track Regulator is located in the footprint of the existing regulator on Camerons Creek River Track (**Figure 4**), about 100 m from its divergence from the Murray River. River Track is frequently used by the public to access camping and recreational areas along the Murray River frontage (R8, 2019a). The Camerons Mid Creek Regulator sits approximately 1.4 km downstream of the Camerons Creek anabranch (**Figure 5**). The structure will be erected approximately 100 m downstream of the existing structure which can be accessed via an unnamed track. A fishway will be constructed on the northern side of the regulator and a containment bank will be adjacent to the regulator and fishway. Being on the fringe of the National Park, the site is adjoined to the south by private property managed for agriculture.

Figure 4: Existing Camerons Creek Track Regulator

Figure 5: Proposed location of Camerons Mid Creek combined regulator and fishway

The Dry Creek Creek Outlet Regulator is located at the low point where Baggots Creek Track crosses Dry Creek (**Figure 6** below). The densely vegetated area is within the National Park and used for accessing recreational areas for camping and fishing. The site is approximately 500 m from privately owned agricultural land to the south west.

Figure 6: Dry Creek Outlet Regulator and Spillway site

Middle Gunbower (upstream Deep Creek)

The Brereton Road Pump Station is located on Murray River at the end of Brereton Road (near a boat ramp) (**Figure 7** below). The site is used to access recreational facilities including camping, fishing and boating. The area, within the National Park, is heavily vegetated with one adjoining privately owned property. The discharge pipeline runs from the Brereton Road Pump Station to Old Straight Cut Channel. Access to this area is via Brereton Road, a fairly heavily vegetated area.

The nearest dwelling to the operation of the Brereton Road Pump Station is located on the Victorian side of the Murray River approximately 330 m from the proposed pumping Station. The pump station location is not visible to any nearby receivers as the line of sight is blocked by banks and vegetation which will be retained.

Pig Swamp Offtake Regulator, Emu Hole Regulator, Middle Forrest Offtake Regulator, Deep Creek River Return Regulator and Dalley Bend Inlet Regulator are all located within the heavily vegetated areas of the National Park. These areas can be accessed using existing access tracks. Dalley Bend Inlet Regulator is located adjacent to the Murray River. All of these areas are used for accessing recreational activities including camping and fishing.

Works to approximately 1 km of the Old Straight Cut Channel will involve the removal of saplings and clearing of debris from the bottom of the channel. Additional works to Brereton Road and the Riverside car parking area seek to improve access and landscape amenity.

Figure 7: Brereton Road Pump Station site

Middle Gunbower (downstream Deep Creek)

The design of the infrastructure for Middle Gunbower (downstream of Deep Creek) is currently being undertaken and therefore only indicative locations have been included in the project footprints. The proposed works include a number of culverts (Munroe Track culverts 1 and 2) to maintain access during environmental water events for maintenance, operation and public access; smaller regulators and spillways (e.g. Broken Axle Creek, Tickells Track, Spur Creek River Return and Forest), drop structures (Spur Creek), River Track and Munroe Track spillway, Broken Axle Creek Culvert/bridge, drainage outlets within containment banks (Munro Track, Tickells Track and River Track). In general, whilst infrastructure will be installed in areas of the National Park which are heavily vegetated, efforts have been made to reduce the impact to native vegetation and the landscape by placing structures in cleared or previously disturbed areas.

It is not expected that structures would be visible from surrounding residential dwellings which are kilometres away from this proposed infrastructure. Whilst some of the remaining smaller regulator structures are also located along existing access tracks and therefore may be visible by park visitors, it is expected that visibility will be partly screened by existing retained vegetation with views generally confined to areas in proximity to the structures.

The removal of native vegetation for the project would occur in discrete areas up to 19.57 hectares in the context of a largely intact expanse of high-quality native vegetation within the 9,330 hectares of Gunbower National Park. The areas of proposed vegetation clearance are also considered minor when compared to the 704 hectares that will benefit from the project.

Overall, the project is expected to have a positive effect on the landscape values of the surrounding floodplains and parks. This is expected due to the project's objective of restoring a more natural inundation regime to approximately 704 hectares of the Gunbower National Park floodplain. For this reason, it is considered that the project is consistent with the management strategies outlined in the Gunbower Forest Environmental Water Management Plan (MDBA, 2012) and the ESO1 that affects the project area. These documents recognise the importance of inundation regimes in protecting the scenic landscapes that maintain recreational and tourism values.

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

☐ NYD ☐ No ☒ Yes Please briefly explain response.

As described above, the project will involve removal of native vegetation and alteration of constructed landforms within areas supporting state and regional landscape values, specifically the Gunbower National Park, the Murray River and its floodplain, within an area that is also part of a Ramsar Wetland and an iconic TLM site. The extent of vegetation removal and landform alteration is approximately 19.57 hectares and generally within areas that have been modified by the construction and use of existing trails, tracks, regulating structures and embankments. From a landscape perspective, the proposed 19.57 hectares represents a comparatively small area within the 9,330 hectare Gunbower National Park, and in comparison to the 704 hectare inundation area.

On balance, in the context of the proposed areas of disturbance and vegetation removal when measured against the 704 hectares of anabranch and floodplain vegetation communities that are expected to benefit from the project, it is considered that the project will not have a significant adverse effect on landscape values of state or regional importance.

Further, it is recognised that the project seeks to restore a more natural inundation regime consistent with the management strategies outlined in the River Red Gum Parks Management Plan, which recognise that ensuring appropriate inundation regimes is critical to protecting the scenic landscapes that maintain the recreational and tourism values of these parks and reserves.

Is mitigation of potential landscape effects proposed?

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

The following measures are proposed to mitigate potential landscape effects:

Design measures

- Siting of proposed structures primarily along or immediately adjacent to existing access tracks and other previously disturbed areas to minimise the removal of native vegetation and other construction impacts
- Limit the extent of ground disturbance and native vegetation removal, particularly LOTs, to the minimum extent necessary
- Design of proposed structures is to be sympathetic to the surrounding landscape and consistent with Parks Victoria infrastructure design guidelines.

Site rehabilitation

- Following construction works, soil is to be reinstated to mimic the contours of the site prior to construction, unless the aim of construction was to alter the land profile (e.g. creek bed excavations). The following methods are proposed to be followed:
  - Photographs of the site taken prior to works should be consulted

- Where soil has been compacted due to construction works, and is not required to maintain structural integrity of works, then the soil should be ripped with narrow tynes to a depth of 50 mm. Ripping that involves the mixing of soil profiles is to be avoided

- Subsoil is to be reinstated first, with separate horizons restored in layers consistent with the surrounding soil profile. Any remaining subsoil should be removed and disposed of off-site, or at a site within the reserve under direction from Parks Victoria / the land manager.

- Vegetation (through natural regeneration) should be established as soon as possible after soil reinstatement to prevent risks of erosion

- Topsoil should not be compacted when reinstated. All topsoil should be used in site reinstatement.

Operation

During the operational phase, inundation events will be managed in accordance with operational guidelines (provided in the Gunbower Operating Plan which is under development) informed by detailed hydrodynamic modelling and ecological investigations and adapted as required in response to proposed monitoring and evaluation frameworks to support achievement of the identified ecological objectives for the project (detailed in the Gunbower National Park Objectives and Hydrological Requirements Justification Paper - **Attachment 2**).

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

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14.2 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.

A number of geotechnical investigations have been undertaken for the project area and proposed structure locations, with key findings summarised by URS (2015) and outlined below. Additional geotechnical works are proposed by VMFRP to supplement these previous investigations. The results of these investigations have informed the detailed design of the project.

Geology and soils of the area

Feasibility stage geotechnical investigations were undertaken by URS in 2014, followed by subsequent investigations as part of the advanced concept design (URS, 2015) and found that the materials encountered at the site were generally consistent with the published geology for the area.

The Gunbower National Park project areas sit in the Riverine Plains area of the Murray Geological Basin. This basin was infilled with sediments during the Tertiary and Quaternary period (R8 2020a). The site geology consists of alluvial, fluvial and lacustrine deposits within the Murray River floodplain and covers depositional periods from recent to Tertiary age (inclusive of the Coonambidgal and Shepparton formations) (URS, 2015).

Geotechnical investigations highlighted that fine grained clays (sandy clay and clay) were the dominant soil types encountered. Sands and clayed sands were interbedded layers and at a number of site the deeper boreholes were terminated with sands (URS, 2015).

Findings and recommendations from URS (2015) have been considered as part of the design process for the project and in particular the 2019/2020 design refinements. However, URS (2015) summarised ground conditions at the proposed project infrastructure included in the Business Case (North Central CMA 2014a) (e.g. environmental watering through irrigation supply) and therefore did not cover the current locations of key pumping infrastructure. As such additional onsite geotechnical Investigations are currently being undertaken as part of the design phase and include boreholes and test pits including key asset sites such as the pump stations which were not included in URS (2015).

The soils encountered on site by URS (2015), were generally found to be dispersive. It is anticipated that locally sourced borrow material may also be dispersive. Treatment measures to minimise the potential for embankment erosion will be determined as the detailed design progresses. Erosion protection measures may include (1) compaction of the fill to 98% of standard compaction and wet of the optimum moisture content prior to topsoiling and revegetation, (2) lime stabilisation treatment of the outer layers, (3) targeted use of geofabric or rock armour.

A hydrological assessment to evaluate change resulting from the operation of the infrastructure, relative to how the area currently inundates and the benefits and risks that are associated with the changes in inundation regime is proposed to be undertaken. The hydrological change assessment will consider each of the operating phases; filling, holding and emptying. The assessment will focus on changes in velocity, shear stress, water depths and inundation extents across the floodplain areas and will provide information on the likelihood and location of soil erosion in the project area.

Acid sulphate soils

A review of CSIRO's Australian Soil Resource Information System (ASRIS) mapping identified that the project is located within an area of 'extremely low probability of occurrence' with a very low level (A4) of confidence (provisional classification, inferred from surrogate data with no ground verification) (CSIRO, 2020).

The Murray Darling Basin Authority have undertaken a regional hazard assessment of ASS throughout the Murray Darling Basin (MDBA, 2011). The results of this assessment in the region closest to the area of investigation indicate that floodplain sediments in the Victorian northern flowing rivers region have a high to moderate potential of exhibiting an ASS hazard. More specifically hazard assessments for Ramsar wetlands suggested that Gunbower Forest was low for acidification and metal release hazard, but high for deoxygenation hazard (MDBA, 2011).

Furthermore, and contrary to risk mapping, some site-specific acid sulphate soil (ASS) investigations have been undertaken for the project as part of groundwater and geotechnical investigations (URS, 2015). Field screening for acid sulfate soils detected a number of selected sites where the soils were classified as acid

sulfate soils. Affected sites included Camerons creek, Old Cohuna Main Channel and ephemeral creeks. The soils classified as acid sulfate soils were the soft to firm and saturated recent alluvium at Camerons Creek, the silt infill within Old Cohuna Main Channel and the soils within inverts of ephemeral creeks within the forests. Given the low level of acidity, the presence of these acid sulphate soils was not expected to pose a significant issue (URS, 2015).

Re-wetting of dried soils (lowering then raising of water tables) or excavation works / soil disturbance within areas of potential ASS could result in the formation of actual ASS. Prior to commencement of construction, the contractor will be required to undertake an ASS investigation and if potential ASS are identified and disturbance cannot be avoided, an ASS Management Plan will be developed to minimise potential effects on surrounding soils, vegetation and water environments.

Are there geotechnical hazards that may either affect the project or be affected by it?

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

Recommendations for design of structures in response to geotechnical conditions identified at the site are contained in URS (2014, 2015) and were considered in the detailed design of the project. Additional geotechnical work is proposed by VMFRP and will further inform detailed design.

Geotechnical hazards (and mitigation measures proposed) include:

Construction

- Soil erosion – mitigated by construction planning and implementation of a sediment and erosion control plan (part of the CEMP).

Operation

- Soil erosion in waterways and in the vicinity of regulating structures – mitigated through the use of rock armouring and drop structures.
- Piping through embankments and around structures – mitigated by appropriate material selection and construction techniques, 'keying in' of structures, cutoff drains.
- Settlement of structures – mitigated by appropriate foundation design (eg. piles), removal of inferior foundation material.

In addition, prior to commencing works the contractor will be required to prepare a CEMP outlining measures to identify and avoid or manage disturbance of potential ASS, an erosion and sediment control plan and a dewatering management plan (if required).

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.

Construction

A temporary increase in traffic along access roads and park access tracks would occur during construction and is expected to involve:

- Haulage of fill / spoil to the proposed construction sites via local roads and existing tracks, and the Murray Valley Highway
- Access to proposed infrastructure via:
  - Tickells Track
  - Camerons Creek River Track
  - River Track
  - Munroe Track
  - Baggots Creek Track
- Delivery and removal of plant as required, including excavators, truck and trailers, graders, rollers and forklifts
- Workers travelling daily to and from site, anticipated to mostly be from Kerang to the West or Echuca to the east

An Access Plan for the Upper Gunbower project has been prepared which utilises the access upgrade types and access track classes detailed in the VMFRP General Design Criteria Report (R8, 2019a).

Access to Camerons Creek River Track Regulator will be obtained via the River Track which extends from Torrumbarry Weir Road. This track is currently a single lane gravel track which is frequently used by the public to access camping and recreation areas along the Murray River frontage. The track is currently in a relatively good condition and is generally suitable for construction vehicles, however some isolated widening, repairs and lopping of low hanging tree branches will be required.

Whilst there are numerous tracks lead from the River Track to the Camerons Creek Mid Regulator, the preferred access route for construction and operation is via the track shown on Figure 13 of R8 (2019a). This track is in fair condition, however it will require grading, isolated widening, repair of rutted areas and lopping of low hanging tree branches. It may also be necessary to provide a gravel wearing course, based on the outcome of a constructability assessment.

Access along the irrigation pipeline will be obtained via an existing informal track which is currently located along the power line corridor in which the pipeline will be installed. It should be noted that once operational, access across the creek section of the pipeline will not be possible due to the wet conditions in this area. Access considerations for this area are yet to be confirmed and will be considered as part of the design process.

Access to the existing levees will be addressed as part of the Levee Risk Assessment.

During construction, public access along the main access tracks will be temporarily closed with signed detours in place for visitors. New or upgraded / raised access tracks may be required where water pools against the existing levee. Access track dimensions on levee crest will be consistent with DELWP access track design and maintenance requirements.

While traffic volumes have not yet been estimated, construction traffic will be managed through standard controls contained in a CEMP and Traffic Management Plan to mitigate impacts. In addition, it is expected that construction will only be undertaken during the day time period, which will avoid night time construction traffic noise impacts.

There is potential for disruptions to recreational access to the Murray River and other parts of the State forests during construction. Engagement will be undertaken with DELWP and Parks Victoria to manage access disruptions and a stakeholder management strategy prepared and implemented so that they are aware of the extent and timing of construction works, and can plan accordingly (e.g. signage, notification to park users).

Operation

Traffic generated during operation of the project will be minimal and limited to maintenance vehicles (e.g. mostly 4WDs).

During managed inundation events, some tracks within Gunbower National Park may not be accessible due to water restricting access or to manage public safety risks, which may limit access to dispersed camping sites and reduce opportunities for active and passive recreation. The restrictions may also impact access to licensed apiary sites, however licence holders will be notified prior to commencement of a managed inundation event, providing them with the opportunity to move sites to higher ground if required. Therefore, there is a low risk of impacting licensed apiary sites. Further assessment will be undertaken in consultation with DELWP and Parks Victoria, to identify opportunities to maintain or provide alternative access to park users, where practicable. Following environmental watering there may be increased visitation due to the improved environmental conditions in the park.

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.

The regulating and pump station structures proposed within the Gunbower Forest are separated from residential dwellings.

The nearest dwelling to the operation of the Brereton Road Pump Station is located on the Victorian side of the Murray River approximately 330 m from the proposed pumping Station. The Camerons Creek Road Pump Station has three nearby sensitive receivers, within between 200 m to 330 m from the pumping facility to the east and south east of the site and another two to the west and north west around 500 m away. The location of the pump station is not visible to any of the nearby residents, due to the topography of the banks and existing vegetation between the pump station locations and the residential properties.

Construction

A small number of dwellings and businesses may potentially experience some additional noise, dust and traffic during construction, particularly during haulage of fill and spoil. This includes 38 buildings in the Upper Gunbower area located at the Torrumbarry Weir Holiday Park, along Torrumbarry Weir Road, Steel Road, Hall road and Headworks Road. There are also three additional buildings near the Middle Gunbower portion of the project; one on Tickells Road, one dilapidated structure southwest of the Brereton Road Pump Station and one northwest of that Pump Station.

The potential effects on the relatively small number of residents and buildings are typical of construction projects. As such, potential effects are well understood and able to be managed through standard controls contained in a CEMP and Traffic Management Plan. In addition, it is expected that construction will only be undertaken during the day time period, which will avoid night time construction noise impacts.

It is not expected that vibration will be a significant impact during construction of the project as all assessed sensitive receivers are greater than 200m away from the construction activities. The most likely areas where significant vibration impacts may occur would be during the construction of coffer dams, regulators, hardstand areas, roads and embankments and areas that required sheet piling.

Operation

The project design includes the use of two pump stations; the Brereton Road Pump Station and Camerons Creek Pump Station. At each of these pump stations three to four pumps will operate on a 24 hour basis for several days / weeks or months at a time with pumping occurring for 10 times in every 10 years for Permanent Wetland Watering and 3-4 times in every 10 years for Forest Floodplain / semi-permanent wetland watering.

The Brereton Road Pump Station is located on the Murray River and therefore construction would occur within the Murray River, with excavation and structural works required for the pump well. The current concept includes a reinforced concrete open structure on the bank extending into the River to house submersible pumps and motors. To enable pumping to occur at varying water levels in the Murray River, multiple pumps will be required. At the concept design stage, two higher flow rate pumps and two lower flow rate pumps are proposed to meet the flow rate range required from 10 ML/d to 125 ML/d. The pumps, motors and pipework all sit up to 7 m below natural surface level so will not be visually obvious to the observer, even at close range but rather will be hidden away by a grated cover flush with the ground level. Only the switchboard and electrical cabinet will be above ground level, as it is required to be above flood level, contained in the fenced in area. The electrical works will be well contained and of standard industry design for these applications, on a footprint approximately 5 m x 3 m, compatible with similar nearby irrigation type structures in appearance. The entire fenced in containment area is 30 m x 18 m, approximately one quarter of this area consisting of access road.

The Camerons Creek Pump Station is located on GMW's National Channel (part of Gunbower Creek) and therefore construction will occur within the creek. The preliminary design of the Camerons Creek Pump Station is currently being undertaken by GMW and therefore details of the main components of works (e.g. nature, siting, approximate dimensions) are not yet available. It is likely that the pump station would include a main pump set that would include two duty pumps and one standby pump for irrigation and environmental flow delivery and one small jockey pump to service smaller stock and domestic flows.

Both Pump Stations will be electrically powered, with the power supply extending from the nearby Powercor supply system to the new pump stations. Details for the proposed power supply are yet to be confirmed, but preliminary details are provided in Section 3.

Operational noise modelling was undertaken using Computer Aided Noise Abatement (CadnaA) Version 2020-MR1 noise modelling software to predict the effects of operational related noise from the pumping site. Findings are provided below:

- Predicted noise levels from conservative scenarios where four pumps are running simultaneously during a pumped inundation event at the Brereton Road Pump Station indicate that noise levels will comply with the strictest noise criteria of 34 dB(A) at all sensitive receivers, as well as meeting the base noise levels of 32 dB(A) from the relevant "*Noise from Industry in Regional Victoria*" guideline.
- Noise levels from conservative scenarios where two pumps as well as a jockey pump are running simultaneously during a pumped inundation event at Camerons Creek Pump Station are predicted to comply with the strictest noise criteria of 34 dB(A) at all sensitive receivers with the exception of the closest dwelling to the site where noise levels are predicted to be 36 dB(A) under this scenario. Following the placement of a 2.5m high earthen bund or noise wall to the south east of the pump

station (between the pump station and the dwelling), the predicted noise level at the dwelling is expected to comply to the noise criteria with a noise level of 33 dB(A).

- General measures to avoid exceedance of the noise criteria would be employed during pumping (such as general maintenance of the equipment used).

As the exact pumps to be used have not yet been selected, specific mitigation measures required will be confirmed to comply with noise criteria for the actual type and capacity of pumps to be used.

All Pump Stations will have external lighting fitted, however these lights will only be used during maintenance events. It is unlikely that maintenance will occur at night and therefore there is unlikely to be any light impacts to resident dwellings located in close proximity to the Pump Stations or fauna in the area.

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.

The proposed construction activities are mostly located within the River Murray Reserve and Gunbower National Park and at a minimum of approximately 200 m away from residential dwellings. Potential adverse effects on local communities during the construction phase would most likely be limited to increases in noise, dust and traffic associated with transport of fill / spoil between the Murray Valley Highway, Gunbower Island Road, Island School Road, Bramley Road, Gamble Road, McPhail Road, Sternber Road, Norman Road, Dye Road, Frees Road, Tickells Road and the smaller public access roads that connect to the construction areas; Brereton Road; Camerons Creek Road, Steel Road, Torrumbarry Weir Road, Hall Road and Headworks Road.

A Traffic Management Plan will be developed to minimise potential risks to communities along haulage routes associated with a temporary increase in heavy vehicle traffic during construction. Stakeholder engagement activities will also continue through the construction phase to manage issues raised by local communities.

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.

The project will not displace any residences or sever residential access to community resources as the works are located within discrete sites within the River Murray Reserve and Gunbower National Park. Although public access along the main river tracks in the River Murray Reserve / Gunbower National Park will be temporarily closed during construction, these impacts would be only temporary in nature and access would be reopened to the public following construction. Apiary licence holders will be consulted to identify opportunities that would minimise disruption / access to sites in close proximity to the construction footprint and inundation area.

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.

The Gunbower Forest National Park is managed for multiple uses, including conservation, recreation, apiary, and indigenous values. The project area also occurs near the Torrumbarry Irrigation area and the Koondrook farming area known for dairy and cropping. Recreational use includes fishing, camping, boating, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving. Given the area also forms part of the Murray River Trail for tourism, caravanning and trail-bike

riding also occur (North Central CMA, 2014a, R8, 2020e). There are no designated camping areas or other recreational facilities located within the permanent footprint of proposed infrastructure.

There are currently fourteen active apiary sites across the Gunbower National Park Floodplain complex which are dependent on seasonal flowering of River Red Gums. Although bees rely on an adequate water source to thrive and it is expected that the objectives of the project would increase the regularity and reliability of flowering, further consultation with potentially affected apiary licence holders will occur to inform management of potential impacts.

No land use activities are expected to be permanently displaced by the project. Consultation will be carried out with two apiary sites that are located within 100 m of the construction footprint and two sites that are within 50 m of the area of inundation to inform the need for any mitigation measures. Construction impacts on the floodplain would be temporary only and will be rehabilitated following construction in accordance with management measures outlined in the project CEMP.

Temporary restrictions on access and land use activities within and adjoining the River Murray Reserve and the Gunbower National Park floodplain complex may occur during construction and managed inundation events as described in the following section.

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.

Temporary disruptions to access and activities within the project area are likely to occur during construction and inundation events, including:

- Temporary loss of land for farming for construction of pipeline infrastructure, particularly with the Cameron's Creek Pipeline, traversing private property boundaries.
- Possible disruptions to recreational access to the Gunbower National Park, Murray River and other parts of the River Murray Reserve during construction and managed inundation events.
- Possible inundation or disruption to up to four licensed apiary sites during construction and managed inundation events.
- Access along some existing access tracks will be closed to the public during managed inundation events. This may reduce opportunities for active and passive recreation using existing tracks, however the project will reconfigure the recreational user experience and environmental water and improved habitat condition is likely to improve the visitor experience and tourist options for use of the site.

These potential impacts are likely to be either temporary and/or undertaken subject to agreements with the potentially affected landowners/managers or asset owners.

The project will not involve any permanent closure of existing access tracks or other facilities that are currently available for public use.

Although temporary disruptions to access and activities within the Gunbower National Park and Murray River Reserve would likely occur during construction and managed inundation events, implementation of the project is expected to improve the condition of vegetation communities and associated habitats within the proposed inundation areas, which would contribute to improved park user experiences in the longer term.

Is mitigation of potential social effects proposed?

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

The constructing authority (LMW) will work closely with Parks Victoria and other interested groups to minimise disruption to recreational users and commercial operations during construction and managed inundation events. A stakeholder and community engagement strategy will be developed and implemented during the construction and operation phases to disseminate information regarding proposed road, track or recreational facility closures in a timely and readily available manner to interested parties to minimise disruption.

The stakeholder and community engagement strategy is to specifically include requirements for:

- Engaging with potentially affected private land and asset owners, to determine potential impacts and associated mitigations required during construction and operation of the project
- Engaging with apiary licence holders in conjunction with Parks Victoria as the public land manager for the Gunbower National Park, to identify opportunities to temporarily or permanently relocate the affected apiary site/s if it cannot be avoided during construction, and to minimise disruption to apiary activities during managed inundation events
- Engaging with Parks Victoria, DELWP, Councils and tourism operators, to ensure they are aware of the extent of upcoming watering events and can plan accordingly (e.g. signage / notification of park users)

In addition, the following mitigation measures will apply to the project:

Design measures

- Provision for infrastructure (e.g. gates) where suitable to facilitate temporary restrictions on public access along certain access tracks during higher risk periods (e.g. flooding) and to provide Parks Victoria and/ or DELWP with operational flexibility to restrict access to parts of the Gunbower National Park and Murray River Reserve where deemed necessary to provide rest and recovery from visitation.
- Further planning and refinement of operating scenarios is to be undertaken to refine the extent, frequency and duration of managed inundation, particularly in relation to potential effects on private land and the Murray Valley Highway road corridor (given this is the main access to the site from the east and the west).

Traffic management plan

- A Traffic Management Plan must be prepared and approved in accordance with the *Road Management Act 2004* and implemented. The plan must be prepared by a suitably qualified and experienced traffic engineer.
- The contractor must liaise with the land manager, the relevant Council and Regional Roads Victoria in the preparation of the Traffic Management Plan. Evidence of this consultation must form part of the plan.
- Site access points and roads are to be located so as to minimise the impact on nearby residences, cultural heritage sites and flora and fauna habitat.
- All vehicles and plant must only operate on existing tracks and in areas marked as parking areas or construction zones.
- Deliveries to the site are to be scheduled to minimise disruptions to local amenity and traffic.

Nearby residents and landholder notifications

- Notify affected residents and landholders of changes to traffic conditions and access to property for duration of the works. Nearby residents are to be notified at least seven days in advance of

works commencing of the nature, duration, and hours of work if they are likely to be impacted by construction activities (i.e., due to noise, vibration, access, traffic).

Noise management

- Prepare and implement a Noise Management Plan as part of the CEMP that includes appropriate measures to minimise noise consistent with EPA publications: Noise Control Guidelines (EPA Publication 1254,) and Environmental Guidelines for Major Construction Sites (EPA Publication 480) and AS 2436 Guide to Noise Control on Construction Maintenance and Demolition Sites. The Noise Management Plan should consider controls such as:
  - Substituting noisy activities with an alternative process where available
  - Restricting times when noisy work is carried out
  - Consultation with affected residents
  - Scheduling deliveries to the site so that disruption to local amenity is minimised
  - Notifying the land owner/manager and nearby residences of any planned and unavoidable out of hours works at least five days in advance.
- All construction plant and equipment used on the works must, in addition to other requirements, be:
  - Fitted with properly maintained noise suppression devices in accordance with the manufacturer's recommendations
  - Be maintained and operated in accordance with manufacturer's recommendations
  - Switched off when not in use.
- Simple avenue for noise and vibration complaints to be registered, all are to be investigated and corrective actions implemented as required.

Pumping Noise

Noise mitigation measures proposed to mitigate pumping noise for the project include:

- An earthen bund or noise wall on the north-northwest side of the Brereton Road pump station to mitigate residual noise impacts to dwelling to the north-northwest.
- An earthen bund or noise wall on the south-southeast side of the National Channel pump station to mitigate noise impacts to dwelling to the south-southeast.
- Consideration of additional noise mitigation measures on the south-south-east side of the Brereton Road Pump Station to mitigate noise impacts to the popular Brereton Road boat ramp site and Masters Landing day-visitor areas nearby. This additional measure is under discussion with PV and may be included in the final design.

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

15.1 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.

Consultation to date with Traditional Owner (TO) groups has included engagement with the following groups:

- Yorta Yorta Nations Aboriginal Coorporation

The Yorta Yorta National Aboriginal Corporation is the Registered Aboriginal Party (RAP) for the project area. A desktop Cultural Heritage Management Plan (CHMP) is in preparation in consultation with the above TO group and Standard Assessment will follow.

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)

The following cultural heritage investigations and studies have been undertaken for the project to date, focussing on the construction footprint:

- Desktop assessment by R8 to determine the requirement for a Cultural Heritage Management Plan (CHMP) for the project. This included identification of Aboriginal cultural heritage values within 50 m of the construction footprint and 10 m of relevant access tracks. Key findings included:
  - A number of cultural heritage investigations have been undertaken in the geographic region, with no previous CHMPs covering any part of the project area. Several of the archeological assessments intersect with the project area. Whilst none of the CHMPs intersect the project area, they are located within the geographic region and have relevance to the project area.
  - A review of the Victorian Aboriginal Heritage Register (VAHR) identified 30 Aboriginal Places totaling 36 individual components within 50 m of the project area, and of these 13 Aboriginal Places with 15 individual components are located entirely within the project area.
  - A project specific CHMP is required as the project is a high impact activity (utility installation) within an area of moderate to high cultural heritage sensitivity.
  - As works cross into New South Wales, an Aboriginal Heritage Information Management System (AHIMS) search has also been undertaken.
- Gunbower National Park Environment Works Project CHMP (Benchmark Heritage Management, 2017) made the following predictive statements:
  1. Scarred trees may occur anywhere within the project area where remnant native trees of an appropriate age survive; these are found predominantly on Box and River Red Gum.
  2. Earth features (mounds) may occur near former swamps and on flood terraces on watercourses.
  3. Freshwater shell middens could potentially be found along the undisturbed banks of larger watercourses. Rock wells may be found on larger rocky outcrops;
  4. Burials are most often found in sandy deposits along watercourses and lake/swamp lunettes, but are considered unlikely within the project area;

5. In terms of any survey, the level of ground surface visibility affects the ability to identify archaeological sites. Poor ground surface visibility hinders the identification of sites and factors include thick vegetation cover or sedimentation since European occupation;
6. Ground disturbance has occurred in sections of the project area by the removal of native vegetation, especially logging, grazing, earth works, construction of tracks, irrigation channels and water infrastructure and this may have impacted on surface soils and affect the integrity and scientific significance of sites;
7. Most sites are to likely date to within the last 6,000 years and most will reflect occupation within the last 1,000 years; and
8. The overall Aboriginal archaeological potential for sites of high scientific significance is considerable.

- Victorian Murray Floodplain Restoration Project, Gunbower Draft Complex Cultural Heritage Management Plan No. 16904 (currently in preparation by R8):
  - A Notice of Intent (NOI) to prepare a CHMP was lodged with Aboriginal Victoria on 24 October 2019
  - VMFRP are currently undertaking stakeholder consultation and associated field work (Standard Assessment, scheduled for late July) and development of the CHMP
  - The CHMP is scheduled to be completed in late 2020
- A preliminary European cultural heritage study (Kaufman and Ballinger, 2014) was undertaken. The desktop and field assessment noted a number of heritage areas and sites within the area of investigation. Sites were either not in the work area (e.g. Deep Creek rock ramp fishways) or no historic cultural heritage issues were identified in relation to sites (e.g. Phylands Lease Works, Old Straight Cut works, Baggot Creek works, Inlet channel and regulator works / Torrumbarry Weir, Cameron Creek sites, Levee Bank works). Sites that were considered to be in the Work Area and may potentially require a Permit under the *Hertiage Act 1995* and *Planning and Environment Act 1987* included Old Cohuna Channel Works. In addition, minor features and structures were noted to contribute to the historic landscape including Forestry Activities sites and other irrigation / floodplain control structures in Gunbower National Park and features relating to Grazing.
- Victorian Murray Floodplain Restoration Project, Gunbower Historical Heritage Desktop Assessment (R8, 2020c), which:
  - Included assessment of historic archaeological values within the area of investigation and inundation area at Gunbower
  - Did not identify, based on desktop review, any historical heritage places within or adjacent to the construction footprint or inundation area.
  - Found that prior historical heritage assessments indicated a number of sites comprising potential historical heritage places
  - Found there is moderate potential for previously unidentified historical heritage to be present within the project area
  - Recommended that a Historical Heritage Assessment (HHA) be undertaken for the project which should include field survey to identify further historical archaeological sites and any unidentified historical heritage places and, if identified, prepare a significance assessment of these places.

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 project area is located within the Murray River floodplain, which would have been a favourable location for Aboriginal occupation and resource procurement given the availability of food and fresh water. Remnant mature River Red Gum and Black Box, especially along the Murray River, have potential for cultural scarring with scarred trees being the most commonly recorded Aboriginal Place type within the region and the Aboriginal Place type most likely to be located within the project area. Landforms with the highest archaeological potential are in the margins, terraces and source-bordering dunes of the waterways

Earth mounds are the second most commonly recorded Aboriginal Place type recorded within the region and are also likely to be located within the project area. Aboriginal Place type, density and distribution away from the watercourses is likely to be lower than along the watercourses.

The level of previous ground disturbance within the National Park, relates to the likelihood of recording intact Aboriginal Places within the area of investigation. It is considered that ground disturbance has occurred in sections of the area of investigation during the removal of native vegetation, extensive logging, grazing, earth works, construction of tracks, irrigation channels and existing water infrastructure which have impacted on surface soils and affect the integrity of and scientific significance of the sties (Benchmark Heritage Management, 2017).

A search of the VAHR identified 30 registered cultural heritage places (Aboriginal Places) containing a total of 36 individual components located within 50 m of the activity area[7] The majority of Aboriginal Places were located between the Murray River and the southwestern edge of the Gunbower National Forest, with almost a third being located within 200 m of the Murray River. A smaller number of Aboriginal Places were also recorded along Gunbower Creek and associated lagoons. Of those recorded within 50 m of the activity area, 13 Aboriginal Places (containing 15 individual components) are located entirely within the activity area. The place types include scarred trees, an artefact scatter, two earth features (mounds). It is considered, there is a moderate-high potential for further undiscovered Aboriginal heritage to be present in the activity area.

This assessment was based on the activity area associated with the current design for the project. As the design process progresses, further assessment will be undertaken for any locations not contained within the current activity area. This assessment will be included as part of the development of the final CHMP.

The CHMP currently being prepared for the project is the mechanism for managing impacts to Aboriginal cultural heritage within both the construction footprint and inundation area. As a part of the CHMP process, consultation with the traditional owner groups is ongoing. The CHMP will include a desktop assessment, standard assessment (field survey) and complex assessment (sub-surface testing).

The CHMP currently being prepared for the project will identify the impact on the Aboriginal heritage places identified above and others found during the standard and complex investigations.

[7] The CHMP activity area is the same extent as the project area of investigation

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.

A desktop heritage assessment has been prepared and is provided in **Attachment 9 – Historical Heritage Assessment.**

No places listed on the Victorian Heritage Register (VHR), Victorian Heritage Inventory (VHI), World Heritage List, National Heritage List or Commonwealth Heritage List are located within or adjoining the area of investigation.

Cohuna and Gannawarra Pumps are currently nominated for the VHR, but their status is not yet confirmed by HV. While not currently registered on any heritage register, this historical heritage place was nominated for listing on the VHR by Kaufman and Ballinger (2014), but its heritage status has not been confirmed with HV. Based on this nomination, this heritage place has interim protection under Part 8 of the *Heritage Act 2017*, which covers a substantial area including the main Cohuna and Gannawarra Headworks remnants, Deep Creek Inlet Channel, connecting channel and broad areas with visible archaeology or archaeological potential. As such, any works in the headworks area will require a Permit from HV.

The nearest historical heritage place to the area of investigation at Gunbower comprises Torrumbarry Weir Lock Chamber, Steam Boiler and Steam Winch Complex (H0993/Campaspe HO202/RNE 101506), which is situated on the Murray River. It is approximately 266 m to the north of the Upper Gunbower Forest area of investigation, and approximately 1 km east of the Upper Gunbower Forest inundation area.

Examination of previous heritage assessments has identified a number of potential heritage values that are not listed on any heritage register (Kaufman and Ballinger, 2014). There are no statutory requirements for these places, as they are not currently included on any heritage register. The places include:

- Old Weir, Mackays Bridge
- Deep Creek Inlet
- McKays Mill
- Redundant Regulator, Deep Creek
- Wooden Bridges, Old Cohuna Channel
- Cameron Creek Bridge
- Concrete Pits, Torrumbarry Weir
- Cameron Creek Regulator (Weir)

In addition, based on an assessment of aerial imagery and a review of relevant historical heritage assessments, there is moderate potential for previously unidentified historical heritage to be present within the area of investigation and the inundation area. Site types most likely to be identified in the area of investigation and the inundation area would be heritage places or archaeological sites associated with the historic land use of Gunbower Island, especially in relation to possible pastoral or rural heritage places associated with the former rural landscape that intersects with the area of investigation.

Refer to **Attachment 9 - Historical Heritage Assessment** for further detail regarding the historical and heritage context of Gunbower.

Is mitigation of potential cultural heritage effects proposed?

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

Aboriginal Cultural Heritage

A CHMP is being developed for the project in consultation with the identified TO groups for approval by Aboriginal Victoria (AV) and will include specific management conditions for identified Aboriginal Places where required, along with general management recommendations relating to induction training, salvage methods and stakeholder engagement, and procedures for unexpected 'finds' of potential Aboriginal cultural material.

- As part of the CHMP altered hydrological conditions within the inundation areas would be assessed as part of a detailed inundation assessment. This will inform the assessment of impacts to Aboriginal cultural heritage as a result of inundation activities. The detailed inundation assessment will be staged to assess:
  - Hydrological change resulting from the operation of the infrastructure, relative to how the area currently inundates and the benefits and risks that are associated with the changes in inundation regime. Hydrological change assessment would consider each of the operating phases; filling, holding and emptying. The assessment would focus on changes in velocity, shear stress, water depths and inundation extents across the floodplain areas.
  - Geomorphological change which would include assessment of possible erosion risk areas and capacity of soil types to withstand shear stresses.
  - Aboriginal cultural heritage impacts which may result from the hydrological and geomorphological changes. This will include review of the high impact areas (if any) resulting from these changes and review of the cultural heritage values which may be impacted.
- The detailed inundation assessment will include a discussion on whether the impacts are considered significant in terms of scale, extent, duration and intensity (magnitude) of change in values, and the results of this assessment will inform the development of management conditions in the CHMP.
- The potential impact to Aboriginal cultural heritage values, including Aboriginal Ancestral Remains within the inundation area would be assessed with the results of the hydrological and geomorphological modelling, detailed above. The results of the modelling will be used to develop impact mitigation measures which would be included as management conditions in the CHMP. Development of management conditions will involve consultation with the Traditional Owners, Aboriginal Victoria, the Victorian Aboriginal Heritage Council and the Ancestral Remains Unit within the Office of the Victorian Aboriginal Heritage Council.

Historical Heritage

- Further historical heritage investigations are to be undertaken to identify risks to potentially unrecorded historical heritage features within the project area. A copy of this report (once completed) is to be kept on site and on file with the project records. All contractors and/or project staff are to be made aware of the heritage status of the heritage places in and adjacent to the project area prior to works taking place.

Unexpected discoveries of archaeological sites

- All historical archaeological sites in Victoria older than 75 years are protected by the Heritage Act 2017, whether they are recorded on the VHI or not. It is an offence to knowingly or negligently deface, damage, or otherwise interfere with an archaeological site without obtaining the appropriate consent from the Executive Director of Heritage Victoria (HV). Under Section 127 of the Heritage Act 2017, if an archaeological site is discovered during construction or excavation on any land, the person in charge of the construction or excavation must as soon as practicable

report the discovery to HV. If any unexpected archaeological sites are uncovered during construction works, the following procedure must be followed:

STOP

- Stop any activity which may impact on the discovery
- Ensure that other people working in the area are aware of it and have also stopped work in the area
- Protect the artefacts or site by erecting temporary fencing or another suitable barrier.

ADVISE

- A supervisor or the cultural heritage consultant must be consulted if they are on site
- Supervisors are to advise HV where the discovery was made and provide a description or photograph of the discovery.

MANAGE

- HV, the onsite heritage consultant or supervisor will advise on how to manage the discovery
- Management of the discovery may involve protection, recovery, recording or removal of the artefacts or features and is likely to require a Consent to Damage from HV.

Historical Heritage induction training

General mitigation measures include:

- Historical heritage awareness training should be completed as part of the site induction for all personnel and/or contractors prior to the commencement of construction works to ensure:
  - An understanding of where all heritage places are located within the project area
  - An understanding of the potential heritage places that may be impacted during the project
  - The procedures required to be undertaken in the event of discovery of historical heritage material, features or deposits, or the discovery of human remains
- If an archaeological site is discovered during construction or excavation, the person in charge of the construction or excavation must as soon as practicable report the discovery to HV.
- A copy of the Historical Heritage Assessment **(Attachment 9**) should be kept onsite and on file with the project records. All contractors and/or project staff should be made aware of the heritage status of the heritage places in the project area prior to works taking place.

Mitigation measures specific to the nine places of potential historical heritage value identified during previous assessments within the area of investigation and inundation area include:

- Avoidance of the heritage places should be undertaken, if possible:
  - Prior to any works, including any vegetation clearance, site establishment or construction works in the area, protective barrier fencing will be erected between the historical structures and the works area, to fence them and thereby avoid inadvertent impact; the fencing would be installed for the duration of works for the project and removed following completion.
- Should impact to the heritage places be unavoidable:

- Prior to the start of works, an archival photographic recording of the sections of the heritage places to be impacted should be carried out, in accordance with the guidelines, Photographic Recording for Heritage Places and Objects (Heritage Victoria, 2006)

Works are to be undertaken in such a way as to minimise direct contact by construction vehicles or machinery with the historical structures. Prior to any works, including any vegetation clearance, site establishment or construction works in the area, where the historical structures will not be impacted, protective barrier fencing will be erected between the remaining historical structures outside the works area, to fence them and thereby avoid inadvertent impact; the fencing will be installed for the duration of works for the project and removed following completion.

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.

Power is required to operate the two pump stations within the project area, when required. Both Pump Stations will be electrically powered, with the power supply extending from the nearby Powercor supply system to the new pump stations. The pump locations, rates of pumping, pumping days and volumes for the Gunbower National Park Floodplain Restoration Project area presented in **Table 20**.

The frequency and duration of water pumping at each site will depend on actual inundation events and the method to achieve environmental watering targets, which could be gravity fed, pumping or a combination at these sites. The pumps would likely operate on a 24 hours basis for several days/weeks or months at a time with pumping occurring for either Forest Floodplain / Semi-permanent watering events for 3 times in every 10 years. Permanent Wetland watering events will occur 10 years in 10 years.

The estimated water quantities to be transferred into Gunbower Forest and provided below for each watering strategy (**Table 20**).

Table 20: Summary of estimated pumping events for Full Forest Watering (Source: VMFRP, 2020b)

Pumping parameters	Gunbower Upper Pump Stations	Gunbower Middle Pump Station
Quantity of water to be pumped from the National Channel / Murray River	205 ML	6,215 ML
Frequency of pumping events (ML/d)	3 in 10 years	3 in 10 years
Duration of pumping events (days)	up to 215	up to 150
Pumping rate (approximate)	0.5 - 20 ML/d	1 - 125 ML/d

Table 21: Summary of estimated pumping events for Permanent and Semi-Permanent Wetland Watering Events (Source: VMFRP, 2020b)

Pumping parameters	Gunbower Upper Pump Stations	Gunbower Middle Pump Station
Quantity of water to be pumped from the National Channel / Murray River	155 ML	500 ML
Frequency of pumping events (yrs)	3 in 10	3-4 in 10
Duration of pumping events (days)	up to 215	up to 150
Pumping rate (approximate) (ML/d)	0.5 – 2+ ML/d	2 - 20 ML/d

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.

The main waste streams as a result of the construction works include:

- Excess spoil
- Cleared vegetation
- General building and miscellaneous wastes such as packaging, off cuts, excess materials
- Worker's waste such as packaging, containers, food scraps, etc.

As part of the CEMP, the contractor will be required to prepare a spoil and waste management plan demonstrating compliance with the *Environment Protection Act 1970* (and *Environment Protection Act 2017*) and EPA Publication 480: Environmental Guidelines for Major Construction Sites.

Excavated materials which are unsuitable for use or which are excess to the needs of construction (i.e. spoil) would be disposed of off-site unless otherwise approved by Parks Victoria or the land manager, and managed in accordance with the *Environment Protection Act 1970* and other relevant legislation.

Subject to approval from Parks Victoria, cleared native vegetation not containing pest plant propagules will be mulched and stockpiled within the designated construction footprint for reuse in rehabilitation of construction or extraction areas. Where directed by Park Victoria, cleared vegetation containing hollows will be salvaged and placed in appropriate locations within the national parks.

No significant volumes of waste would be generated during operation of the project.

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

☒ 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.

The estimated Scope 1 GHG emissions[1] for each pump event are approximately 135 t CO_2-e for Upper Gunbower and 148 t CO_2-e for Middle Gunbower, with a combined GHG emission of approximately 283 t CO_2-e (R8, 2020f). These estimates reflect the highest annual emissions expected for any single year of pumping operation.

The estimated combined GHG emissions for the project are significantly less than the 200,000 t CO2-e per annum trigger for a referral as set out in the *Ministerial Guidelines for Assessment of Environment Effects under the Environment Effects Act 1978* (Department of Sustainability and Environment, 2006). The 200,000 t CO_2-e per annum referral trigger is for emissions directly attributable to operation of the project (i.e. Scope 1 emissions).

The estimated emissions are also significantly less than the annual reporting threshold of 25,000 t CO_2-e for individual facilities under the *National Greenhouse and Energy Reporting Act 2007* (Cth).

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.

[1] Any Scope 1 emissions associated with the construction phase of the project (e.g. fuel use from site vehicles) were excluded from this calculation. Similarly, embodied emissions of construction materials (e.g. embodied emissions from the construction of concrete and steel), are Scope 3 emissions and were excluded from the calculation. This section of the referral requires consideration of the potential for the project to exceed the annual NGERs reporting thresholds which incorporate Scope 1 and 2 emissions only.

Draft Environmental Management Framework

A draft Environmental Management Framework (EMF) has been prepared for the VMFRP program containing an overview of:

- Project description – location, environmental context, project objectives, construction and operational activities
- Roles and responsibilities for implementation of environmental management during construction and operation of the program
- An overview of related environmental management documentation and associated approval processes (e.g. CEMP, CHMP, EWMP, Operating Plans, etc)
- An overview of relevant legislation and statutory approval requirements
- The approach to identifying and evaluating potential risks to environmental values during construction and operation of the project
- Environmental management measures to avoid or mitigate environmental impacts
- Monitoring, reporting and auditing requirements to inform adaptive management.

A copy of the draft EMF is provided in **Attachment 8 – Draft Environmental Management Framework**. The draft EMF includes the general mitigation measures for construction and operation of the project that will be undertaken to avoid and minimise impacts on the environment. The draft EMF will evolve as the project assessment and approvals process progresses.

Design and construction

The project has undergone a comprehensive design process, with a number of design options considered. During this process, measures (as identified in this referral and contained in the draft EMF) to mitigate impacts on environment and heritage values have been integrated into the design and will continue to be as further design refinements are made.

In accordance with the draft EMF, the contractor will be required to prepare a Construction Environmental Management Plan (CEMP) for the project, including:

- The project's environmental management system, procedures and processes, including all project

forms and registers

- A project environmental risk assessment and control program
- Clear delegation of responsibilities (i.e. within the contractor's project team)
- Project legislative requirements
- Details of approvals, permits, agreements and/or licences for the various stages of work
- Relevant environmental procedures and work instructions
- An environmental inspection/monitoring program and inspection checklist
- Worksite specific plans
- A checklist that demonstrates that each requirement of the draft EMF has been addressed in the preparation of the CEMP.

Operation

The primary environmental management documentation for managing adverse environmental effects and maximising environmental benefits during operation of the project will be the:

- Environmental Watering Management Plan
- Operating Plan.

Environmental Watering Management Plan

The Gunbower Forest EWMP (MDBA, 2012) will be updated once the project is fully approved. The EWMP will include:

- Long-term management objectives and inundation regime requirements for the Forests. These have already been developed as part of the Ecological Objectives and Hydrological Requirements Justification Paper for Gunbower (North Central CMA, 2014b) and have been described in Section 3 – ecological objectives.
- Management measures to manage the risk associated with achieving the project's ecological objectives (i.e. factors outside delivery of environmental water inhibiting ability to achieve objective) and delivery of environmental water.
- Complementary actions to enhance the outcomes of environmental watering (e.g. pest plant and animal control).
- A summary of environmental monitoring (long term and intervention) included in the VMFRP Ecological MER Plan (ARI, 2020a).
- Summary of consultation that has been undertaken as part of the EWMP development.
- Roles and responsibilities for environmental water delivery and associated management of Gunbower National Park / Gunbower Forest. These will be assigned as part of process for developing the EWMP.

The EWMPs will be used to inform the development of Seasonal Watering Proposals and Seasonal Watering Plans for the Gunbower National Park Floodplain and Long-term Watering Plans that will be developed by the State under the Basin Plan Chapter 8 (MDBA 2014).

An Operating Plan will be developed for the project and will provide the framework for operation of the Gunbower National Park floodplain environmental watering works to meet key ecological objectives and comply with relevant legislative requirements (e.g. *Water Act 2007* (Cth), s52-54 of Murray-Darling Basin Agreement) The plan will outline:

- Description of those parts of the forests (ecological components) that are relevant to the operating scenario.
- Intention of the operating scenario from an ecological perspective.
- Inundation regime requirements for the ecological components in order to achieve the objectives.
- Infrastructure operations to achieve the inundation regime requirements.
- Other important considerations for operating the works including:
    - Refinement of a strategies to cue fish to exit the floodplain
    - Climate and water availability conditions

The Operating Plan is not intended to prescribe particular watering events and is a 'living document' that will be further refined and updated over time if legislation changes or operations in the major river systems require it. As the asset owner, Goulburn Murray Water will adopt their own Operating Plan on completion of construction.

Complementary management activities

It is acknowledged that to achieve the targeted ecological objectives at Gunbower National Park, more than just environmental watering regimes and inundation regimes closer to natural conditions are required. Complementary management activities will need to be delivered to maximise the ecological, social and cultural benefits of environmental watering and assist in achieving project objectives. These activities will be undertaken in partnership with PV, DELWP, North Central CMA, the local council and communities. Potential complementary management activities include, but are not limited to:

- Culturally sensitive invasive animal management: monitor pest animal activity (e.g. European Fox, Rabbit and Feral Pig) and employ appropriate management techniques (e.g. baiting, fumigation).
- Invasive plant control: target high threat weeds (e.g. Weeds of National Significance: - Bridal Creeper, Paterson's Curse, African Boxthorn, Blackberry, Bathurst Burr, Prickly Pear) particularly weed infested areas.
- Active revegetation (seeding and/or pugging) of flora species representative of the targeted EVCs if passive revegetation is not successful due to lack of soil stored seed bank or species unable to disperse into the inundation area from adjacent areas.
- Measures to address off-farm impacts such as stock access (point source) and fertilizer runoff (diffuse source).
- Rationalisation of access tracks. Four wheel driving off-track during wet weather has led to significant damage to soils, roads and vegetation.
- Improved facilities at camping sites.
- Improvement of visitor facilities to enhance recreational opportunities e.g. walking, bird watching and fishing.

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.

The project has some potential for cumulative effects in relation to other VMFRP projects. The potential for cumulative effects is generally associated with:

- Water quality impacts associated with water discharge to the Murray River during and following an environmental watering event.
- Removal of large, hollow-bearing trees and associated habitat for threatened species such as Superb Parrot, Corben's Bat, Carpet Python, and Lace Monitor from River Red Gum and Black Box communities along the Murray River floodplain.
- Removal of native vegetation and associated habitat from similar EVCs across multiple sites due to the need to locate proposed infrastructure at certain elevations on the floodplain and potential impacts on bioregional conservation status of particular EVCs.

Further assessment of potential cumulative effects, including considering other activities in the vicinity of the project, will be carried out as design development and environmental investigations are advanced at other VMFRP sites. Cumulative impacts associated with the VMFRP sites have not been considered in detail, as it has not yet been determined which projects will proceed.

20. Investigation program

20.1 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.

Environmental investigations completed for the project to date include:

ARI (2015), Performance, operation and maintenance guidelines for fishways and fish passage works. Authors: O'Connor J, Mallen-Cooper M, and Stuart I of Arthur Rylah Institute for Environmental Research.

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DHI (2017), NCCMA Gunbower National Park SDL Offset Project Model Update and Management Scenario Modelling Report. Prepared for the North Central Catchment Management Authority, July 2017.

Ecological Associates (2003), Flooding Enhancement of Gunbower Forest – Investigation of Priority Options – Part A, unpublished report prepared for North Central Catchment Management Authority, Bendigo.

Ecological Associates (2010), Upper Forest Channel Risk Assessment. Report prepared for Mallee Catchment Management Authority.

Ecological Associates (2014a), Ecological objectives and hydrological targets in Upper Gunbower Forest. Ecological Associates report AA021-1-B prepared for North Central Catchment Management Authority, Huntly. October 2014.

Ecological Associates (2014b), Preliminary Modelling Advice – draft report, prepared for North Central Catchment Management Authority, Huntly.

GHD (2017), Gunbower National Park Flora and Fauna Assessment. Report prepared for the North Central CMA.

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Has a program for future environmental studies been developed?

☐ No ☒ Yes If yes, briefly describe.

The effectiveness of the proposed project and its operation will primarily be monitored and reported on through the North Central CMA's well-established monitoring, evaluation and reporting (MER) strategies and protocols. These strategies and protocols build upon experience and lessons learned through the ongoing, long-term ecological monitoring programs undertaken within the TLM program, which includes condition and intervention monitoring across several sites in the North Central region. The North Central CMA has been implementing and coordinating the local, annual TLM Monitoring, Evaluation and Reporting Framework process since 2005.

These strategies and protocols provide a routine process to:

- Establish a robust program logic to define the correlation between works and other inputs and identified outputs and ecosystem outcomes. This provides the basis for a suite of quantifiable ecological targets that are relevant to the specific site;
- Monitor progress against those targets on a regular basis;
- Evaluate the implications of the results for the operational parameters of the scheme;
- Amend and adjust the operational arrangements to optimise performance and outcomes;
- Utilise monitoring data to plan watering events, optimise water delivery, manage risks and refine ecological objectives. The evaluation process involves analysing collected data and improving operations accordingly.

Ecological Monitoring and evaluation will focus on the effects of local watering actions and include:

- Evaluating water use;
- Measuring ecological outcomes;
- Refining conceptual models and improving knowledge;
- Managing risks.

Detailed ecological monitoring and evaluation objectives were previously outlined in the North Central Waterway Strategy (North Central, CMA 2014d). The monitoring and evaluation plan identifies the agencies responsible for commissioning, reviewing and acting on monitoring data. The linkages back to decision-making are described in the detailed plan. A new Monitoring, Evaluation and Reporting Framework is currently being funded by the project and is due to be completed by June 202 (VMFRP, 2020c). This framework will aim to establish a social, heritage and environmental benchmark and monitoring programme to demonstrate the ongoing benefits of the project.

Initial monitoring will provide a baseline of the existing status of the ecological values relevant to the project objectives, and outcome monitoring will measure progress towards these objectives and their targets. This information will inform the ongoing operations at the site. Over time, the results of the outcome monitoring would test assumptions and assist with refining conceptual models and ecological objectives. Monitoring data would identify emerging hazards and enable operational decisions to minimise risk through the adaptive management framework incorporated into Operating Plans and Environmental Water Management Plans.

The final Ecological Monitoring, Evaluation and Reporting Framework approach for this project would be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin Plan. This project is expected to contribute to the achievement of outcomes under two key Chapters of the Plan, namely: (i) the delivery of ecological outcomes under Chapter 8; and (ii) meeting the relevant SDLs under Chapter 10, which must be complied with under the relevant State water resource plan/s (WRPs) from 1 July 2019.

Both Chapter 8 and Chapter 10 of the Basin Plan are captured under the MDBA's own monitoring and evaluation framework. Once specific Basin Plan Chapters commence within a State, the State must report to the MDBA on relevant matters. This will include five yearly reporting on the achievement of environmental outcomes at an asset scale in relation to Chapter 8, and annually reporting on WRP compliance in relation to Chapter 10.

VMFRP is satisfied that its participation in the MDBA's reporting and evaluation framework will effectively allow for progress in relation to this project to be monitored, and for success in meeting associated ecological objectives and targets to be assessed.

This approach closely aligns with agreed arrangements under the Basin Plan Implementation Agreement, where implementation tasks are to be as streamlined and as cost-effective as possible.

A Monitoring, Evaluation and Reporting Plan for Cultural and Socio-Economic components of the VMFRP Program of works is also being developed by VMFRP (Aither, 2020). This plan guides the monitoring and evaluating of the delivery and achievement of cultural and socio-economic outcomes from environmental watering and the project works themselves. The program logic associated with the plan identifies how activities that will be undertaken at each of the VMFRP sites will collectively contribute to the program-level cultural and socio-economic outcomes. It also considers that the project works, and environmental watering may also result in negative outcomes or disbenefits to stakeholders and that the project outcomes can also be influenced by a range of circumstances outside of the projects control.

20.2 Consultation program

Has a consultation program been conducted to date for the project?

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

The North Central CMA worked with key stakeholders, community groups and landowners to develop and refine the Sustainable Diversion Limits (SDL) Business Case for the Gunbower National Park project over a period from 2014 to early 2019.

The project was then rebranded and funded as the Victorian Murray Floodplain Restoration Project with additional engagement occurring from early 2019 to current. Consultation activities are ongoing and will continue throughout the duration of the project.

Government stakeholders and project partners are involved through participation in various project governance and technical review groups, or alternatively have been briefed directly about the project, including:

- A Project Control Group, consisting of members from Goulburn Murray Water (GMW), Lower Murray Water (LMW), Mallee CMA (MCMA), North Central CMA (NCCMA) and Parks Victoria;
- A Regulatory Approvals Group, consisting of members from the Victorian Department of Environment, Land, Water and Planning (DELWP), and Department of Premier and Cabinet, the Commonwealth Department of Agriculture, Water and the Environment, and Parks Victoria;

- An Asset Design Group, consisting of members from GMW, DELWP, Parks Victoria and the Murray Darling Basin Authority;
- Project briefings to Campaspe Shire Council, Gannawarra Shire Council and Murray River Council; and
- Via various direct consultation activities with local officers and key contacts e.g. project briefings and site tours.

Recent communication and engagement activities conducted with non-government stakeholders have been undertaken in accordance with VMFRP's Stakeholder Engagement and Communication Plan (for all sites) and have included:

- Face-to-face briefing sessions with all adjacent landowners providing project updates and discussing potential impacts and opportunities for private landowners;
- Presentations, onsite visits and information sharing with the Yorta Yorta Nations Aboriginal Corporation; and,
- Project briefings to other interested stakeholders including – VicForests, Murray River Trails, and the Gunbower Island Community Reference Committee (who contribute to the management of The Living Murray project area).

This engagement has been supported with tailored Gunbower National Park Floodplain Project documentation, including:

- Fact sheets, media releases, electronic communication (website, emails, newsletters), brochures, correspondence and individual maps of landowner properties showing how project infrastructure interfaces with private properties.

This direct approach to engagement has helped capture the views and local knowledge of key stakeholders and community members to directly integrate these into the project designs, resulting in avoided or minimised impacts to private property and industry operations.

Broad community awareness of the project is further evidenced by the sustained interest in the proposal as illustrated by ongoing requests to provide briefings, presentations and updates as project designs further progress.

Information regarding the Gunbower National Park Floodplain Restoration Project is published on the VMFRP website:

https://www.vmfrp.com.au/wp-content/uploads/2020/06/VMFRP-FactSheet-A4-Gunbower-TR-2019-044229-Edit-OJ-30062020.pdf

Has a program for future consultation been developed?

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

Targeted, tailored consultation will continue to be conducted in accordance with VMFRP's Stakeholder Engagement and Communication Plan with key stakeholders throughout the project, aligning to project milestones, assessments and approvals processes where necessary and/or appropriate. This includes further face-to-face briefings, presentations, site visits and regular project updates via mail-outs and newsletters.

Primary consultation will occur with affected government and non-government stakeholders, including:

- Government land managers (DELWP and Parks Victoria)
- Environmental water managers (NCCMA, VEWH, CEWH)

- Environmental water infrastructure operators (GMW, MDBA)
- Directly affected private landowners
- Traditional Owner groups
- Directly affected industry stakeholders (VicForests, Apiary licensees)
- Local government economic development teams
- Special interest groups (Gunbower Island Community Reference Group, Murray River Trails, local tourism operators, VR Fish, and local angling clubs)

Broader engagement via traditional and social media, community events and information displays will also continue to provide general project awareness and rolling updates and dedicated project engagement staff are available to accommodate face-to-face meetings for any individuals or groups wanting further information.

Authorised person for proponent:

I, Josh White (full name),

Project Director, VMFRP (position),

confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date: 11 September 2020

Person who prepared this referral:

I, Josh White (full name),

Project Director, VMFRP (position),

confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date: 11 September 2020

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Appendix A. List of Attachments

Attachment 1 – Project Overview Maps

- Attachment 1.1 – Map 1 - Project Location Map
- Attachment 1.2 – Map 2 - Project Structures, Construction and Access.
- Attachment 1.3 – Map 3 - Managed Inundation Area Map – Upper Gunbower
- Attachment 1.4 – Map 4 - Managed Inundation Area Map – Middle Gunbower

Attachment 2 – Gunbower National Park Ecological Objectives and Hydrological Requirements

Attachment 3 – Flora and Fauna Assessment

Attachment 4 – Waterways and Wetland Map

Attachment 5 – Ramsar Assessment

Attachment 6 – Groundwater Assessment

Attachment 7 – Land Use Planning Assessment

Attachment 8 – Draft Environmental Management Framework

Attachment 9 - Historic Heritage Assessment