Department of Planning and Environment

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Millewa Forest Supply Project

Review of Environmental Factors

Department of Planning and Environment—Water | Decemeber 2023

Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land, and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Millewa Forest Supply Project

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This review of environmental factors has been prepared in a template developed by the Department of Planning and Environment–Water and the National Parks and Wildlife Service specifically for use in assessing the potential environmental impacts of works proposed as part of the Murray and Murrumbidgee Valley National Parks Sustainable Diversion Limit Adjustment Supply Measure Project. It combines key elements of the review of environmental factors templates of each respective organisation.

Declaration

This review of environmental factors (REF) has been prepared by 3Rivers, a joint venture between Jacobs Group (Australia) and GHD, on behalf of the Department of Planning and Environment—Water. The REF has been prepared to satisfy the requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979*. The REF takes into account the environmental factors specified in the *Guidelines for Division 5.1 Assessments* (Department of Planning and Environment, 2022a).

Further, the REF has adequately addressed the matters in Chapter 5 of State Environmental Planning Policy (Biodiversity and Conservation) 2021.

The REF provides a true and fair assessment of the proposed replacement of two environmental regulators, the refurbishment of two other environmental regulators, and the removal of a disused and defunct pipe culvert within Millewa Forest (the 'proposed activity') in relation to its likely effects on the environment. It examines and takes into account to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activity.

Based on the information provided in the REF, it is concluded that:

(1) The proposed activity is not likely to have a significant impact on the environment, and an environmental impact statement is not required

(2) The proposed activity is not likely to significantly affect threatened species or ecological communities or their habitat, or be carried out in a declared area of outstanding biodiversity value. A species impact statement is not required

(3) The proposed activity is not likely to significantly affect any matters of national environmental significance, nor is the activity being carried out on or is it likely to impact Commonwealth land. The proposed activity was referred to the Commonwealth Department of Climate Change, Energy, the Environment and Water in accordance with the EPBC Act and the Commonwealth Minister for the Environment and Water deemed it not to be a controlled action on 27 July 2023.

Based on the information presented in this REF, it is concluded that by adopting the safeguards identified in this assessment, it is unlikely that there would be significant adverse environmental impacts associated with the proposed activity. Subject to the adoption of the measures to avoid, minimise or manage environmental impacts listed in this REF, the proposed activity is recommended for approval.

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Executive summary

The Department of Planning and Environment—Water proposes to carry out works at four existing environmental regulators and one existing culvert within Millewa Forest in south-western NSW. It is proposed to replace Pinchgut and Nestrons regulators, refurbish Moira regulator and Little Edward River offtake regulator, and remove Pigsty culvert (the 'proposed activity'). The proposed activity includes installing fishways at the replacement Pinchgut and Nestrons regulators and the refurbished Moira regulator and Little Edward River offtake regulator.

The purpose of the proposed activity is to modernise existing ageing infrastructure by providing infrastructure that is safer and more efficient to operate. The fishways installed at the replacement and refurbished environmental regulators would also provide opportunities for the site environmental water managers to improve fish movement past these structures.

Key details of the proposed activity are provided in Table E-1. A comprehensive description of the proposed activity is provided in Section 3.

Table E-1 Key details of the proposed activity

Description of the proposed activity	• Replacement of the existing Pinchgut regulator with a new triple bay box culvert regulator immediately downstream of the existing structure. The replacement regulator would include a fishway • Replacement of the existing Nestrons regulator and the existing timber log bridge that carries Millewa River Road over Nestrons Creek with a new trafficable triple bay box culvert regulator. The replacement regulator would be built at the site of the existing timber log bridge, about 20 metres downstream of the existing regulator. The replacement regulator would include a fishway • Refurbishment of the existing Moira regulator to address the poor condition of the existing drop boards and make the structure safer and more efficient to operate. A fishway would be constructed on the left (western) abutment of the refurbished regulator • Refurbishment of the existing Little Edward River offtake regulator including construction of a fishway on the left (western) abutment of the structure • Removal of Pigsty culvert and block bank to leave an open channel.
Name of NPWS park or reserve	Murray Valley National Park and Murray Valley Regional Park

Description of the proposed activity	• Replacement of the existing Pinchgut regulator with a new triple bay box culvert regulator immediately downstream of the existing structure. The replacement regulator would include a fishway • Replacement of the existing Nestrons regulator and the existing timber log bridge that carries Millewa River Road over Nestrons Creek with a new trafficable triple bay box culvert regulator. The replacement regulator would be built at the site of the existing timber log bridge, about 20 metres downstream of the existing regulator. The replacement regulator would include a fishway • Refurbishment of the existing Moira regulator to address the poor condition of the existing drop boards and make the structure safer and more efficient to operate. A fishway would be constructed on the left (western) abutment of the refurbished regulator • Refurbishment of the existing Little Edward River offtake regulator including construction of a fishway on the left (western) abutment of the structure • Removal of Pigsty culvert and block bank to leave an open channel.
Location of activity **(e.g. precinct name or nearby street)**	• Pinchgut regulator, Nestrons regulator and Little Edward offtake regulator are located in Murray Valley Regional Park • Moira regulator and Pigsty culvert are located in Murray Valley National Park.
Street address (if available)	Not applicable
Current and proposed management and ownership authority	Pinchgut, Nestrons and Moira regulator and Little Edward River offtake regulator are jointly owned by WaterNSW and the Murray-Darling Basin Authority. These regulators are operated by the joint operations working group comprising the Murray-Darling Basin Authority, NSW National Parks and Wildlife Services (NPWS) and WaterNSW. This operating arrangement would continue after the proposed works. The existing asset owners will remain in ownership of the assets, pre, during and post construction activities. The Department of Planning and Environment–Water is delegated under separate instruments to be the constructing authority for the performance of the construction works. At completion of the construction and commissioning phases, a formal handover transaction will occur with all assets.
Estimated commencement date	The proposed activity would commence within two years of receipt of all approvals. Construction works are expected to start in the summer of 2024-2025 (i.e. December 2024 to February 2025).
Estimated completion date	The construction phase of the proposed activity is expected to conclude in the summer of 2025-2026 (i.e. December 2025 to February 2026).

1 Introduction

1.1 Proposed activity overview

In 2015, the former Office of Environment and Heritage (OEH) prepared a preliminary business case for the Murray and Murrumbidgee Valley National Parks Sustainable Diversion Limit (SDL) Adjustment Supply Measure Project. The business case identified a range of works to existing water supply infrastructure in the Murray Valley National Park and Regional Park and Murrumbidgee Valley National Park to improve their efficiency and effectiveness and, as a result, create water savings.

The Department of Planning and Environment—Water has been tasked with progressing the works proposed in the 2015 business case. It has reviewed the package of works proposed in the business case and prepared concept designs for those works recommended for development. Concept designs have been prepared for the replacement of two environmental regulators, refurbishment of two other environmental regulators, and removal of a disused and defunct pipe culvert within Millewa Forest (the 'proposed activity').

3Rivers on behalf of the Department of Planning and Environment—Water has prepared this review of environmental factors (REF) to assess the potential environmental impacts of the proposed activity in accordance with the requirements of Division 5.1 the Environmental Planning and Assessment Act 1979 (EP&A Act), section 170 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) and the *Guidelines for Division 5.1 Assessments* (Department of Planning and Environment, 2022a).

1.1.1 The proposed activity

The proposed activity consists of a package of five works to be carried out along waterways within Millewa Forest:

- Demolishing and removing the existing Pinchgut regulator and replacing it with a new triple bay box culvert regulator immediately downstream of the existing structure. The replacement regulator would include a fishway
- Demolishing and removing the existing Nestrons regulator and replacing it with a new trafficable triple bay box culvert regulator. The replacement regulator would be built at the site of an existing timber log bridge that carries Millewa River Road over Nestrons Creek, about 20 metres downstream of the existing regulator. The existing timber log bridge would be removed and

traffic on Millewa River Road would instead drive over the replacement regulator to cross Nestrons Creek. The replacement regulator would include a fishway

- Refurbishing the existing Moira regulator to address the poor condition of the existing drop boards and make the structure safer and more efficient to operate. A fishway would be constructed on the western abutment of the refurbished regulator
- Refurbishing the existing Little Edward River offtake regulator including constructing a fishway on the left (western) abutment of the structure
- Removal of Pigsty culvert and block bank to leave an open channel.

The proposed activity is located on land reserved under Part 4 of the *National Parks and Wildlife Act 1974* (NPW Act) — Nestrons and Little Edward River offtake regulators are located in Murray Valley Regional Park, and Moira regulator and Pinchgut regulator are located in Murray Valley National Park. Murray Valley National Park and Regional Park are located in south-western NSW on the northern side of the Murray River, between Deniliquin to the north and Moama to the south. The location of Murray Valley National Park and Regional Park is shown in Figure 1-1.

The proposed activity is described in detail in Section 3.

Figure 1-1 Regional context

1.1.2 Background information

1.1.2.1 Sustainable Diversion Limit Adjustment Mechanism

The Murray-Darling Basin Plan (the Basin Plan) aims to improve the management, health and sustainability of the Murray-Darling Basin (the Basin). Central to the Basin Plan are the Sustainable Diversion Limits (SDLs), which limit the amount of water that can be extracted from the Basin, while leaving sufficient water to maintain the environmental health of the Basin.

In 2009, the Murray-Darling Basin Authority determined that the average baseline diversion level, or the existing level of water extraction, for the basin was 13,623 gigalitres. The Murray-Darling Basin Authority also determined that the long-term SDL for the entire basin was 10,873 gigalitres per year, which is 2,750 gigalitres lower than the 2009 baseline diversion level. As part of the Basin Plan, this 2,750 gigalitres of water is proposed to be recovered for the environment through a combination of licence buybacks, water recovery, and efficiency projects.

To provide flexibility, the Basin Plan includes a Sustainable Diversion Limit Adjustment Mechanism (SDLAM) to adjust the SDLs. If the environmental outcomes targeted in the Basin Plan can be achieved with less water, more water can remain in the system for other users, including irrigated agriculture. Similarly, if farming practices can be made more efficient, more water can be made available for the environment. An SDL adjustment can be achieved through the following measures:

- Supply projects — These include projects or activities (works and measures) that improve the efficiency of how water is delivered to the environment. For example, environmental works, such as building or improving river or water management structures or changes to the rules under which a river is operated, which achieve environmental outcomes with less water. These projects therefore deliver equivalent environmental outcomes without requiring additional water to be removed from productive use.
- Efficiency projects — These include projects or activities that change water use practices and save water for the environment. These efficiencies could include improved on-farm efficiencies or water delivery efficiencies (e.g., lining channels to reduce water losses). These projects contribute to the overall water saving target without having to directly purchase water from irrigators.
- Constraints relaxation or management projects — These projects aim to overcome some of the physical barriers and river management practices that impact the delivery of environmental water in the system. Constraints projects provide more flexibility to move environmental water around the Basin when and where it is needed most.

The Murray-Darling Basin Authority has adjusted the target for recovering water from the Basin for the environment from 2,750 gigalitres to 2,680 gigalitres following a review of the Northern Basin. As of 2019, 2,118 gigalitres of this target had been recovered through the purchase of water rights and efficiency measures that have involved the development of new infrastructure. The balance of the target (605 GL) is proposed to be recovered through SDLAM projects, removing the need for further water buybacks.

In 2017, the Murray-Darling Basin states and the Commonwealth Government agreed on a package of 36 SDLAM projects across the southern connected Murray-Darling Basin, with the aim of recovering 605 gigalitres of water each year for the Murray-Darling river system. The NSW Government is currently developing nine projects in collaboration with local communities, key

stakeholders and other Basin states with funding from the Commonwealth Government. The NSW Government has brought forward the implementation of five SDLAM projects through the NSW SDLAM Acceleration Program (the Acceleration Program, refer to Figure 1-2). The Acceleration Program will deliver up to 45 gigalitres of the outstanding amount needed to reach the 605 gigalitre target required by the Basin Plan each year. The Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Project is one of the five projects in the Acceleration Program.

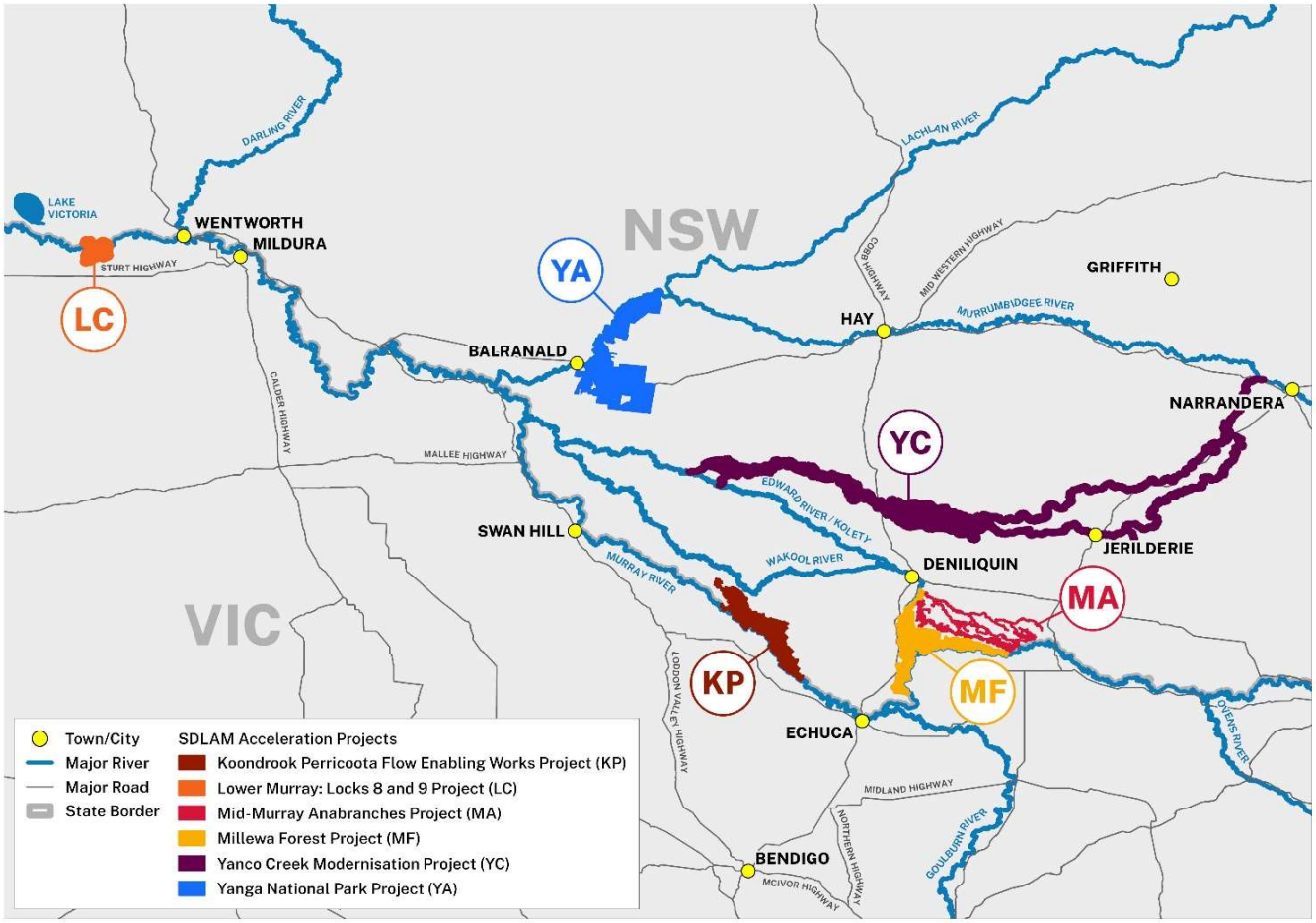

Figure 1-2 Overview of the NSW SDLAM Acceleration Program

1.1.2.2 Millewa Forest Supply Project

The proposed activity is part of the Millewa Forest Supply Project, which, together with the Yanga National Park Supply Project, forms the Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure Project.

The proposed activity is located in Millewa Forest, which covers an area of about 38,000 hectares, mostly in Murray Valley National Park (refer to Figure 3-1Figure 3-1). Barmah Forest is located immediately south of Millewa Forest in Victoria and the two forests function as a single eco-hydrological system.

From the 1930s, the Millewa Forest water channel network was manipulated by the installation of many banks and regulators and, in some cases, construction of artificial channels. These management interventions influenced the movement of water on the floodplain largely to optimise floodplain forestry. Further infrastructure was constructed during the 1990s to assist with river operations in the Murray and Edward River systems. Many of these structures are now old, in poor repair, fail to meet contemporary safety standards and were not designed to optimise fish movement.

1.2 Purpose of this document

The purpose of this REF is to describe the proposed activity, document the likely impacts on the environment, and detail measures to mitigate impacts that cannot be avoided. The REF addresses the Department of Planning and Environment—Water's obligations under section 5.5 of the EP&A Act, including taking into account the environmental factors listed in Table 1 of the *Guidelines for Division 5.1 Assessments* (Department of Planning and Environment, 2022a).

The findings of the REF would be considered when assessing:

- Whether the proposed activity is likely to have a significant impact on the environment and therefore the requirement for an environmental impact statement to be prepared and approval sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The permissibility of the works under the NPW Act and the authorisation that would be issued under the NPW Act to construct and operate the new infrastructure
- The significance of any impact on threatened species as defined by the *Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act) (referred to in section 1.7 of the EP&A Act) and therefore the requirement for a species impact statement or a biodiversity development assessment report.

2 Proposed activity need and justification

2.1 Overview and objectives of the proposed activity

The aims of the Murray and Murrumbidgee Valley National Parks SDLAM Project are to:

1. Enable smarter use of available environmental water, including the ability to sustain key refuge habitats during drier periods
2. Improve environmental outcomes, primarily for flood-dependent vegetation communities, waterbirds and fish
3. Increase the area of floodplain that can be actively managed using environmental water
4. Modernise ageing infrastructure, removing constraints to the movement of water across the floodplain and reopening pathways for native fish
5. Create a community and government partnership, providing project benefits for irrigators while minimising disruption to floodplain ecosystems.

The proposed activity is aligned with aim numbers 1, 2 and 4.

The purpose of the proposed activity is to:

- Replacing aging environmental regulators with simple structures that comply with contemporary safety standards and have low operational and maintenance costs
- Provide fish passage past the replacement and refurbished environmental regulators
- Provide for increased flow capacity at the replacement Pinchgut and Nestrons regulators to improve these regulators' potential to provide environmental flows into Millewa Forest.

2.2 Existing infrastructure

The proposed activity is located within the approximately 84,000-hectare NSW Central Murray Forests Ramsar site, which comprises three geographically discrete but interrelated areas: Millewa Forest (comprising approximately 38,000 hectares), Werai Forest, and Koondrook-Perricoota Forest. The proposed activity is also near the Barmah Forest Ramsar site, which is located in Victoria on the southern side of the Murray River opposite Millewa Forest. Barmah-Millewa Forest is part of the

largest complex of tree-dominated floodplain wetlands in southern Australia. and is nationally the largest continuous stand of River Red Gum Forest (Murray-Darling Basin Commission, 2007). The size and intact nature of this forested floodplain makes it one of the best representatives of the wetland type Xf (freshwater tree-dominated wetlands) in the bioregion. In addition, the site forms an extensive area of intact floodplain and is one of the few such areas with native vegetation in the bioregion (Hale and Butcher, 2011).

The Murray River at Barmah-Millewa Forest is characterised by the Barmah Choke, an 80-kilometre stretch of the Murray River along which channel depth and width progressively decreases. The Barmah Choke restricts the flow of the Murray River to about 7,000 megalitres per day, estimated at Picnic Point. This is the lowest channel flow capacity of any stretch of the Murray River. Because the Murray River is so narrow at Murray Valley National Park, flows often spill over onto the floodplain. The Barmah Choke results in flooding of the park commencing above flows of about 9,000 megalitres per day at Yarrawonga (Jones et al., 2022).

The Barmah Choke can cause high flows delivered for irrigation in summer to overtop banks and flow onto floodplain areas. These flows can result in unseasonal flooding of River Red Gum Forests and low-lying wetlands that would typically not have occurred prior to river regulation under a natural flow regime (Harrington and Hale, 2011).

Prior to development and river regulation, once the river capacity constraint was breached water moved onto and across the floodplain via a network of braided channels and flood runners (small watercourses which flow only during periods of high flow), usually in winter, spring and early summer. Since development, earth banks (causeways, embankments and sills) and other structures that obstruct and divert flows (weirs, regulators) have been installed along the Murray River and throughout the floodplain to support river regulation, required to optimise River Red Gum forestry and meet irrigation needs.

An overview of existing infrastructure within the Millewa Forest is shown in Figure 2-1.

A schematic diagram of the key waterways and regulators in Millewa Forest is provided in Figure 2-2 and existing structures and waterway systems relevant to the proposed activity are described in the following sections.

Figure 2-1 Existing infrastructure within Millewa Forest

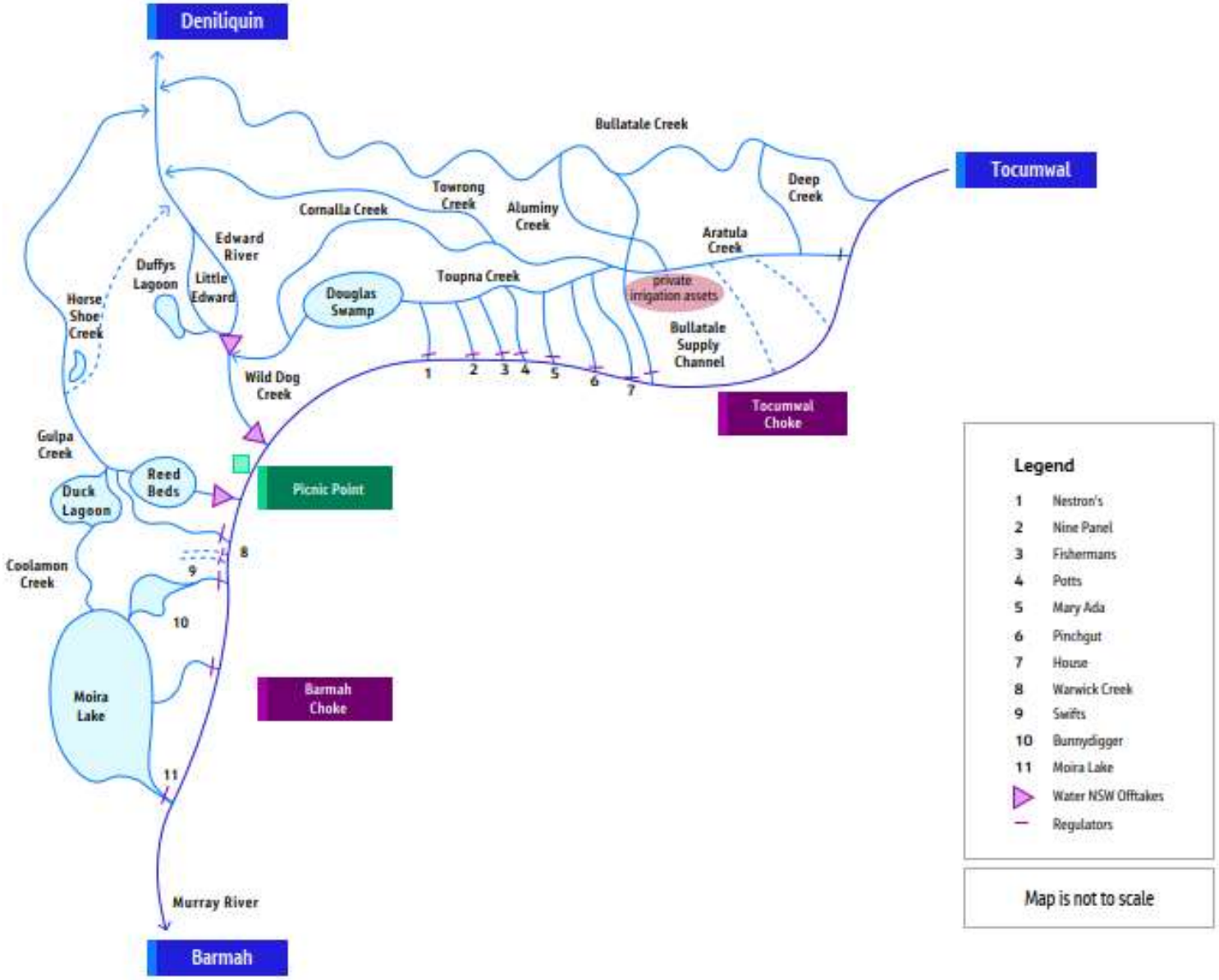
Deniliquin
Bullatale Creek
Tocumwal
Towrong Creek
Aluminy Creek
Deep Creek
Cornalla Creek
Aratula Creek
Edward River
Duffys Lagoon
Little Edward
Toupna Creek
private irrigation assets
Horse Shoe Creek
Douglas Swamp
Bullatale Supply Channel
1
2
3
4
5
6
7
Wild Dog Creek
Tocumwal Choke
Gulpa Creek
Reed Beds
Picnic Point
Duck Lagoon
8
9
Coolamon Creek
10
Moira Lake
Barmah Choke
11
Murray River
Barmah
Legend
1 Nestron's
2 Nine Panel
3 Fishermans
4 Potts
5 Mary Ada
6 Pinchgut
7 House
8 Warwick Creek
9 Swifts
10 Bunnydigger
11 Moira Lake
Water NSW Offtakes
Regulators
Map is not to scale

Figure 2-2 Key waterways and regulating structures in Millewa Forest

2.2.1 Toupna Creek

Toupna Creek is a forest anabranch that receives water from the Murray River through the large Mary Ada regulator and six (smaller) secondary environmental regulators – House Creek, Pinchgut, Potts Creek, Fishermans, Nine Panel and Nestrons (refer to Figure 2-2). The levels in the Murray River at which flow commences in each of these creeks and their regulators are shown in Figure 2-3.

Figure 2-3 Commence to flow (CTF) levels at the waterways and regulators connecting the Murray River to Toupna Creek

Toupna Creek is a major fish movement pathway to and from Millewa Forest, however fish are often prohibited from moving from the Murray River due to the Mary Ada regulator, which poses an almost impenetrable barrier for upstream and downstream fish passage (Stuart et al., 2020). A proportion of fish will subsequently move to and pass through the secondary regulating structures along Toupna Creek.

The site environmental water managers currently use the regulators on the waterways connecting the Murray River to Toupna Creek to manage flows in Toupna Creek and downstream to Douglas Swamp as well as for environmental watering of Millewa Forest. Typically, the site environmental water managers open Mary Ada regulator when flows in the Murray River are rising and before they exceed about 5,000 megalitres per day downstream from Yarrawonga Weir. The six secondary regulators are also opened when flows start to exceed about 9,000 megalitres per day, when spill over the river's banks starts to occur at Barmah Choke (Jones et al., 2022)). The regulators are later

progressively closed when flows in the Murray River falls back below this level. The actual sequence of opening and closing regulators varies from year to year depending on seasonal conditions, held entitlements and in response to fish tracking studies currently being implemented to optimise the operation of these regulators.

The six secondary regulators are simple sheet pile structures with raised concrete sills. They were built to a common design in 1957, with the original drop-board gates being replaced with under-shot gates in the 1990s. The original design included:

- A main cantilever sheet pile wall supporting the walkway and drop bars (now replaced), which are predominantly flat web sections, except for Nine Panel regulator, which uses Larsen style sheet pile
- Reinforced concrete cap at the gate sill
- Walkways attached to the wall
- A sheet pile toe wall (flat web) to provide scour protection and support the rock erosion protection
- Rock erosion protection
- Earth banks which tie into the abutment piles and prevent outflanking.

The gates are vertical lift timber panels, which manual rack and pinion lifting gear. The gate number and size vary.

2.2.1.1 Pinchgut regulator

The existing Pinchgut regulator is located about 20 metres downstream of where Pinchgut Creek joins the Murray River (refer to Figure 2-4). It is approached by an existing track that extends for about 300 metres from Millewa River Road and stops at the regulator. There is no vehicle access across the regulator. There is pedestrian access across the regulator to enable operation of the structure's gates.

Figure 2-4 Location of the existing Pinchgut regulator

The existing Pinchgut regulator is shown in Photo 2-1 to Photo 2-3. It has leaking gates (refer to Photo 2-4), partly due to design deficiencies, and partly due to its age and state of repair. Elements of the existing structure that are either obsolete or near worn out include:

- Timber undershot gates that are obsolete and have a shrink-swell behaviour that contributes to leakage and stress on the lifting gear
- Sheet piles that are over 65 years old
- A concrete cap that does not entirely prevent exposure of the sheet piles at the water line
- Walkway approaches that are trip hazards
- Walkway dimensions that are not compliant with current WaterNSW standards
- A rack and pinion (Trewella jack) lifting gear that does not comply with current workplace health and safety standards.

In addition to the above, the structure is an obstruction to fish passage when it is closed, which does not comply with the Fisheries NSW *Policy and Guidelines for Fish Habitat Conservation and Management* (2013 update) (DPI Fisheries, 2013).

The existing condition of Pinchgut regulator makes it at risk of failing and if this were to occur there could be an uncontrolled flow of water from the Murray River into Millewa Forest via Pinchgut Creek and as a result an unmanaged change in the ecological character of Pinchgut Creek, Toupna Creek, Douglas Swamp and the adjoining forest.

Photo 2-1 Existing Pinchgut regulator passing flows

Photo 2-2 Existing Pinchgut regulator, upstream side

Photo 2-3 Existing Pinchgut regulator, downstream side

Photo 2-4 Water leaking through the gates on the existing Pinchgut regulator

2.2.1.2 Nestrons regulator

The existing Nestrons regulator is located about 20 metres downstream of where Nestrons Creek joins the Murray River (refer to Figure 2-5). It is approached by an existing track that extends for about 20 metres from Millewa River Road and stops at the regulator. There is no vehicle access across the regulator. There is pedestrian access across the regulator to enable operation of the structure's gates.

The existing Nestrons regulator is shown in Photo 2-5 to Photo 2-7. It has leaking gates, partly due to design deficiencies and partly due to its age and state of repair. The outer gate leaves are cut to match the sloping concrete, and this sub-optimal geometry prevents them from sealing effectively. The gates also leak around the slots as shown in Photo 2-5, possibly due to corrosion at the gate frame. Elements of the existing structure that are either obsolete or near worn out and not suitable for incorporation into a new structure include:

- Timber undershot gates that are obsolete and have a shrink-swell behaviour that contributes to leakage and stress on the lifting gear
- Sheet piles that are over 65 years old

- A concrete cap that does not entirely prevent exposure of the sheet piles at the water line
- Settlement of earth and rock and exposure of piles at the water line which would contribute to a reduction in the asset's life
- Walkway approaches that are trip hazards
- Walkway dimensions that are not compliant with current WaterNSW standards
- A rack and pinion (Trewella jack) lifting gear that does not comply with current workplace health and safety standards.

The existing condition of Nestrons regulator makes it at risk of failing and if this were to occur there could be an uncontrolled flow of water from the Murray River into Millewa Forest via Nestrons Creek and as a result a change in the ecological character of Nestrons Creek, Toupna Creek, Douglas Swamp and the adjoining forest.

Figure 2-5 Location of the existing Nestrons regulator

Photo 2-5 Existing Nestrons regulator, downstream side, showing leakage through the fully closed gates

Photo 2-6 Existing Nestrons regulator, downstream

Photo 2-7 Existing Nestrons regulator, downstream side, shortly after opening of the gates

2.2.2 Moira Lake

The Moira Lake wetland system covers about 1,500 hectares and is one of the largest and most significant wetlands of the mid-Murray valley (Harrington & Hale, 2011). The system comprises two large, shallow open water lakes surrounded by marshy wetlands, rushes and reeds and grassy plains surrounded by River Red Gum Forest. Moira Lake is the NSW component (refer to Photo 2-8) and Barmah Lake the Victorian component, and both are recognised under the Ramsar Convention as significant breeding sites for colonial nesting water birds (Sharpe, 2018) and native fish (Jones & Stuart, 2004).

Photo 2-8 Moira Lake during a drying phase, March 2021

Existing infrastructure in the vicinity of Moira Lake includes Moira regulator, Moira cutting, Bunnydigger regulator and Swifts regulator (refer to Figure 2-2 and Figure 2-6).

Moira cutting is located on the southern edge of Moira Lake. It was constructed as part of the Moira Private Irrigation District (MPID). The MPID was constructed more than 50 years ago and currently supplies irrigation and stock and domestic water to 125 farms (85 members) between Deniliquin in the north and Moama in the south with its east boarded by the Murray River and west towards Bunnaloo (MPID, 2008). The MPID pumps its water entitlement from the Murray River via Moira Creek (refer to Photo 2-9).

The levels of the banks of the Moira cutting where it crosses Moira Lake determine the amount of inflow to the lake from the Murray River. The southern bank is consistently higher than the northern bank and is a greater hydraulic restriction on the floodplain than the northern bank.

Photo 2-9 Pumps to extract water from the Murray River at Moira Creek to supply the MPID

Photo 2-10 Moira cutting through the southern part of Moira Lake

2.2.2.1 Moira regulator

The existing Moira regulator is understood to have been constructed circa 1994, with funding from the NSW Environment Protection Authority (Wells, 2018) and oversight from the NSW Murray Wetlands Working Group (Gippel, 2003). Its purpose is to isolate Moira Lake from the Murray River to allow independent management of the water levels, particularly the exclusion of unseasonal summer inflows when regulated flows in the Murray River are at their highest.

The existing Moira regulator is a cantilever sheet pile wall with drop board regulation (refer to Photo 2-11 and Photo 2-12). The access walkway is supported by the sheet pile wall. The design plan of the structure (Drawing 107/850, dated 1993) shows:

- A single line of sheet pile 4.5 metres deep below the apron
- A reinforced concrete apron 250 millimetres thick extending 3 metres each side of the piles
- Scour cut offs 1.2 metres deep at each end
- Every fourth sheet pile extending above the apron and acting as a pier, reinforced with a steel column acting as a drop bar guide
- Nominal 1200-millimetre-wide openings (actual 1170 millimetres)
- Steel walkway and handrail cantilevered off the steel piles
- Sill/apron level 92.25, and top of piles RL 94.0. These were subsequently confirmed by survey (Price Merrett, 2022) at a slightly higher elevation (varying and in the order of 0.05 to 0.1 metres higher respectively).

3Rivers carried out a condition assessment of the existing Moira regulator in May 2022 when there was low flow in the Murray River. The condition assessment found that while the concrete apron and sheet pile below the mud line were in good condition, the sheet pile above the bed level and exposed to aerated conditions had lost up to 40 percent of its section to corrosion with deeper pitting up to 57 percent of the section. Estimated material loss was about 1.5 to 2.0 millimetres on each side of the section below the design water level. The steel drop board guides were found to be completely corroded and failing at the webs, which suggests a material loss of 2.5 millimetres on each side of the member. This is consistent and slightly greater than the worst of the sheet pile measurements. It was thought that the difference may be due to the frequent exposing of the surface due to drop bar operations, and the greater aeration in the gate opening. The condition assessment also identified a scour hole downstream of the apron up to 0.85 metres deep. While this is less than the 1.2-metre depth of the scour cut offs, it shows that the underlying material is erodible.

The condition of the drop boards makes them at risk of failure, which could result in a loss of control of the water level at Moira Lake and as a result a change in the ecological character of the lake.

Figure 2-6 Location of the existing Moira regulator

Photo 2-11 Moira regulator

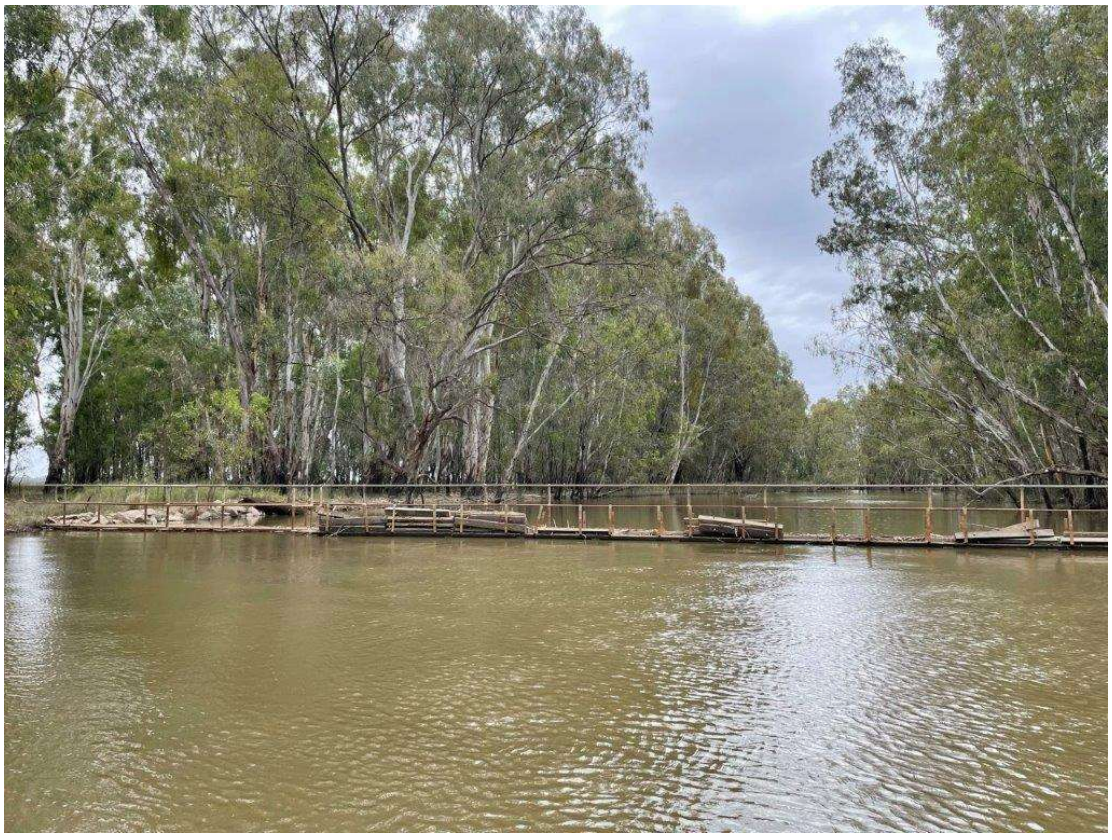

Photo 2-12 Moira regulator at higher flow

2.2.3 Edward River

The Edward River starts at the Murray River about 400 metres upstream of Picnic Point and flows in a northerly direction, bisecting Millewa Forest. WaterNSW diverts water from the Murray River into the Edward River at the Edward River offtake to meet downstream consumptive demands and environmental flow requirements. Floodplain flows and diversions through secondary regulators also contribute to flow in the Edward River. Flow in the Edward River is regulated up to a flow of about 1,600 megalitres per day, at which the channel capacity is exceeded, as noted in clause 33(2)(d) of the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016. Floodplain flows and diversions through secondary regulators also contribute to flow in the Edward River.

The Little Edward River is an anabranch of the Edward River that starts about 7.6 kilometres downstream of the Murray River, and ends about seven kilometres further downstream. The upstream section of the Little Edward River is a single defined flow path which extends for about two kilometres downstream of the offtake regulator. This section of the waterway provides deep pool habitat, with extensive woody habitat. Downstream of this the waterway becomes less defined, shallower, and dense stands of emergent vegetation and River Red Gum saplings grow in the bed.

Wild Dog Creek flows into the Edward River about 1.5 kilometres upstream of where the Little Edward River starts.

2.2.3.1 Little Edward River offtake regulator

Inflow to the Little Edward River is controlled by the Little Edward River offtake regulator (refer to Figure 2-7). WaterNSW operates the regulator in either the fully open or fully closed position. The regulator is generally closed during summer/autumn to isolate the Little Edward River during regulated flow conditions in the Edward River. It is operated in combination with other regulators on the Edward River west bank (Corey's, Bonners, Dwyer's, Hussey's) to prevent unseasonal inundation of the adjoining floodplain. The regulator is generally fully open in winter, spring and for flows exceeding the regulated capacity of the Edward River.

The range of water levels over which regulation at the Little Edward River offtake regulator is required is narrow but they span the most frequent summer operating levels. Water starts to flow over the sill of the existing Little Edward River offtake regulator at a flow above about 700 megalitres per day in the Edward River. The commence to flow rate in the Little Edward River is about 1,200 megalitres per day in the Edward River, although at this flow rate the flow only extend to the deep pool habitat in the upper reaches of the river. A flow of about 1,300 to 1,400 megalitres per day is required in the Edward River to establish a flow that can pass along the length of the river and enables the Little Edward River offtake regulator to operate. As noted above, the gates of the offtake regulator are typically open when flows exceed the regulating capacity of the Edward River,

which at Little Edward River is about 1,800 megalitres per day. This flow rate is greater than the 1,600 megalitre per day at which flow in the Edward River ceases to be regulated, which reflects inflows from Wild Dog Creek to the Edward River upstream of the Little Edward River during high Murray River flows.

The Little Edward River offtake regulator is an obstruction to fish passage except when it is fully opened.

The Little Edward River offtake regulator is a sheet pile weir structure fitted with four split leaf gates (refer to Photo 2-13). The bed of the approach channel approximately matches the elevation of the gate sill.

Figure 2-7 Location of the existing Little Edward River offtake regulator

Photo 2-13 Existing Little Edward River offtake regulator – upstream

2.2.3.2 Pigsty culvert

Pigsty culvert is located near the confluence of Towrong Creek and the Edward River, about one kilometre downstream of Taylor's Bridge Road crossing of the Edward River and about 250 metres downstream of the Tuppal Road crossing of Towrong Creek (refer to

Figure 2-8). The culvert is on Pigsty Creek, which is a flood runner and one of several outlets of Towrong Creek to the Edward River.

Pigsty culvert comprises a pipe through a raised embankment and a superstructure constructed from timber cribwork (refer to Photo 2-14 to Photo 2-19). Timber beams extent through the raised embankment, which is about one metre higher than the surrounding natural bank. The structure and the earthworks are in poor condition.

Pigsty culvert has no known function. It may have been built to prevent loss of water from the Edward River into Towrong Creek via Pigsty Creek, or to retain water in the forest for River Red Gum watering. The structure allows water to move more or less freely from the Edward River into Pigsty Creek. The structure reduces the maximum rate at which flow in Pigsty Creek can discharge into the Edward River.

Access to Pigsty culvert is along an informal track from Tuppal Road on the northern side of Towrong Creek. Tuppal Road is accessed through Murray Valley National Park via either Edward River Road or Taylors Bridge Road.

Figure 2-8 Location of the existing Pigsty culvert

Photo 2-14 Existing Pigsty culvert in low flow – upstream (left photo) and downstream (right photo)

Photo 2-15 Existing Pigsty culvert in higher flow – upstream

Photo 2-16 Existing Pigsty culvert – upstream is on the left of the photo and downstream on the right of the photo

Photo 2-17 Existing Pigsty culvert in higher flow – downstream

Photo 2-18 Existing Pigsty culvert facing upstream along Pigsty Creek

Photo 2-19 Existing Pigsty culvert facing downstream along Pigsty Creek towards where it joins the Edward River

2.3 Existing operation and management

Pinchgut, Nestrons and Moira regulators and Little Edward River offtake regulator are jointly owned by WaterNSW and the Murray-Darling Basin Authority. These assets vested to WaterNSW in accordance with State Water Corporation Act 2004 (Transfer Order No. 1) dated March 2007.

Decisions on the operation of Pinchgut, Nestrons and Moira regulators and Little Edward River offtake regulator are made by a joint operations working group comprising the Murray-Darling Basin Authority, NPWS and WaterNSW. WaterNSW is responsible for implementing the decisions of the joint operations working group. In practice, NPWS often implements the tripartite working group's decisions on behalf of WaterNSW as it has rangers working at Murray Valley National Park and Regional Park who can more quickly and conveniently carry out the agreed operational changes by operating the gates or changing the drop board configuration.

The overall operating regime for the regulators at Millewa Forest is broadly to mimic the inundation of the forest that would have occurred but for the Murray River and Edward River being operated to deliver water from the Hume Dam to downstream customers. Before development, the Murray River

typically had high flows in winter, spring and early summer, although there would be large variation from one year to the next. The natural flow regime in the river has been impacted by the storage of runoff in Hume Dam in the upper catchment and the release of this water to fulfil orders, mostly during the irrigation season, which typically runs from September to April. Under this regime, high flows occur in summer and autumn. In simple terms, closing the regulator gates during the irrigation season prevents unseasonal inundation of Millewa Forest and optimises river operations. The actual operating regime is more nuanced and reflects climatic conditions, water availability and site-specific environmental water objectives.

The process for decision making on the timing, duration, location and size of environmental watering of Millewa Forest is discussed in Section 6.2.1.8.

2.4 Proposed activity need

The proposed activity is needed to modernise existing environmental regulators to meet contemporary safety standards and to optimise native fish movement.

Specific characteristics of the existing Pinchgut and Nestrons regulators that are obsolete or near worn out are detailed in Sections 2.2.1.1 and 2.2.1.2 respectively and include gates that leak, exposed sheet piles and lifting gears that do not comply with current workplace health and safety standard. Moira regulator has drop boards that are at risk of failure, as detailed in Section 2.2.2.1. While Little Edward River offtake regulator is in better condition that Pinchgut, Nestrons and Moira regulators, none of the structures has the flexibility to provide fish passage other than when the gates of the existing structure are open.

The site environmental water managers are expected to be able to operate the replaced and refurbished environmental regulators more efficiently than the structures they replace, and they are likely to become preferred structures for managing environmental flows. Improvements in the efficiency of environmental watering of Millewa Forest would contribute to the 45 gigalitre per annum water saving targeted by the Acceleration Program (refer to Section 1.1.2).

Pigsty culvert does not currently serve a purpose and its removal would remove an unnecessary restriction to native fish movement between Pigsty Creek and the Edward River.

2.5 Options and alternatives considered

Options initially investigated for the proposed activity are detailed in the *Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure Business Case* (Office of Environment and

Heritage, 2015). The business case was developed in consultation with relevant NSW Government agencies and the Murray-Darling Basin Authority.

The Department of Planning and Environment—Water has further developed and reviewed these initial options through a series of workshops and meetings with key stakeholders. A range of alternative designs, layouts and locations for various works within the selected areas have been investigated to identify preferred options that best achieve the aims of the Murray and Murrumbidgee Valley National Parks SDLAM Project.

The 'do nothing' option was considered for all proposed works. Generally, retaining the existing structures instead of replacing, refurbishing or removing them as proposed would impede the ongoing delivery of environmental flows to the subject creek systems and watercourses, thereby resulting in the continued degradation of ecosystem health and water quality.

2.5.1 Areas investigated for potential works

Three areas were investigated for potential works:

- Toupna Creek ('central Millewa') — The area of investigation included Toupna Creek and the waterways that connect it to the Murray River, Douglas Swamp and Reed Beds Swamp
- Moira Lake ('lower Millewa') — The area of investigation included Moira, Bunnydigger and Swifts regulators, which connect Moira Lake to the Murray River
- Edward River ('north Millewa') — The area of investigation included Little Edward River offtake regulator, Buchanans regulator and Pigsty culvert.

The options investigated at each of these areas are described below.

2.5.2 Alternative options considered

2.5.2.1 Toupna Creek

The following options to improve environmental flows along the Toupna Creek system were investigated:

- *Upgrading Mary Ada regulator:* Upgrades to the existing Mary Ada regulator were investigated. In particular, an option to provide a fish ladder and lay flat gates at Mary Ada regulator was considered. High-level assessments found that the length of the fish ladder required would exceed the length of the cutting that connects Mary Ada regulator to Toupna Creek, making it unfeasible
- *Douglas Swamp:* Construction of a bund around the existing road culverts, replacing the existing Clay Island Road Bridge with a new trafficable regulator, and potential track raising along a section of Millewa River Road. There were a number of issues associated with this option

including potential surplus inundation of Douglas Swamp, barriers to fish movement caused by the bunds, and potential water quality issues.

- *Reed Beds Swamp south and Gulpa Creek*: Installation of overflow sills on the south side of the cutting matching the regulated capacity of Gulpa Creek. There is no defined road to access the south bank of Gulpa Creek and the most direct access path crosses through an area of high cultural sensitivity and should be avoided. Without the construction of roads to allow the area to be accessed, the most suitable means of investigating works in this area would be by dropping water levels in Gulpa Creek. Such an outcome is not likely in the near future.
- *Warrick Creek regulator*: Installation of a sheet pile regulator at the intersection of Warrick Creek and the Gulpa Creek and Channel, adjacent to the north west corner of Reed Beds Swamp. This option is subject to a number of environmental and constructability constraints with construction access limited and a number of scarred trees and middens present.
- *Pinchgut and Nestrons regulators:* The areas selected for proposed works to occur as part of the proposed activity (refer to Section 3.2.1 and Section 3.2.2).

2.5.2.2 Moira Lake

Existing infrastructure in the vicinity of Moira Lake includes Moira Cutting, Bunnydigger regulator, and Swift's regulator. To gain an understanding of Moira Lake hydraulics and fish movement, site investigations and assessments of Swifts regulator, Bunnydigger regulator and Moira Cutting were undertaken. No works are planned at Swift's or Bunnydigger regulators as they are outside the scope of the SDLAM program of investigation.

Moira Cutting and its northern and southern banks are part of a private irrigation scheme. While these areas were investigated to understand the hydraulic operation of the system and fish movement, no works are planned for these areas, so as to avoids any risk of impacts on irrigation activities.

The area selected for proposed works to occur as part of the proposed activity was Moira regulator (refer to Section 3.2.3).

2.5.2.3 Edward River

Works investigated for inclusion in the proposed activity in the vicinity of the Edward River within Millewa Forest included:

- *Buchanans regulator and 'site 3'*: Site 3 is a backwater of the Edward River. The business case proposed constructing an environmental regulator at this location as a water savings measure and potentially as a drought refuge for native fish. However, hydraulic modelling carried out as part of the investigation of this option indicated that an environmental regulator at this location

would not be feasible because it would only be able to isolate the forest if all alternate flow paths were blocked, which seems unlikely

- *Fish passage at Tuppal Road*: Site inspections have determined that there is no fish passage obstruction at this location under the observed conditions and it appears unlikely that there would be an obstruction for most lower water levels than the ones observed
- *Little Edward River offtake regulator and Pigsty culvert*: The areas selected for proposed works to occur as part of this proposed activity (refer to Section 3.2.4 and Section 3.2.5).

2.6 Justification for preferred option

The preferred option is to replace Pinchgut and Nestrons regulators with modern regulators with vertical lift gates, refurbish Moira regulator principally by replacing the existing drop boards with vertical lift gates or alternatively replacing the entire regulator, refurbish Little Edward River offtake regulator, and install fishways at the replacement Pinchgut and Nestrons regulators and refurbished Moira and Little Edward River offtake regulators. Additionally, Pigsty culvert would be removed to leave an open channel. A detailed description of the preferred option is provided in Chapter 3.

The proposed activity is the preferred option because it would achieve aim numbers 1, 2 and 4 of the Murray and Murrumbidgee Valley National Parks SDLAM Project (refer to Section 2.1) at the lowest capital cost while avoiding the operation and maintenance risks and costs and environmental impacts associated with some of the alternatives discussed in Section 2.5.2.

Specific justifications for the proposed works at Pinchgut and Nestrons regulators are provided in the following section.

2.6.1 Toupna Creek

The reasons why Pinchgut regulator is proposed for replacement rather than other regulators on waterways connecting the Murray River to Toupna Creek include:

- Pinchgut is located upstream of Mary Ada and the bifurcation of Cornella Creek from Toupna Creek, providing the flexibility to deliver environmental flows into these waterways as well as Pinchgut Lagoon
- It is preferred over House regulator because House Creek has a higher commence to flow rate than Pinchgut Creek and there is limited opportunity to lower the sill of House regulator due to restrictions in the downstream waterway
- It is preferred over Potts regulator because passing environmental flows along Potts Creek could cause undesirable inundation of Millewa River Road if the size of the structure were increased

- It is preferred over Fishermans regulator because there is no potential for sill lowering at this structure
- Fish have been observed trying to leave the forest through Pinchgut regulator (NPWS, 2017), and its discharge point is relatively closer to Mary Ada than other sites.

It is envisaged that during an environmental watering event the replacement Pinchgut regulator would be opened first and closed last among the seven environmental regulators on creeks that flow from the Murray River to Toupna Creek. This would provide a safe pathway for fish to pass into and out of the forest and minimise stranding of fish within the forest when high flows recede and at the end of environmental watering events.

The replacement Pinchgut regulator would also be a preferred structure for providing drought top-up flows to the upper reach of Toupna Creek.

The reasons why Nestrons regulator is proposed for replacement include:

- It has the lowest commence to flow threshold of the seven regulators on waterways connecting the Murray River to Toupna Creek
- It is the furthest downstream of the seven regulators, which gives it the shortest flow path to Douglas Swamp
- It provides a pathway between Toupna Creek and the Murray River downstream of Mary Ada regulator
- Nestrons Creek has the shortest flow path between the Murray River and Toupna Creek of the seven regulated creeks that connect these two waterways.

Replacing the existing Nestrons regulator with a modern environmental regulator that includes a fishway is likely to make it the preferred structure for the site environmental water managers to deliver a regulated flow from the Murray River to Douglas Swamp. The replacement Nestrons regulator may also be used to manage water quality in the lower reach of Toupna Creek and maintain habitat for aquatic biota.

3 Proposed activity description

A concept design has been prepared for the proposed activity and it forms the basis for the assessment of environmental impacts provided in this REF. The key features of the concept design are described in the following sections.

3.1 Location of the proposed activity

The proposed activity comprises works at five sites in Murray Valley National Park and Regional Park as shown in Figure 3-1.

Key details of each work site are provided in Table 3-1 and described in detail in Section 3.2. Details of land ownership and tenure are provided in 3.11.

Table 3-1 Key details of the proposed activity sites

Existing water asset	Nearest named access track	Existing water asset owner	Reserve
Pinchgut regulator	Millewa River Road	Joint venture assets – WaterNSW and Murray-Darling Basin Authority	Murray Valley Regional Park
Nestrons regulator	Millewa River Road		Murray Valley Regional Park
Moira regulator	Narrows Road		Murray Valley National Park
Little Edward River offtake regulator	Little Edward River Road		Murray Valley Regional Park
Pigsty culvert	Tuppal Road	n/a	Murray Valley National Park

3.1.1 Asset ownership and management during construction

The owner of each of the existing assets that is proposed for replacement or refurbishment is shown in Table 3-1 and discussed in Section 2.3. The existing asset owners will remain in ownership of the assets, pre, during and post construction activities. The Department of Planning and Environment—

Water is delegated under separate instruments to be the constructing authority for the performance of the construction works. At completion of the construction and commissioning phases, a formal handover transaction will occur with all assets.

Figure 3-1 Location of the proposed activity

3.2 Description of the proposed new infrastructure

3.2.1 Pinchgut regulator

It is proposed to replace the existing Pinchgut regulator with a new triple bay box culvert regulator located immediately downstream of the existing regulator.

An indicative drawing of the replacement Pinchgut regulator is show in Figure 3-4.

The replacement Pinchgut regulator would consist of three precast concrete box culverts with steel gates attached to cast-in-situ piers on the upstream side. The gates would be used to regulate flow through the structure. Penstock gates are proposed on the outer culverts and a split leaf gate on the middle culvert. The split leaf gate would allow for adjustment in the overshot condition. Each gate would have a steel bulkhead on the immediate upstream side to block flow through the regulator and act as a safety barrier during regulator maintenance by removing water forces off the gates. The bulkheads would have the same height (1.8 metres) and width (2.4 metres) and approximate mass as the gates. The gates and bulkheads would be removable to enable their replacement if required.

The top of the culverts would be trafficable. Pedestrian walkways would be provided on both side of the regulator, protected from traffic by guardrails. The pedestrian walkway on the upstream side of the regulator would be elevated to enable operation of the gates and bulkheads and would have handrails on both sides and steps at either end. The pedestrian walkway on the downstream side of the regulator would have a steel grating surface and a handrail on the water side only.

Section and cross-section views of the replacement Pinchgut regulator are provided in Figure 3-2 and Figure 3-3 respectively.

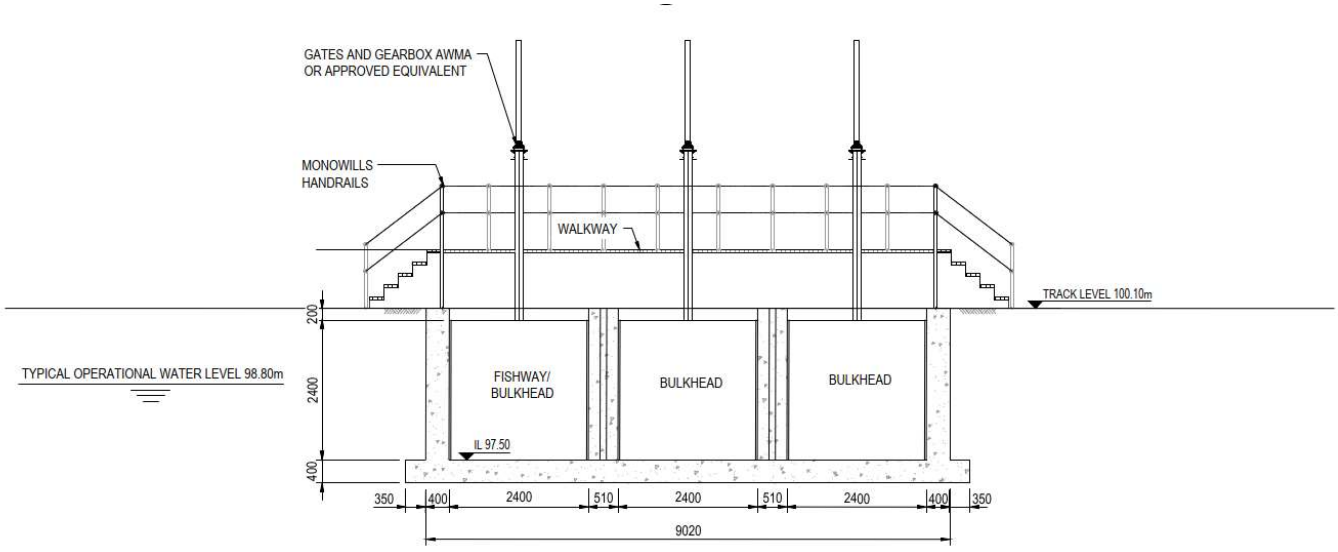

Figure 3-2 Section view of the replacement Pinchgut regulator

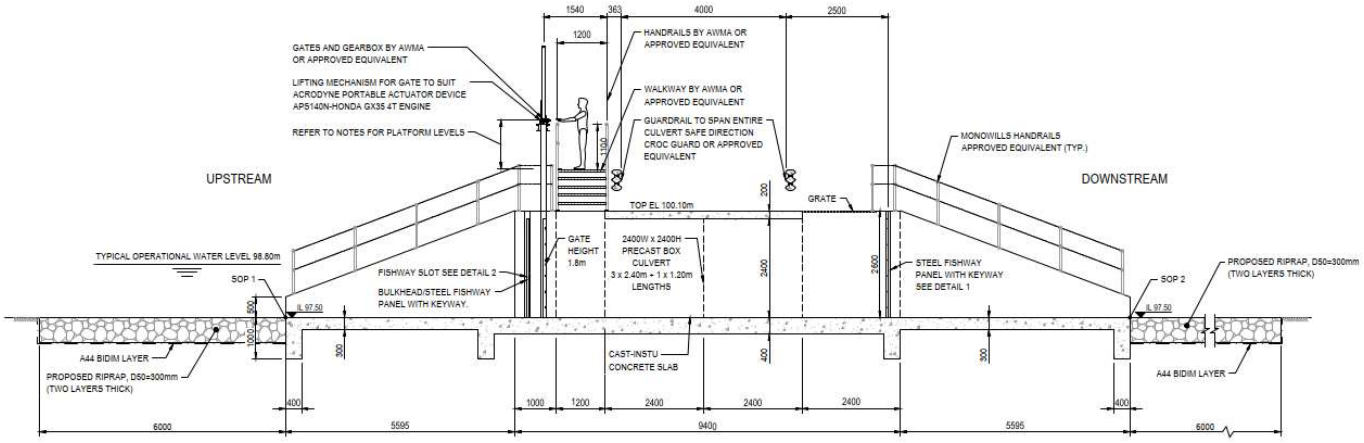

Figure 3-3 Cross-section view of the replacement Pinchgut regulator

The existing Pinchgut regulator, including the sheet piles, concrete, walkway, rack and pinion lifting gear, and timber gates would be demolished and removed.

Replacing the existing Pinchgut regulator with a modern environmental regulator that includes a fishway is likely to make it a preferred structure for the site environmental water managers to use to pass a flow from the Murray River to Toupna Creek. It is envisaged that during an environmental watering event the replacement Pinchgut regulator would be opened first and closed last among the seven environmental regulators on creeks that flow from the Murray River to Toupna Creek. This would provide a safe pathway for fish to pass into and out of the forest and minimise stranding of native fish within the forest when high flows recede and at the end of environmental watering events. The replacement Pinchgut regulator is also likely to be a preferred structure for providing drought top-up flows to the upper reach of Toupna Creek.

During normal operation, upstream fish passage past the replacement regulator would occur through the fishway and gates when the structure's gates are fully opened. The concrete slab of the new structure would become a velocity barrier at higher flows, and fish passage for small fish would be provided through the fishway at these times, as noted above. Downstream fish passage past the replacement regulator would be through the fully open gates under most circumstances.

The replacement regulator would be accessed by the same track that provides access to the existing regulator from Millewa River Road. Maintenance of this access track would be carried out prior to the start of construction in accordance with a separate planning approval.

The proposed construction footprint for the works is shown in Figure 2-4. About 0.19 hectares of native vegetation would need to be cleared to carry out the works.

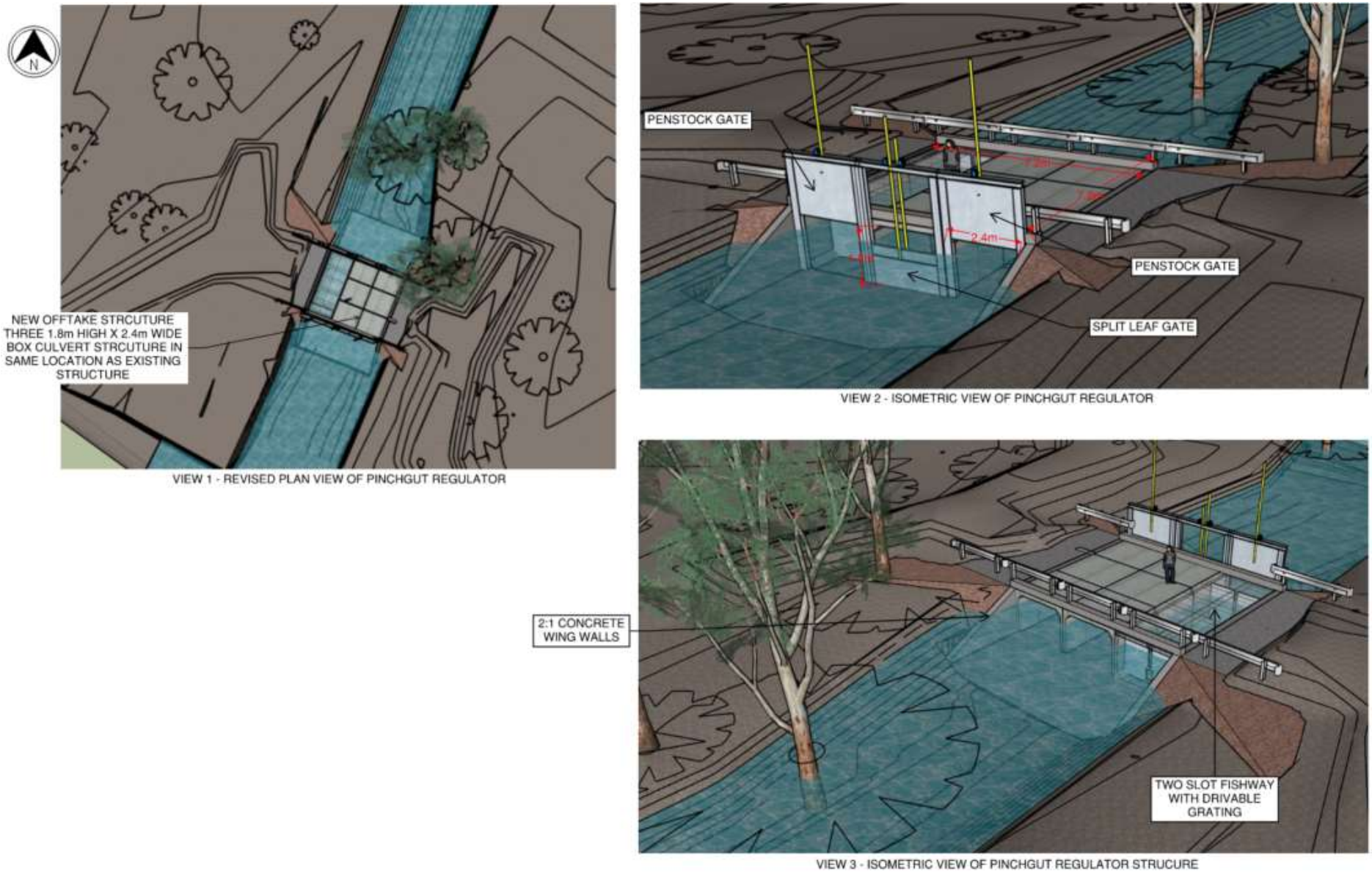

Figure 3-4 Indicative concept design of the replacement Pinchgut regulator

3.2.2 Nestrons regulator

It is proposed to replace the existing Nestrons regulator with a new regulator. The new regulator would be built in the same location as the existing timber log bridge that carries Millewa River Road over Nestrons Creek, which is about 20 metres downstream of the existing regulator and about 40 metres downstream of where Nestrons Creek joins the Murray River. Building a new regulator that replaces both the existing regulator and bridge over Nestrons Creek would consolidate assets within Millewa Forest and simplify construction access. An indicative drawing of the replacement Nestrons regulator is shown in Figure 3-7. The design of the replacement Nestons regulator would be very similar to the design of the replacement Pinchgut regulator. The replacement Nestrons regulator would consist of three precast concrete box culverts with steel gates attached to cast-in-situ piers on the upstream side. The gates would be used to regulate flow through the structure. Penstock gates are proposed on the outer culverts and a split leaf gate on the middle culvert. The split leaf gate would allow for adjustment in the overshot condition. Each gate would have a steel bulkhead on the immediate upstream side to block flow through the regulator and act as a safety barrier during regulator maintenance by removing water forces off the gates. The bulkheads would have the same height (1.8 metres) and width (2.4 metres) and approximate mass as the gates. The gates and bulkheads would be removable to enable their replacement if required.

The top of the culverts would be trafficable and with the addition of short ramps at either end of the regulator vehicles travelling along Millewa River Road would be able to drive over the regulator to cross Nestrons Creek. Minor vertical and horizontal alignment changes would be required to Millewa River Road either side of the replacement regulator. The replacement regulator would only be wide enough for one-way traffic. Signage to control one way traffic over the regulator would be erected on Millewa River Road on both the approaches to the regulator. The imposed (live) loads from road traffic considered in the design of the replacement regulator were in accordance with Australian Standard 1597.2-2013: *Precast reinforced concrete box culverts Large culverts (exceeding 1200 mm span or 1200 mm height and up to and including 4200 mm span and 4200 mm height)*, and assume the replacement regulator would accommodate the SM1600 design loading for vehicle traffic during normal operation.

Pedestrian walkways would be provided on both sides of the regulator, protected from traffic by guardrails. The pedestrian walkway on the upstream side of the regulator would be elevated to enable operation of the gates and bulkheads and would have a steel mesh floor, handrails on both sides and steps at either end. The pedestrian walkway on the downstream side of the regulator would have a handrail on the water side only and a steel mesh floor where it crosses the fishway.

Section and cross-section views of the replacement Nestrons regulator are provided in Figure 3-5 and Figure 3-6 respectively.

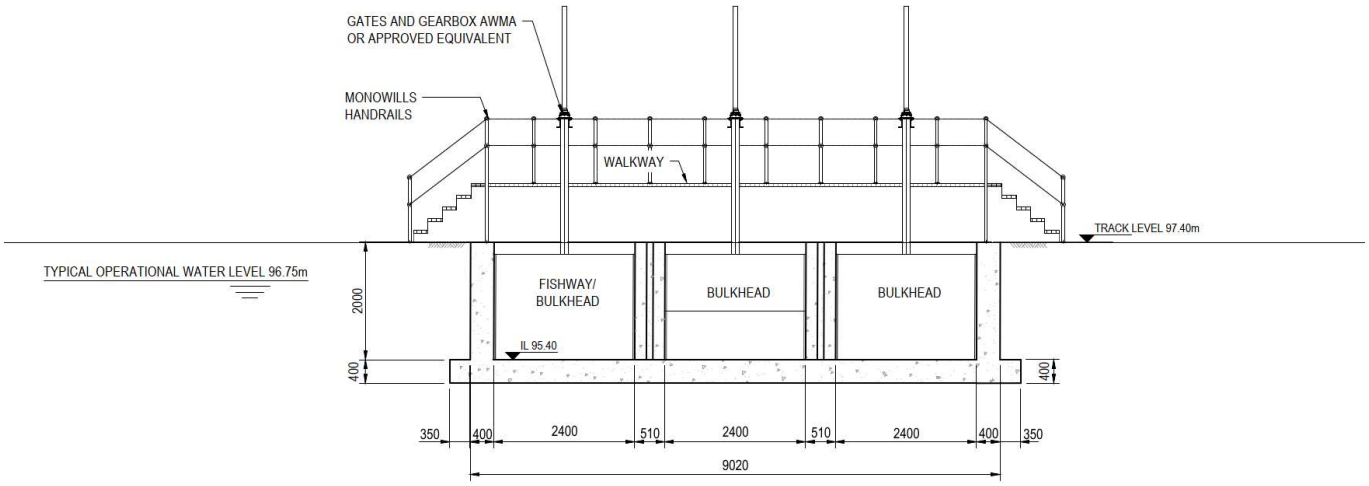

Figure 3-5 Section view of the replacement Nestrons regulator

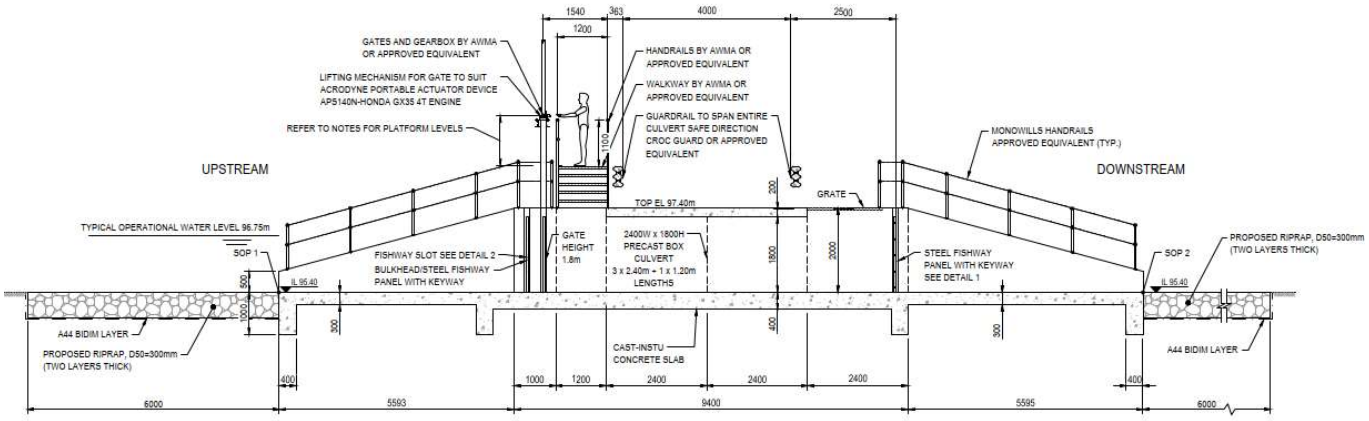

Figure 3-6 Cross-section view of the replacement Nestrons regulator

The existing Nestrons regulator, including the sheet piles, concrete, walkway, rack and pinion lifting gear, and timber gates would be demolished and removed. The existing timber log bridge over Nestrons Creek would also be demolished and removed.

Nestrons Creek has the shortest flow path between the Murray River and Toupna Creek of the seven regulated creeks that connect these two waterways. Nestrons regulator is also the furthest downstream of the seven regulators, which gives it the shortest flow path to Douglas Swamp, located adjacent to the downstream end of Toupna Creek. Douglas Swamp is a wetland mosaic of open water, swamp, rush and reed land that provides important habitat, breeding and feeding opportunities for aquatic fauna and birds. The site is a traditional nesting site for waterbirds (particularly egrets) and is surrounded by a locally significant stand of River Red Gum Forest. Douglas Swamp is bisected by Wild Dog Creek, a distributary channel of Toupna Creek which conveys water to the swamp. Replacing the existing Nestrons regulator with a modern environmental regulator that includes a fishway is likely to make it the preferred structure for the site environmental water managers to deliver a regulated flow from the Murray River to Douglas Swamp in late spring and early summer to maintain waterbird breeding habitat. This is most likely to

occur in years where significant waterbird breeding is occurring in Douglas Swamp (i.e. in the hundreds). Top up flows to maintain water levels in Douglas Swamp could be delivered through the replacement Nestrons regulator until waterbirds have successfully fledged their young. The replacement Nestrons regulator may also be used to manage water quality in the lower reach of Toupna Creek and maintain habitat for aquatic biota.

The fishways proposed at Pinchgut and Nestrons regulators would complement one another as they are located on the waterways between the Murray River and Toupna Creek that are the second most upstream and farthest downstream respectively (refer to Figure 2-2), and so could be used together to optimise fish movement from the forest back to the Murray River.

The fishway proposed at the replacement Nestrons regulator would comprise a two-slot vertical slot bay. The fishway would enable upstream passage for fish when water velocities through the fully opened regulator structure are in excess of 0.3 metres per second, which is the sustained swimming speed for small-bodied native fish. At this and greater flow rates, velocities and turbulence in the culverts downstream of the open regulator gates prevent small-bodied fish from continuing upstream. The slotted entrance to the downstream end of the fishway is aligned with this flow rate, which means that if fish move laterally across the downstream end of the culverts they would detect the attraction flow from the fishway entrance slot. They would then enter the fishway and proceed through the structure, exiting via the second vertical slot at the upstream end of the fishway and then being able to continue upstream. The resting pool between the two vertical slots would be about 2.4 metres wide and 8.9 metres long. Steel mesh grating walkways at the upstream side of the downstream entrance slot and at the downstream side of the upstream exit slot would provide natural light to both sides of the two slots. The soffit of the trafficable section of the culvert is elevated, providing natural light to the resting pool.

The fishway could be used to control a low flow for drought relief while simultaneously providing downstream fish passage. The replacement regulator would have a sill level of 95.40 metres AHD, which is slightly lower than the upstream creek bed, thereby enabling upstream fish passage directly through the regulator at lower Murray River levels. The concrete slab of the new structure would become a velocity barrier at higher flows, and fish passage for small fish would be provided through the fishway at these times. Downstream fish passage past the replacement regulator would be through the fully open gates under most circumstances.

The replacement Nestrons regulator would have lower commencement flows and increased flow capacity than the existing regulator. The gates would be operated manually.

The replacement regulator would be accessed from Millewa River Road. Maintenance of this access track would be carried out prior to the start of construction in accordance with a separate planning approval.

The proposed construction footprint for the works is shown in Figure 2-5. About 0.09 hectares of native vegetation would need to be cleared to carry out the works.

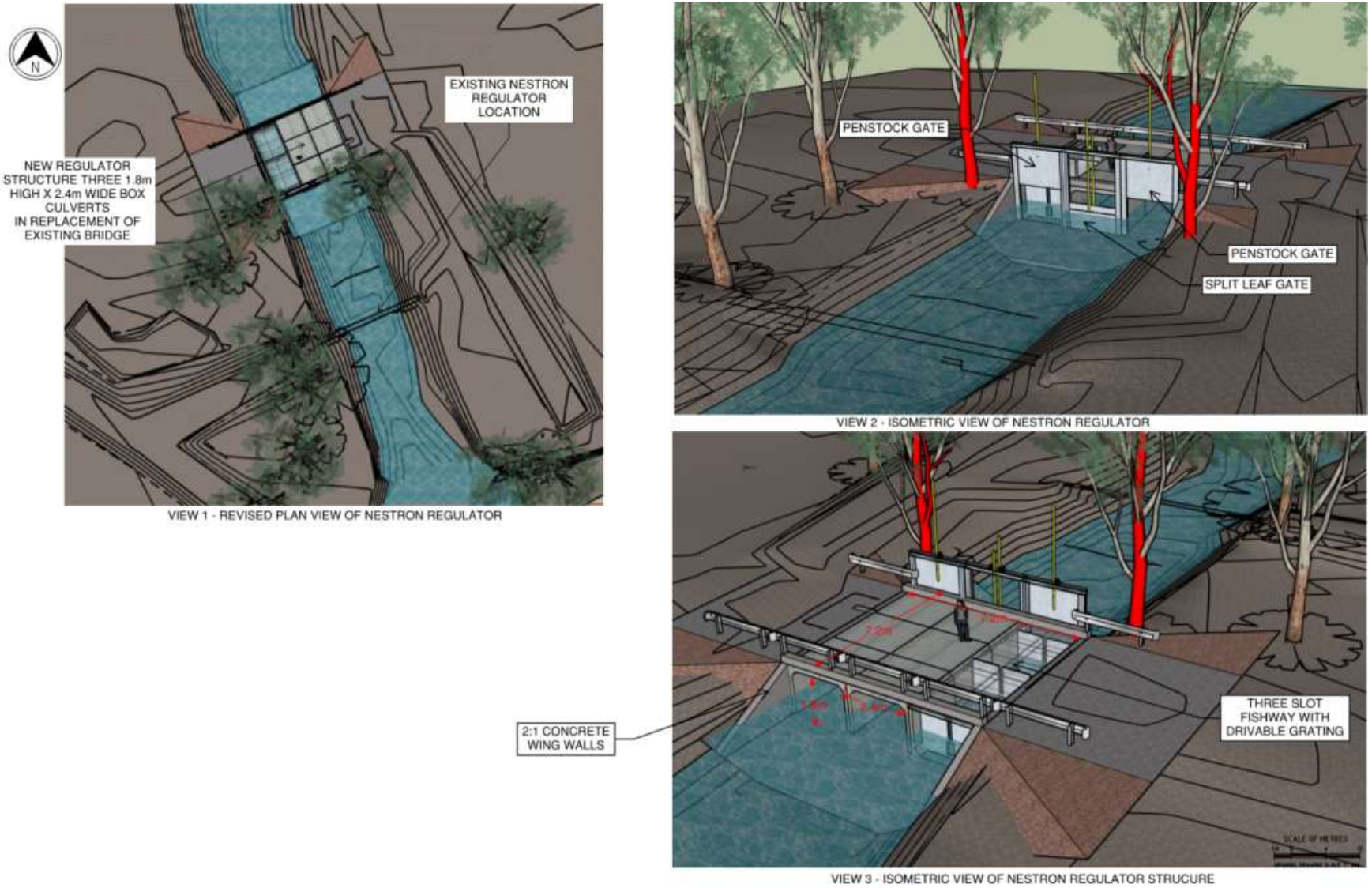

Figure 3-7 Indicative concept design of the replacement Nestrons regulator

3.2.3 Moira regulator

It is proposed to refurbish the existing Moira regulator to address the poor condition of the existing drop boards and make the structure safer and more efficient to operate. As part of the proposed works a vertical slot fishway would be constructed on the western abutment of the regulator to facilitate the bidirectional movement of native fish between Moira Lake and the Murray River (refer to Figure 3-8).

The concept design for the works includes replacing drop board slots with vertical lift gates. Most of the gates would be penstock gates which would operate in the open/close positions, and one or two of the gates would be split leaf to regulate outflows and to allow for fish passage. The refurbished regulator would retain similar capacity and functionality as the existing regulator with improved operation and fish passage. The ability to more safely and efficiently manage water levels at Moira Lake in response to natural river level cues is expected to benefit the ongoing restoration of Moira Lake and its unique Moira grassland, as well as fish and bird breeding.

The floor level and headwall of the regulator would remain unchanged, and the hydraulic capacity would approximately replicate the existing capacity. The existing sheet pile structure would be refurbished with new steel works and other potential coatings to improve asset life. The associated walkways, handrail, and other site access would be refurbished to current WaterNSW standards.

An isolation gate, walkway mesh and handrail would be installed at the fishway for inspection access. The regulator apron downstream of the fishway entry and the gates would be filled with reinforced concrete for localised erosion protection. A four slot fishway is expected to provide adequate functionality, however the number of slots would be determined at a later stage in consultation with DPI Fisheries. The fishway would have the capacity to pass about 25 megalitres per day.

The refurbished regulator would be accessed from existing access tracks that provide access to both sides of the regulator (refer to Section 3.4). Maintenance of these access track would be carried out prior to the start of construction in accordance with a separate planning approval.

The proposed construction footprint for the works is shown in Figure 2-6. About 0.50 hectares of native vegetation would need to be cleared to carry out the works.

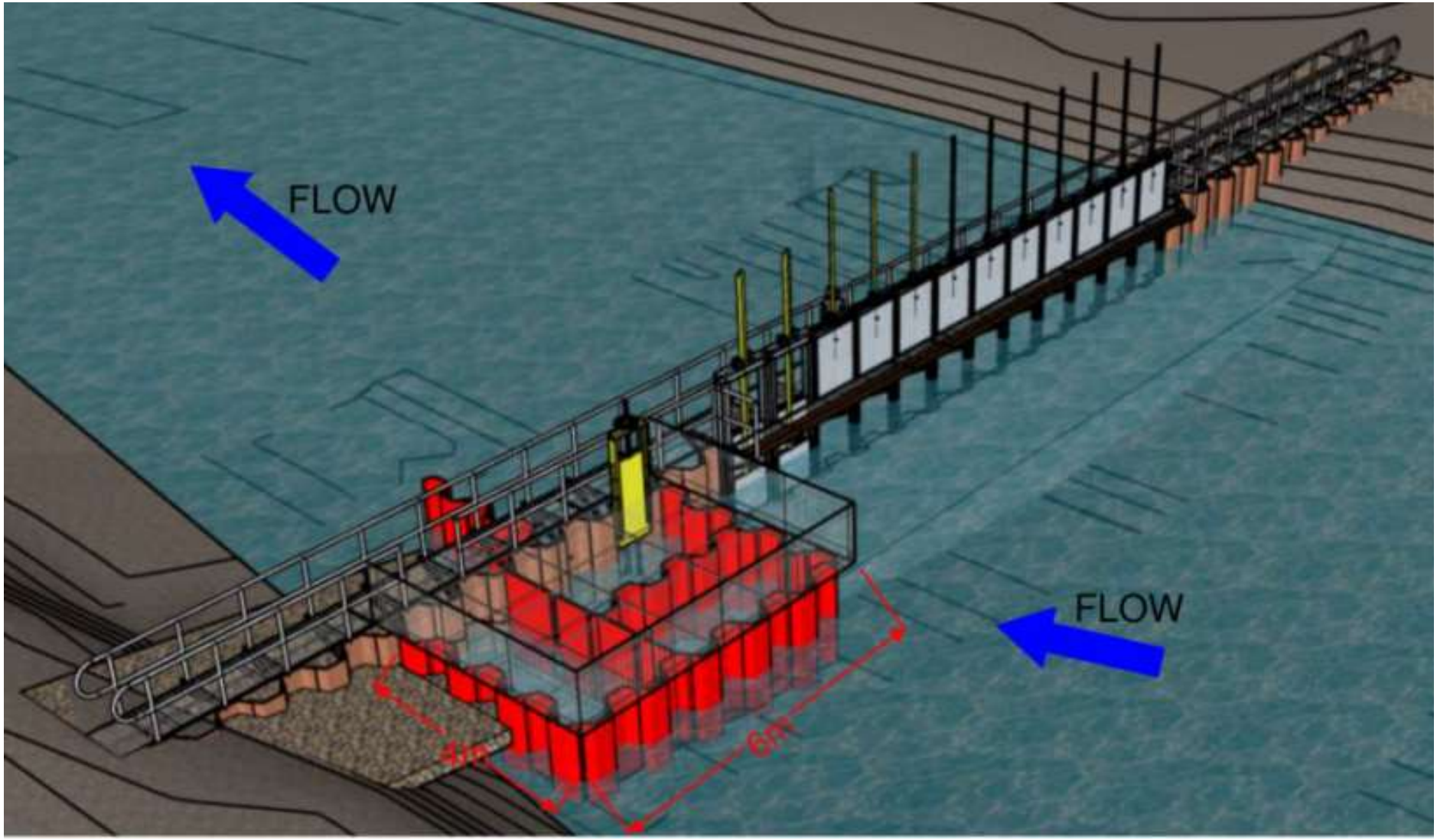

Figure 3-8 Indicative concept design for the refurbishment of Moira regulator

3.2.4 Little Edward River offtake regulator

It is proposed to refurbish the existing Little Edward River offtake regulator and construct a fishway on the left (western) abutment of the structure (refer to Figure 3-9). The operating regime of the offtake regulator is not proposed to change.

The proposed works would include refurbishing and concrete encasing the existing sheet pile wall of the regulator and installing a new concrete apron and riprap protection both upstream and downstream of the structure. A new walkway with handrails would also be installed on the eastern side (right bank) of the regulator.

The primary benefit of the proposed fishway under the current operating regime is that it could be kept open temporarily to provide a cue to native fish to return to the Edward River when a high flow event or environmental watering event is receding, and the gates of the Little Edward River offtake regulator would typically be changed from open to closed. Keeping the fishway open at these times would prevent native fish from getting stranded in the pools that form at the upper reach of the Little Edward River after the gates of the offtake regulator are closed.

The fishway may also provide a marginal benefit for small fish if it is open when the offtake regulator gates are open. When there are high flows through the gates the fishway would provide small fish with safer passage past the structure compared to passing through the gates.

Although it is not proposed for the fishway to be open when flows in the Edward River at the Little Edward River are between about 1,300 and 1,800 megalitres per day other than when a high flow is receding as described above, the hydraulic capacity of the fishway has been designed with consideration of the maximum flow that it could deliver to the Little Edward River when the gates of the offtake regulator are closed without causing undesirable spills to the broader floodplain. Two sets of working models were developed to inform the concept design of the fishway. A one-dimensional model of the Little Edward River was extracted from the Murray-Darling Basin Authority's Barmah-Millewa Forest model, and this was used to establish stage-discharge relationships at critical points. These were checked against field observations, highlighting discrepancies resulting from inaccuracies in the LiDAR data and possibly adopted roughness coefficients in highly vegetated areas of this section of forest.

A localised two-dimensional HEC-RAS model was subsequently developed and calibrated, where possible, to field observations. While the model has provided valuable insights into the flow behaviour and spill points from the Little Edward River, the areas inundated (shown in the figures below) should be treated with caution and the outputs cannot be relied on to provide reliable design levels.

On-ground assessments were used to overcome uncertainties in model accuracy and observe the relationship between:

- Flow in the Edward River and outfalls through the Little Edward River offtake regulator
- Threshold flows at which water commences spilling from the Little Edward River into the adjacent floodplain.

The on-ground assessments included:

- Field observations associated with unregulated flows in late 2021 and early 2022
- Flow trials using environmental water to allow the downstream effect of flows of up to 50 ML/day at the Little Edward River offtake regulator to be observed
- Flow measurement by WaterNSW at the Little Edward River offtake regulator on 23 May 2022, coinciding with the flow trial delivery and zero inflow conditions to the Edward River from Wild Dog Creek.

The intent of the flow trial was to observe the hydraulic behaviour of the Little Edward system over a range of steady flows of 50 megalitres per day and less. The flow trial showed that when 50 megalitres per day was flowing through the Little Edward River offtake regulator there was no spill to the floodplain.

The fishway would be built from steel sheet pile, anticipated to be of a similar size and weight to the existing offtake regulator design. The floor and apron downstream of the entry would be cast in situ concrete. The sheet piles and walkway would match the level of the existing regulator headwall.

The existing regulator gates would be either retained or replaced with new gates or a similar split leaf type. The gates would continue to be capable of being operated manually.

Maintenance of Little Edwards Road between the existing regulator and Millewa Road was carried out in 2023 and, as a result, the access to this site is currently suitable for use by construction vehicles.

The proposed construction footprint for the works is shown in Figure 2-7. About 0.06 hectares of native vegetation would need to be cleared to carry out the works. The construction footprint would also include an additional 0.04 hectares of non-native vegetation, which mostly comprises bare ground used for camping and an access track.

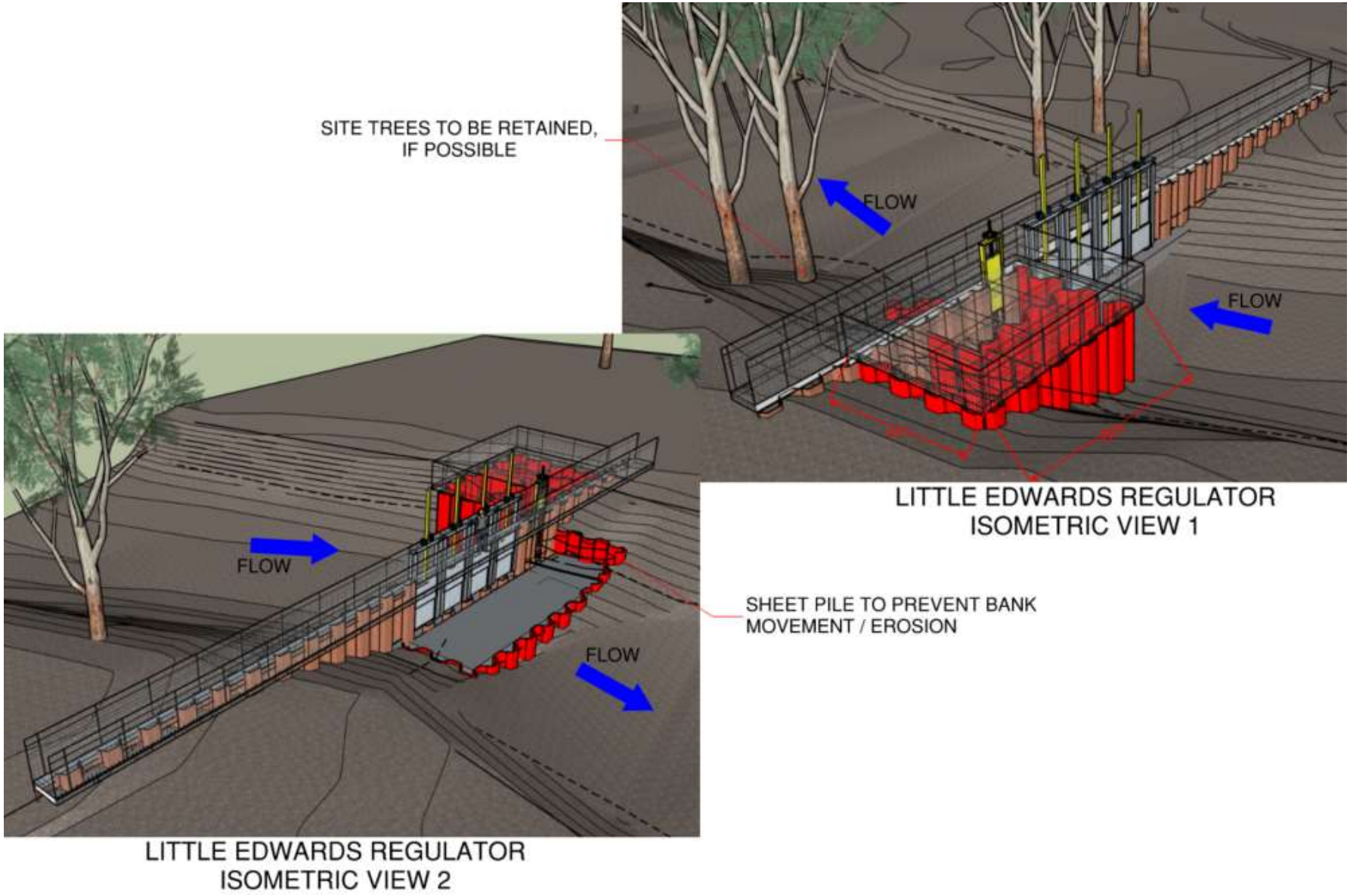

Figure 3-9 Indicative concept design of the refurbished Little Edward River offtake regulator

3.2.5 Pigsty culvert

It is proposed to remove Pigsty culvert and block bank and leave an open channel. This would reduce water backing up when Pigsty Creek (Towrong Creek) is flowing, and eliminate an obstruction to fish passage.

Pigsty culvert would be accessed from existing access tracks that end close to this location (refer to Section 3.4). Maintenance of these access track would be carried out prior to the start of construction in accordance with a separate planning approval.

The proposed construction footprint for the works is shown in

Figure 2-8. About 0.11 hectares of native vegetation would need to be cleared to carry out the works. The proposed construction footprint includes areas for the storage of excavated material, truck loading, and a temporary access track between Pigsty culvert and where the existing NPWS management trail ends.

An area of about 16 metres by 8 metres would be excavated to a maximum depth of about three metres to remove the culvert. Once the excavation works are completed, the batter slopes at the open cut would be covered with geofabric and beaching stone. If possible, surplus excavated material from Pigsty culvert would be used as fill material on access track upgrades within Millewa Forest. Once the culvert is removed, flow in the newly created section of open channel would reflect flows in Towrong Creek and backflow from the Edward River.

3.3 Construction works

A key requirement during the construction phase of the proposed activity is dry in-stream work sites where works are to occur within waterways. Details are provided in the following section of the key steps proposed during the construction phase at each work site including how dry in-stream work sites would be established.

3.3.1 Pinchgut regulator

The construction footprint for works proposed at Pinchgut regulator is shown in Figure 3-10. Following are the key steps of the construction works to replace Pinchgut regulator:

-
- Vegetation within the construction footprint would be cleared to create space for plant, equipment and materials laydown and temporary storage. Vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan (refer to Table 6-17). Other cleared

vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park

- Cofferdams would be installed upstream of the existing regulator and downstream of where the replacement regulator is to be built
- The creek banks and bed would be modified to accommodate the replacement regulator
- The replacement regulator and fishway would be installed in accordance with the detailed design and its associated steps
- The existing regulator would be demolished and removed
- The creek bed and banks where the existing regulator was removed would be backfilled, the natural bank contours reinstated, and the creek bed and banks stabilised with rock
- The replacement regulator and fishway would be commissioned
- Disturbed areas of the construction footprint would be stabilised.

Earth removed during the works at Pinchgut regulator that is surplus and can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility. Refer to Section 6.15.2.1 for further discussion on the disposal of construction waste.

Construction plant required to carry out the works at Pinchgut regulator would include:

- 20 to 25-tonne excavator, for multiple applications
- Tipper truck and tag trailer, to cart materials and plant
- Truck and dog trailer, to cart materials
- Concrete agitator trucks, to deliver concrete
- Concrete pumping truck, for in-situ concrete pours
- Skid steer, for site clearing and final trimming
- Electrical generator, for site office and use of electrical equipment
- 15 to 20-tonne Franna crane, to unload and place the regulator gates.

An on-site workforce of about six personnel would be required to carry out the construction works at Pinchgut regulator.

Figure 3-10 Pinchgut regulator replacement - construction footprint

3.3.2 Nestrons regulator

The construction footprint for works proposed at Nestrons regulator is shown in Figure 3-11. Following are the key steps of the construction works to replace Nestrons regulator:

- Vegetation within the construction footprint would be cleared to create space for plant, equipment and materials laydown and temporary storage. Vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan (refer to Table 6-17). Other cleared vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park
- Cofferdams would be installed upstream of the existing regulator and downstream of where the replacement regulator is to be built
- The existing timber Millewa River Road bridge over Nestrons Creek would be demolished and removed
- The creek banks and bed would be excavated to accommodate the replacement regulator
- The replacement regulator and fishway would be installed in accordance with the detailed design and its associated steps
- The existing regulator would be demolished and removed
- The creek bed and banks where the existing regulator was removed would be backfilled, the natural bank contours reinstated, and the creek bed and banks stabilised with rock
- The replacement regulator and fishway would be commissioned
- Disturbed areas of the construction footprint would be stabilised.

Earth removed during the works at Nestrons regulator that is surplus and can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility. Refer to Section 6.15.2.1 for further discussion on the disposal of construction waste.

Construction plant required to carry out the works at Nestrons regulator would include:

- 20 to 25-tonne excavator, for multiple applications
- Tipper truck and tag trailer, to cart materials and plant
- Truck and dog trailer, to cart materials
- Concrete agitator trucks, to deliver concrete
- Concrete pumping truck, for in-situ concrete pours
- Skid steer, for site clearing and final trimming

- Electrical generator, for site office and use of electrical equipment
- 15 to 20-tonne Franna crane, to unload and place the regulator gates.

An on-site workforce of about six personnel would be required to carry out the construction works at Nestrons regulator.

Figure 3-11 Nestrons regulator replacement – construction footprint

3.3.3 Moira regulator

The construction footprint for works proposed at Moira regulator is shown in Figure 3-12. Following are the key steps of the construction works to refurbish Moira regulator:

- The drop boards of the existing Moira regulator would be closed to create dry instream conditions immediately downstream of the structure
- Vegetation within the construction footprint would be cleared to create space for plant, equipment and materials laydown and temporary storage. Cleared vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan (refer to Table 6-17). Other cleared vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park
- Cofferdams would be installed upstream and downstream of the regulator
- Any water collected between the upstream cofferdam and the regulator would be pumped out to create a dry work site on the upstream side of the structure
- The parts of the structure which are to remain would be treated in accordance with the rehabilitation elements of the design
- The parts of the existing structure which need to be disposed of would be demolished and removed from site
- Concrete would be poured for the new fishway foundation and pile arrangement for placement of gates
- The fishway would be installed and any other required works to refurbish the regulator would be carried out as per the detailed design
- Any disturbance caused to the creek bed and banks during the works would be contoured in accordance with the design and stabilised with in-situ material or rock as applicable
- The downstream cofferdam would be removed
- The upstream cofferdam would be removed
- The newly installed gates and fishway would be commissioned
- The construction area would be stabilised.

Earth removed during the works at Moira regulator that is surplus and can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility. Refer to Section 6.15.2.1 for further discussion on the disposal of construction waste.

Construction plant required to carry out the works at Moira regulator would include:

- 20 to 25-tonne excavator, for multiple applications
- Tipper truck and tag trailer, to cart materials and plant
- Truck and dog trailer, to cart materials
- Concrete agitator trucks, to deliver concrete
- Concrete pumping truck, for in-situ concrete pours
- Skid steer, for site clearing and final trimming
- Electrical generator, for site office and use of electrical equipment
- 80 to 85-tonne crawler crane, to unload and place the regulator gates
- Sandblasting machine, to treat the existing sheet piles.

An on-site workforce of about 10 personnel would be required to carry out the construction works at Moira regulator.

Figure 3-12 Moira regulator refurbishment – construction footprint

3.3.4 Little Edward River offtake regulator

The construction footprint for works proposed at Little Edward River offtake regulator is shown in Figure 3-13. The NPWS campground next to Little Edward River offtake regulator would be temporarily closed while construction works are occurring at this site. Following are the key steps of the construction works to install a fishway at Little Edward River offtake regulator:

- The gates of Little Edward River offtake regulator would be closed to create dry instream conditions immediately downstream of the structure
- Vegetation within the construction footprint would be cleared to create space for plant, equipment and materials laydown and temporary storage. Vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan (refer to Table 6-17). Other cleared vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park
- Cofferdams would be installed upstream and downstream of the regulator
- Any water collected between the upstream cofferdam and the regulator would be pumped out to create a dry work site on the upstream side of the structure
- The parts of the structure which are to remain will be treated in accordance with the rehabilitation elements of the design
- The parts of the existing structure which need to be disposed of will be demolished and removed from site
- A fishway would be installed at the existing regulator
- Any disturbance caused to the creek bed and banks during the works would be contoured in accordance with the design and stabilised with in situ material or rock as applicable.
- The downstream cofferdam would be removed
- The upstream cofferdam would be removed
- The newly installed fishway would be commissioned
- The construction area would be stabilised.

Earth removed during the works at Little Edward River offtake regulator that is surplus and can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility. Refer to Section 6.15.2.1 for further discussion on the disposal of construction waste.

Construction plant required to carry out the works at Little Edward River offtake regulator would include:

- 20 to 25-tonne excavator, for multiple applications
- Tipper truck and tag trailer, to cart materials and plant
- Truck and dog trailer, to cart materials
- Concrete agitator trucks, to deliver concrete
- Concrete pumping truck, for in-situ concrete pours
- Skid steer, for site clearing and final trimming
- Electrical generator, for site office and use of electrical equipment
- 15 to 20-tonne Franna crane, to unload and place the regulator gates
- Sandblasting machine, to treat the existing sheet piles.

An on-site workforce of about six personnel would be required to carry out the construction works at Little Edward River offtake regulator.

Figure 3-13 Little Edward River offtake regulator refurbishment – construction footprint

3.3.5 Pigsty culvert

The construction footprint for works proposed at Pigsty culvert is shown in Figure 3-14. Following are the key steps of the construction works to remove Pigsty culvert and block bank:

- Vegetation within the construction footprint would be cleared to create space for plant, equipment and materials laydown and temporary storage. Vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan (refer to Table 6-17). Other cleared vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park
- Cofferdams would be installed upstream and downstream of the culvert (if required at the time of works)
- Any water collected between the upstream and downstream cofferdams would be pumped out to create a dry work site
- The block bank and culvert would be demolished and removed
- The creek bed and banks would be shaped to reinstate the natural bank contours, so that they resemble the creek bed and banks immediately upstream and downstream
- The creek bed and banks would be stabilised with rock
- Removed vegetation that would create suitable aquatic habitat (e.g. woody debris) would be placed within the disturbed area of the creek and banks
- The downstream cofferdam would be removed
- The upstream cofferdam would be removed
- The construction area would be stabilised.

Earth removed during the works at Pigsty culvert that is surplus and can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility. Refer to Section 6.15.2.1 for further discussion on the disposal of construction waste.

Construction plant required to carry out the works at Pigsty culvert would include:

- 20 to 25-tonne excavator, for multiple applications
- Tipper truck and tag trailer, to cart materials and plant.

An on-site workforce of about two personnel would be required to carry out the construction works at Pigsty culvert.

Figure 3-14 Pigsty culvert removal – construction footprint

3.4 Access and ancillary facilities

The construction work sites would be accessed from the Cobb Highway and then via the following local roads maintained by Murray River Council and access tracks within Murray Valley National Park and Regional Park maintained by NPWS:

- Pinchgut regulator — Jones Street, Picnic Point Road, Millewa Road, Millewa River Road, unnamed access track to Pinchgut regulator
- Nestrons regulator — Jones Street, Picnic Point Road, Millewa Road, Millewa River Road, unnamed access track to Nestrons regulator
- Moira regulator (west side) — Coolamon Road, Dora Road, unnamed access track along the northern side of Moira channel
- Moira regulator (east side) — Poverty Point Road, Porters Creek Road, Narrows Road, unnamed access track to Moira regulator (east side)
- Little Edward River offtake regulator – Jones Street, Picnic Point Road, Millewa Road, Little Edwards Road
- Pigsty culvert — Jones Street, Picnic Point Road, Millewa Road, Edward River Road, Tuppal Road, unnamed access track to Pigsty culvert.

The Department of Planning and Environment—Water, on behalf of NPWS, proposes to carry out maintenance work on some of the access tracks that connect the work sites to Millewa Road or the western boundary of the parks. While this access track maintenance work does not form part of the proposed activity, it does need to be completed before construction of the proposed activity starts to ensure that construction vehicles can safely access the work sites.

A temporary construction phase laydown area is proposed within each of the construction footprints shown in Figure 3-10 to Figure 3-14. The laydown areas would be used to unload and store building materials including prefabricated sections of the new regulators, store plant and equipment, and stockpile spoil and fill materials. A portable ablution and site office facility would be required temporarily at the Pinchgut, Nestrons and Moir regulator work sites.

3.5 Procurement

The NSW Procurement Board has established the Accreditation Program for Construction Procurement under which a NSW Government agency accredited by the board may procure construction services. Agencies accredited under the program have greater autonomy to procure construction services than unaccredited agencies. The Department of Planning and Environment—Water is an accredited agency under the Accreditation Program for Construction Procurement.

NPWS regulates new building and infrastructure works within lands reserved or acquired under the NPW Act in accordance with its *Construction Assessment Procedures* (Office of Environment and Heritage, 2011). The procedures detail the requirements and processes for ensuring that building and infrastructure works, including alterations and additions, demolition and a change of building use, in the national parks system meet relevant requirements of the Building Code of Australia, the *Disability (Access to Premises – Buildings) Standards 2010* and Australian Standards. The procedures do not apply in certain circumstances, including infrastructure works project-managed by an agency accredited by Treasury NSW (which includes the NSW Procurement Board) where other processes apply. As The Department of Planning and Environment—Water is an accredited agency for construction procurement the procedures do not apply to the proposed activity.

Accredited agencies have a responsibility to comply with all relevant NSW Government legislation, policies and procedures. Accordingly, the construction works for the proposed activity will be required to comply with demolition and construction standards.

3.6 Operation and maintenance

The Department of Planning and Environment—Water would hand over the replacement and refurbished regulators to WaterNSW once they are commissioned. Similar to the existing regulators, the replacement and refurbished regulators would serve two purposes:

- Operated by the joint operations working group to deliver water via the Murray River and Edward River to downstream irrigators and avoid unseasonal inundation of Millewa Forest
- Used by the site environmental water managers opportunistically for environmental watering of Millewa Forest.

The operation and maintenance of the replacement and refurbished regulators for each of these purposes is described in the following sections.

There is no operational component to the works proposed at Pigsty culvert.

3.6.1 Murray River and Edward River operations

Each river in the Murray-Darling Basin is managed by the Murray-Darling Basin Authority or a state body, depending on its location.

The Murray-Darling Basin Authority manages and operates the Murray River, on behalf of the NSW, Victorian and South Australian governments because the river flows through all three states. Water in the Murray River is shared based on the rules set out in the Murray-Darling Basin Agreement.

The Edward River is an anabranch of the Murray River and is also managed and operated by the Murray-Darling Basin Authority.

Other rivers in the Murray-Darling Basin are managed by the states. Figure 3-15 shows who is responsible for managing the different rivers and dams in the southern Basin.

The Murray-Darling Basin Authority, as part of its Murray River operations, would coordinate operation of the replacement Pinchgut and Nestrons regulators and refurbished Moira regulator and Little Edward River offtake regulator during the irrigation season to deliver water to downstream irrigators via the Murray River and Edward River and avoid unseasonal inundation of Millewa Forest. This coordination would occur by way of the joint operations working group (refer to Section 2.3). The Murray-Darling Basin Authority's coordination of the operation of the replacement and refurbished regulators for this purpose would be similar to their operation of the existing regulators.

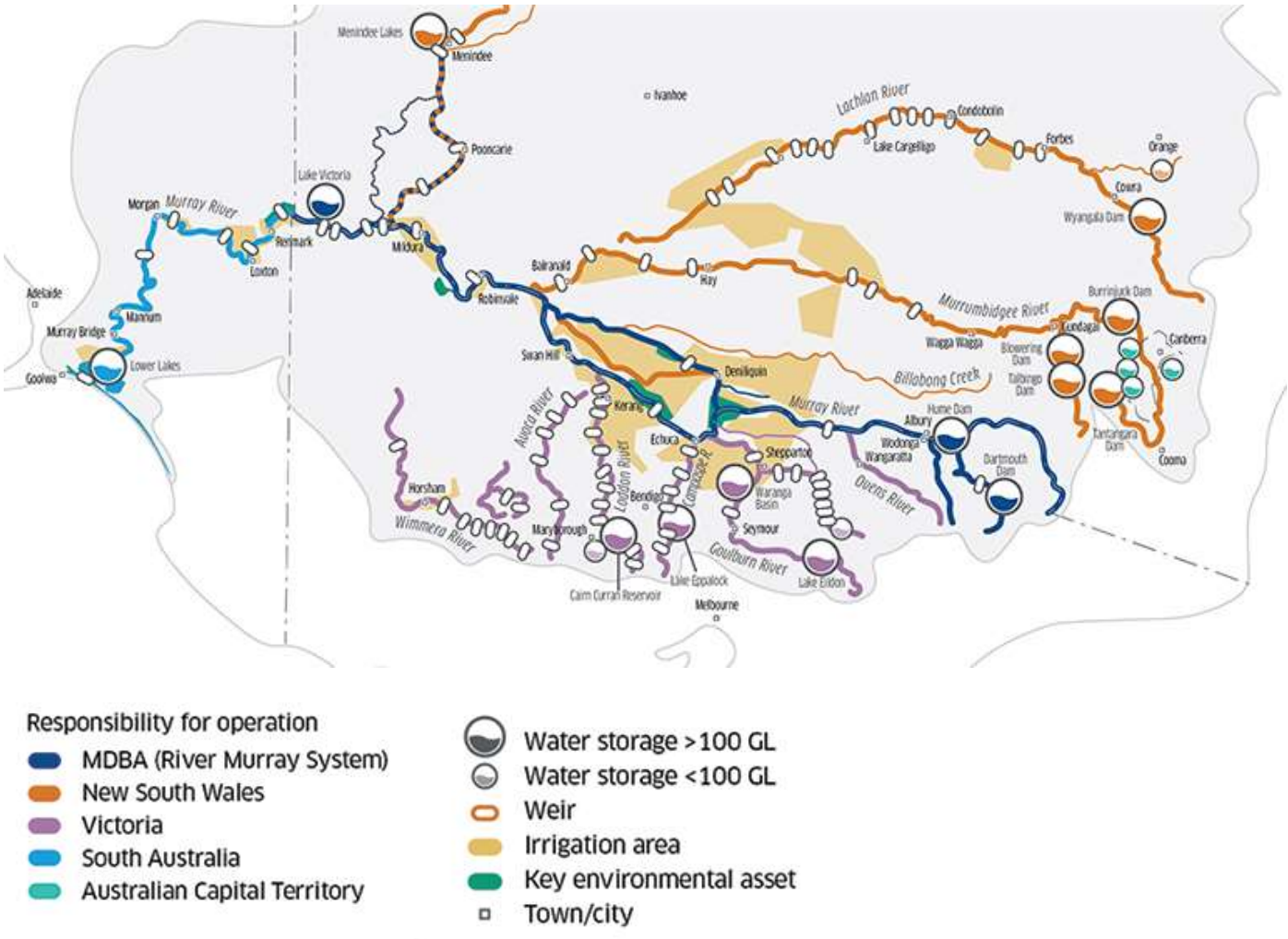

Figure 3-15 Operational responsibility for rivers in the Murray-Darling Basin

Source: Murray-Darling Basin Authority (2023)

3.6.2 Environmental watering of Millewa Forest

The replacement and refurbished environmental regulators would be available to use in managed environmental watering of Millewa Forest. Stakeholders with an interest in and/or responsibility to carry out environmental watering of the forest are:

- NPWS, as the icon site manager for The Living Murray
- The Biodiversity and Conservation Division of the Environment and Heritage Group of the Department of Planning and Environment, which manages the Barmah-Millewa water account
- The Commonwealth Environmental Water Office and the Murray-Darling Basin Authority, which hold the water entitlement for The Living Murray.

While all these stakeholders are involved in the management of environmental watering of Millewa Forest, for practical reasons NPWS has assumed day-to-day responsibility for carrying out environmental watering of the forest. For simplicity, environmental watering of the forest is discussed in this REF as the responsibility of 'the site environmental water managers'. Decisions by the site environmental water managers on how and when structures in Millewa Forest are operated are guided by a range of detailed management plans that have been reviewed and approved by multiple government agencies. Key planning documents that provide recommendations on the environmental water requirements of the Millewa Forest include:

- *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012)
- *Murray-Lower Darling Long Term Water Plan* (Department of Planning, Industry and Environment, 2020a).

Decisions to deliver water to Millewa Forest are also guided by adaptive management processes that support the continual improvement of environmental watering in response to ecological monitoring outcomes.

The replacement and refurbished environmental regulators would be operated at the discretion of the site environmental water managers to deliver environmental water to Millewa Forest in line with the same environmental watering protocols and adaptive management processes that are currently followed. The replacement Pinchgut and Nestrons regulators would have a greater capacity to pass flows than the existing Pinchgut and Nestrons regulators, which would enable the site environmental water managers to carry out environmental watering of Millewa Forest along Toupna Creek and Douglas Swamp more efficiently.

3.6.3 Maintenance of the replacement and refurbished regulators

In line with the existing operation and maintenance arrangements (refer to Section 2.3), WaterNSW would be responsible for maintaining the replacement and refurbished regulators, including the fishways. Maintenance works would occur as required and are most likely to be needed following large flows events that result in high flows past the regulators and potentially also their inundation. Maintenance would be required to:

- Remove sediment, debris and aquatic vegetation that has deposited on the upstream side of the regulator gates and along the base of the culverts and fishways, to maintain the discharge capacity of the regulators. The flow velocities through the regulators, including the fishways, have been designed to minimise sediment build-up during operation
- Repair the gates if they have been damaged by the impact of floating debris or other causes
- Clean and apply lubricants to the gate lifting mechanisms to maintain their operability
- Other repairs to the regulators including the walkways, steps, handrails and guardrails as required.

WaterNSW would prioritise maintenance works based on risks to human safety, customer water supply demand, whether the required maintenance works are preventing or inhibiting the function of the regulators and their fishways, and other environmental considerations.

3.7 Proposed activity footprint

The proposed activity would directly impact an area of 0.99 hectares during the construction phase. The construction footprints at each work site are shown in Figure 3-10 to Figure 3-14 and the areas of the footprint are provided in Table 3-2. The construction footprints include the proposed new infrastructure, existing infrastructure to be refurbished or removed, and adjoining areas for laydown and storage of plant and equipment, prefabricated sections of the new infrastructure, and stockpiles of building and landscaping materials and spoil.

Table 3-2 Construction footprints

Existing asset	Construction footprint area (hectares)		
	Cleared	Vegetated	Total
Pinchgut regulator		0.19	**0.19**
Nestrons regulator		0.09	**0.09**

Existing asset	Construction footprint area (hectares)		
	Cleared	Vegetated	Total
Moira regulator		0.50	**0.50**
Little Edward River offtake regulator	0.04	0.06	**0.10**
Pigsty culvert		0.11	**0.11**
TOTAL	**0.04**	**0.95**	**0.99**

The operational footprint for the proposed activity is the same as the operational footprint of the existing infrastructure and includes Pinchgut Creek, Nestrons Creek, Toupna Creek, Douglas Swamp, Moira Creek and Moira Lake and Little Edward River.

As discussed in Section 3.6, the replacement and refurbished regulators would be available for the site environmental water managers to use for environmental watering of Millewa Forest. Environmental watering of the forest would occur in accordance with the same management plans that are currently being implemented and, therefore, the inundation area would be the same.

3.8 Timing and staging

The construction works proposed at each site are expected to take between six and 14 weeks to complete, subject to the weather being dry and contractor resourcing. The works at each site could occur at the same time or at different times, which means the total duration of construction could be several months.

3.9 Capital investment value

A preliminary estimate of the cost to construct the proposed activity has been prepared by 3Rivers and is about $4.1 million excluding GST (3Rivers, 2023).

3.10 Public utility adjustment

No public utility adjustments are required to enable the proposed construction works to occur.

3.11 Land ownership, tenure, access and acquisition

The proposed activity is located on land owned by the State of NSW through the Minister administering the NPW Act. The tenure of the land on which the works are proposed is detailed in Table 3-3. The table also includes details of the existing authorisation under which WaterNSW is able to access, operate and maintain the existing Pinchgut, Nestrons, Moira and Little Edward River offtake regulators and Pigsty culvert.

No land acquisition is required for the proposed activity.

Table 3-3 Land ownership and tenure of the proposed activity sites

Existing water asset	Lot and DP	Tenure	Existing water asset authorisation
Pinchgut regulator	Lot 67 DP756261	Murray Valley Regional Park — Reserved land under Part 4 of the NPW Act subject to section 5 and clause 6 of Schedule 1 of the *National Park Estate (River Red Gum Reservations) Act 2010*	Existing interest (as assets existing and operational on park at the time of gazettal) under section 47ZA of the NPW Act (as section 39 of the NPW Act)
Nestrons regulator	The existing Nestrons regulator is in Lot 11 DP756261 The replacement Nestrons regulator would be in Lot 10 DP756261	Murray Valley Regional Park — Reserved land under Part 4 of the NPW Act subject to section 5 and clause 6 of Schedule 1 of the *National Park Estate (River Red Gum Reservations) Act 2010*	Existing interest (as assets existing and operational on park at the time of gazettal) under section 47ZA of the NPW Act (as section 39 of the NPW Act)
Moira regulator	Not applicable	Murray Valley National Park — Reserved land under Part 4 of the NPW Act subject to section 5 and clause 7 of Schedule 1 of the *National Park Estate (River Red Gum Reservations) Act 2010* – as per Misc R 00195	Existing interest (as an asset existing and operational on park at the time of gazettal) under section 39 of the NPW Act. Rights of entry delegated under Commonwealth powers MDBA

Existing water asset	Lot and DP	Tenure	Existing water asset authorisation
Little Edward River offtake regulator	Access via trail located across Lot 34 DP7563033 as park and Part 11 road.	Murray Valley Regional Park — Reserved land under Part 4 of the NPW Act subject to section 5 and clause 6 of Schedule 1 of the *National Park Estate (River Red Gum Reservations) Act 2010* – as per Misc R 00194	Existing interest (as an asset existing and operational on park at the time of gazettal) under section 47ZA of the NPW Act (as section 39 of the NPW Act)
Pigsty culvert	Lot 2 DP756260	Murray Valley National Park — Reserved land under Part 4 of the NPW Act subject to section 5 and clause 7 of Schedule 1 of the *National Park Estate (River Red Gum Reservations) Act 2010*	Existing interest (as an asset on park at the time of gazettal) under section 39 of the NPW Act

4 Legislative context

4.1 Permissibility and assessment pathway

State Environmental Planning Policy (Transport and Infrastructure) 2021 (the Transport and Infrastructure SEPP) facilitates the effective delivery of infrastructure across NSW.

Clause 2.73(1)(a) of the Transport and Infrastructure SEPP allows development for any purpose to be carried out without consent on land reserved under the NPW Act, or acquired under Part 11 of the NPW Act, if the development is for a use authorised under the NPW Act.

The potential for the proposed activity to be authorised under the NPW Act has been considered with respect to:

- the objects of the NPW Act
- the plan(s) of management (or equivalent management plan) for the land on which the proposed activity would be carried out
- the lease, license and easement provisions under Part 12 of the NPW Act
- The regulations of use of parks under Part 2 of the National Parks and Wildlife Regulation 2019 (NPW Regulation).

4.1.1 National Parks and Wildlife Act 1974

4.1.1.1 Objects of the NPW Act

The proposed activity is considered to be consistent with the objects of the NPW Act. Table 4-1 identifies how the proposed activity is consistent with the objects of the Act.

Table 4-1 Consistency of the proposed activity with the objects of the NPW Act

Object of the NPW Act (Section 2A of the NPW Act)			Consistency of the proposed activity with the objects
(1)	The objects of this Act are as follows—		
	(a)	the conservation of nature, including, but not limited to, the conservation of—	The proposed activity would replace or refurbish regulators that are at risk of failure due to their

Object of the NPW Act (Section 2A of the NPW Act)			Consistency of the proposed activity with the objects
	(i)	habitat, ecosystems and ecosystem processes, and	current condition. These regulators are currently operated to prevent unseasonal inundation of Millewa Forest. The proposed activity would ensure that Pinchgut, Nestrons, Moira and Little Edward offset regulators would be able to continue to be used to avoid unseasonal inundation of Millewa Forest and thereby maintain more natural ecosystem processes. The proposed activity also includes building fishways at the replacement and refurbished regulators to provide fish passage past these structures. These fishways would be able to be operated to reduce stranding of native fish in Millewa Forest on a receding high flow event, which would support local native fish populations. Refer to Sections 6.4.2 and 6.5.2 for detailed descriptions of the potential impact of the proposed activity on terrestrial and aquatic biodiversity.
	(ii)	Biological diversity at the community, species and genetic levels, and	
	(iii)	Landforms of significance, including geological features and processes, and	
	(iv)	Landscapes and natural features of significance including wilderness and wild rivers,	
(b)	the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to—		The proposed activity would not impact places, objects and features of significance to Aboriginal people, as detailed in Section 6.6. The proposed activity would also not impact any items of historic heritage, as detailed in Section 6.7.
	(i)	places, objects and features of significance to Aboriginal people, and	
	(ii)	places of social value to the people of NSW, and	
	(iii)	places of historic, architectural or scientific significance,	
(c)	Fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,		As discussed under object 1(a) above, the proposed activity would ensure that Pinchgut, Nestrons, Moira and Little Edward offset regulators would be able to continue to be used

Object of the NPW Act (Section 2A of the NPW Act)			Consistency of the proposed activity with the objects
			to avoid unseasonal inundation of Millewa Forest and thereby maintain more natural ecosystem processes. Therefore, the proposed activity would enable the public to continue to enjoy the natural and cultural heritage of Millewa Forest. If the proposed activity did not occur, there would be an increased risk of the existing regulators failing, which would result in unseasonal inundation of Millewa Forest. Over time this could result in degradation of the natural environment, which may diminish the public's enjoyment of Millewa Forest.
	(d)	providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.	The replacement and refurbished regulators would be safer and more efficient to operate than the existing regulators, which would provide the site environmental water managers with more flexibility for environmental watering of Millewa Forest in accordance with the *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012) and the current The Living Murray annual watering plan (refer to Section 6.2.1.8). Alignment of the proposed activity with the management principles for national parks and regional parks is provided in Table 4-2.
(2)	The objects of this Act are to be achieved by applying the principles of ecologically sustainable development.		Table 10-1 details how the proposed activity aligns with each of the four principles of sustainable development identified in section 193 of the EP&A Regulation.

4.1.1.2 National Park Estate (Riverina Red Gum Reservations) Act 2010

The *National Park Estate (Riverina Red Gum Reservations) Act 2010* was enacted to facilitate the reservation of certain former State Forest land in the Riverina area to the national park estate under the NPW Act on 1 July 2010. The Act facilitated the reservation of Murray Valley National Park and

Murray Valley Regional Park from several former State Forests. Pinchgut, Nestrons, Moira and Little Edward River offtake regulators were all in existence when Murray Valley National Park and Regional Park were gazetted from former State Forests. The regulators were not subject to an existing easement, lease, licence or permit at the time of the gazettal.

WaterNSW's access to and operation and maintenance of Pinchgut, Nestrons, Moira and Little Edward River offtake regulators was unaffected by the gazettal of Murray Valley National Park and Regional Park in accordance with Sections 39 and 47ZA respectively of Part 4 of the NPW Act, which preserves existing interests that were permitted at the time of a national park or regional park being reserved.

4.1.1.3 Murray Valley Statement of Management Intent

Murray Valley National Park and Regional Park are managed in accordance with the *Statement of Management Intent: Murray Valley National Park and Murray Valley Regional Park* (Murray Valley SoMI) (NPWS, 2014). Section 6 of the Murray Valley SoMI states that a plan of management will set out the ongoing management objectives for the parks. Currently, no specific management objectives have been defined for Murray Valley National Park or Murray Valley Regional Park. The NPWS's (2021) *Managing Parks Prior to a Plan of Management Policy* states that parks and reserves without a plan of management are to be managed in a manner consistent with the intent of the NPW Act and the precautionary principle.

The proposed activity is considered to be consistent with the management principles for national parks and regional parks in sections 30E and 30H respectively of the NPW Act, refer to Table 4-2.

Section 6 of the Murray Valley SoMI requires all management activities to be preceded by the preparation of an environmental assessment or heritage assessment where this is a requirement of NPWS policy or legislation. In accordance with this requirement the proposed activity is the subject of this REF and the REF has been informed by an Aboriginal cultural heritage assessment report (refer to Attachment C).

Table 4-2 Consistency of the proposed activity with the management principles for national parks and regional parks in Sections 30E and 30H respectively of the NPW Act

Management principle			Consistency of the proposed activity with the management principle
30E	**National parks**		
	(1)	The purpose of reserving land as a national park is to identify, protect and conserve areas containing outstanding or representative	The proposed activity would support the protection and conservation of ecosystems, natural features and landscapes at Millewa Forest by refurbishing Moira regulator to prevent unseasonal inflows to Moira Lake

Management principle			Consistency of the proposed activity with the management principle
	ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor or tourist use and enjoyment so as to enable those areas to be managed in accordance with subsection (2).		and inundation of the surrounding forest and removing the obstruction to fish passage created by Pigsty culvert. The proposed activity would also improve the site environment water managers' ability to manage flows between the Murray River and Moira Lake for the purpose of conserving biodiversity, maintaining ecosystem functions and protecting the ecological integrity of the lake's ecosystems. The proposed activity would have a minimal impact on visitor and tourist use and enjoyment of Murray Valley National Park. There would be some temporary air quality, noise, traffic and visual impacts during the construction phase of the proposed activity (refer to Sections 6.8.2.1, 6.9.2.1, 6.10.2.1 and 6.11.2.1). These impacts would be minor with implementation of the safeguards in Table 9-1.
(2)	A national park is to be managed in accordance with the following principles—		
	(a)	the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes,	The proposed activity would support the conservation of biodiversity and maintenance of ecosystem function at Millewa Forest by refurbishing Moira regulator to prevent unseasonal inundation of Moira Lake and removing the obstruction to fish passage created by Pigsty culvert. The proposed activity would also improve the site environment water managers' ability to manage flows between the Murray River and Moira Lake for the purpose of conserving biodiversity and maintaining ecosystem functions. If the proposed activity did not occur, there would be an increased risk of the existing Moira regulator failing, which would result in unseasonal inundation of Moira Lake and Millewa Forest. Over time this could

Management principle			Consistency of the proposed activity with the management principle
			result in degradation of the biodiversity and ecosystems of the lake and surrounds. The proposed activity would not impact geological and geomorphological features of Millewa Forest (refer to Section 6.1).
	(b)	the conservation of places, objects, features and landscapes of cultural value,	The proposed activity would not impact places, objects features and landscapes of cultural value, as detailed in Sections 6.6 and 6.7.
	(c)	the protection of the ecological integrity of one or more ecosystems for present and future generations,	The proposed activity would support the protection of the ecological integrity of ecosystems at Millewa Forest by replacing Moira regulator to prevent unseasonal inundation of Moira Lake and the surrounding forest. If the proposed activity did not occur, there would be an increased risk of the existing Moira regulator failing, which would result in unseasonal inundation of the lake and forest. Over time this could result in degradation of the ecological integrity of the ecosystems of the lake and surrounds.
	(d)	the promotion of public appreciation and understanding of the national park's natural and cultural values,	The proposed activity would not impact NPWS's ability to promote public appreciation and understanding of Murray Valley National Park's natural and cultural values.
	(e)	provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the national park's natural and cultural values,	The proposed activity would have a minimal impact on visitor and tourist use and enjoyment of Murray Valley National Park. There would be some temporary air quality, noise, traffic and visual impacts during the construction phase of the proposed activity (refer to Sections 6.8.2.1, 6.9.2.1, 6.10.2.1 and 6.11.2.1). These impacts would be minor with implementation of the safeguards in Table 9-1.
	(f)	provision for the sustainable use (including adaptive reuse) of any buildings or structures	Moira regulator would be refurbished rather than replaced to reuse elements of the existing regulator

Management principle				Consistency of the proposed activity with the management principle
			or modified natural areas having regard to the conservation of the national park's natural and cultural values,	that have not reached the end of their design life or which can be rehabilitated in-situ. Neither Moira regulator nor Pigsty culvert have historic heritage significance (refer to Section 6.7). The proposed activity would not impact any buildings.
		(fa)	provision for the carrying out of development in any part of a special area (within the meaning of the *Hunter Water Act 1991*) in the national park that is permitted under section 185A having regard to the conservation of the national park's natural and cultural values,	The proposed activity is not within a special area.
		(g)	provision for appropriate research and monitoring	The proposed activity would not impact the provision of research and monitoring at Murray Valley National Park.
30H	**Regional parks**			
	(1)		The purpose of reserving land as a regional park is to identify, protect and conserve areas in a natural or modified landscape that are suitable for public recreation and enjoyment so as to enable those areas to be managed in accordance with subsection (2).	The proposed activity would support the protection and conservation of landscapes at Millewa Forest by replacing and refurbishing regulators that prevent unseasonal inundation of the forest. Fish passage past the replacement and refurbished regulators would be improved compared to the existing regulators, which would reduce the potential for native fish to become stranded in Millewa Forest on a receding high flow in the Murray River. The proposed activity would also improve the site environment water managers' ability to manage flows between the Murray River, Toupna Creek and Douglas Swamp for the purpose of conserving biodiversity, maintaining ecosystem functions (e.g. native bird breeding at

Management principle				Consistency of the proposed activity with the management principle
				Douglas Swamp) and protecting the ecological integrity of ecosystems. If the proposed activity did not occur, there would be an increased risk of the existing regulators failing, which would result in unseasonal inundation of Millewa Forest that may adversely impact public access to Murray Valley Regional Park for recreation and enjoyment.
	(2)	A regional park is to be managed in accordance with the following principles–		
		(a)	the provision of opportunities, in an outdoor setting, for recreation and enjoyment in natural or modified landscapes,	The proposed activity would have a minimal impact on visitor and tourist use and enjoyment of Murray Valley Regional Park. There would be some temporary air quality, noise, traffic and visual impacts during the construction phase of the proposed activity (refer to Sections 6.8.2.1, 6.9.2.1, 6.10.2.1 and 6.11.2.1). The Little Edward River camp ground would be temporarily closed while works are occurring at Little Edward River offtake regulator, and Millewa River Road would be closed to visitor traffic at Nestrons Creek while the replacement regulator is being built. Impacts to recreational users of Murray Valley Regional Park would be minor with implementation of the safeguards in Table 9-1.
		(b)	the identification, interpretation, management and conservation of the park so as to maintain and enhance significant landscape values,	The proposed activity would maintain the landscape values of Millewa Forest by replacing and refurbishing regulators that prevent unseasonal inundation of the forest. If the proposed activity did not occur, there would be an increased risk of the existing regulators failing, which would result in unseasonal inundation of Millewa Forest that in the long-term would alter the forest's landscape values.

Management principle				Consistency of the proposed activity with the management principle
		(c)	the conservation of natural and cultural values,	The proposed activity would conserve the natural values of Millewa Forest by replacing and refurbishing regulators that prevent unseasonal inundation of the forest. Fish passage past the replacement and refurbished regulators would be improved compared to the existing regulators, which would reduce the potential for native fish to become stranded in Millewa Forest on a receding high flow in the Murray River. The proposed activity would also improve the site environment water managers' ability to manage flows between the Murray River, Toupna Creek and Douglas Swamp for the purpose of conserving biodiversity, maintaining ecosystem functions (e.g. native bird breeding at Douglas Swamp) and protecting the ecological integrity of ecosystems. If the proposed activity did not occur, there would be an increased risk of the existing regulators failing, which would result in unseasonal inundation of Millewa Forest that in the long-term would degrade the forest's natural values. The proposed activity would not impact the cultural values of Murray Valley Regional Park as detailed in Sections 6.6 and 6.7.
		(d)	the promotion of public appreciation and understanding of the regional park's natural and cultural values,	The proposed activity would not impact NPWS's ability to promote public appreciation and understanding of Murray Valley Regional Park's natural and cultural values.
		(e)	provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the regional park's natural and cultural values,	The proposed activity would have a minimal impact on visitor and tourist use and enjoyment of Murray Valley Regional Park. There would be some temporary air quality, noise, traffic and visual impacts during the construction phase of the proposed activity (refer to Sections 6.8.2.1, 6.9.2.1, 6.10.2.1 and 6.11.2.1). The Little

Management principle				Consistency of the proposed activity with the management principle
				Edward River camp ground would be temporarily closed while works are occurring at Little Edward River offtake regulator, and Millewa River Road would be closed to visitor traffic at Nestrons Creek while the replacement regulator is being built. Impacts to visitors and tourists would be minor with implementation of the safeguards in Table 9-1.
		(f)	provision for the sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to the conservation of the regional park's natural and cultural values,	Little Edward River offtake regulator would be refurbished rather than replaced to reuse elements of the existing regulator that have not reached the end of their design life or which can be rehabilitated in-situ. Pinchgut, Nestrons and Little Edward River offtake regulators do not have historic heritage significance (refer to Section 6.7). The proposed activity would not impact any buildings.
		(g)	provision for the carrying out of development in any part of a special area (within the meaning of the *Hunter Water Act 1991*) in the regional park that is permitted under section 185A having regard to the conservation of the regional park's natural and cultural values.	The proposed activity is not within a special area.

4.1.1.4 Leases, licences and easements under the NPW Act

Part 12 of the NPW Act provides for the granting of a lease, licence or easement for the use of land, buildings or structures within a reserve. The Department of Planning and Environment—Water, on behalf of WaterNSW and the Murray-Darling Basin Authority, has engaged with NPWS regarding the application of Part 12 of the NPW Act to the proposed activity and this has confirmed that easements for water supply will need to be granted under section 153 of the NPW Act to operate the replacement Pinchgut and Nestrons regulators and refurbished Moira and Little Edward River offtake regulators.

WaterNSW and Murray-Darling Basin Authority will negotiate the terms of the draft easements with NPWS. Once the construction and commissioning works are completed, the replacement and refurbished regulators will be surveyed in accordance with the *Conveyancing Act 1919* prior to the easements being granted.

4.1.1.5 Protection of Aboriginal objects and Aboriginal places

Part 6 of the NPW Act provides for the protection of Aboriginal objects and Aboriginal places. Sections 86 and 87 of the Act makes it an offence to harm or desecrate Aboriginal objects and Aboriginal places unless the harm or desecration was authorised by an Aboriginal heritage impact permit or due diligence was exercised to determine whether the subject act would harm an Aboriginal object and it was reasonably determined that no Aboriginal object would be harmed. Section 90 of the Act details the requirements for applying for and granting of Aboriginal heritage impact permits.

An Aboriginal cultural heritage assessment report has been prepared in accordance with the *Code of Practice for the Investigation of Aboriginal Objects in NSW* (DECCW 2011) to inform this REF and is provided in Attachment C and summarised in Section 6.6. The assessment determined that the proposed activity would not alter any existing Aboriginal cultural heritage or values and, therefore, an Aboriginal heritage impact permit is not required.

4.1.1.6 Assets of intergenerational significance

Part 12A of the NPW Act provides for the declaration of land reserved or acquired for reservation to be an environmental or cultural asset of intergenerational significance and makes it an offence to damage, harm or disturb such assets unless it was carried out in accordance with a conservation action plan, an Aboriginal cultural practice, a planning approval under the EP&A Act or an authorised action under the *Rural Fires Act 1997*.

The proposed activity is not located on a declared asset of intergenerational significance site. The Koala (*Phascolarctos cinereus*) is a threatened species asset of intergenerational significance and it has potential habitat at all construction footprints and scats were found in the vicinity of Pinchgut and Nestrons regulators (refer to Section 6.4.1.2). However, Murray Valley National Park and Regional Park are not included in the reserves where the conservation action plan for the Koala applies.

4.1.2 National Parks and Wildlife Regulation 2019

The NPW Regulation regulates the use of parks. The NPW Regulation prohibits the following conduct within a park without the consent of a park authority:

- Sections 9 and 10 prohibit the entry and use of heavy and noisy machinery

- Section 14 prohibits interfering with animals or their nests, eggs, habitation or resting place or any beehive
- Section 20 prohibits the construction, operation or use of any structure, installation, engineering, plant or equipment
- Section 21 prohibits the cutting, felling, removal, damage or destruction of vegetation.

Construction of the proposed activity will require a consent from NPWS. The construction works will need to be carried out in accordance with the conditions of the consent.

4.1.3 Environmental Planning and Assessment Act 1979

This REF has been prepared in accordance with Part 5 Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The REF examines and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity, in accordance with section 5.5 of the EP&A Act.

Section 171(1) of the Environmental Planning and Assessment Regulation 2000 requires that a determining authority must take into account the environmental factors specified in the environmental factors guidelines that apply to the activity. Accordingly, this REF has taken into account the environmental factors specified in the *Guidelines for Division 5.1 Assessments* (Department of Planning and Environment, 2022a).

NPWS has developed guidelines for the preparation of REFs for activities proposed within national parks. The *Guidelines for Preparing a Review of Environmental Factors: How to Assess the Environmental Impacts of Activities Within NSW National Parks* (Department of Planning and Environment, 2021) are designed to help proponents to develop the contents of an REF and also understand post-determination requirements. The guidelines were considered during the development of the template and contents of this REF.

4.1.4 State Environmental Planning Policies

4.1.4.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

As discussed in Section 4.1, the proposed activity is permissible without consent in accordance with clause 2.73(1)(a) of Division 12 of the Transport and Infrastructure SEPP, which addresses land reserved under the NPW Act or acquired under Part 11 of the Act.

4.1.4.2 State Environmental Planning Policy (Biodiversity and Conservation) 2021

The State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP) contains provisions to protect the biodiversity values and amenity of trees and other vegetation in non-rural areas of NSW (Chapter 2), encourage the proper conservation and

management of areas of natural vegetation that provide habitat for koalas (Chapters 3 and 4), conserve and enhance the riverine environment of the Murray River (Chapter 5), and control development in certain water catchments (Chapter 6). Only Chapter 5 of the Biodiversity and Conservation SEPP is relevant to the proposed activity.

The objectives of Chapter 5 of the Biodiversity and Conservation SEPP are to ensure that appropriate consideration is given to development with the potential to adversely affect the riverine environment of the Murray River, to establish a consistent and co-ordinated approach to environmental planning and assessment along the Murray River, and to conserve and promote the better management of the natural and cultural heritage values of the riverine environment of the Murray River. Part 5.2 identifies planning principles that a determining authority must take into account when considering a proposed development that may adversely affect the riverine environment of the Murray River. Specific principles are provided in clause 5.9 and include access, bank disturbance, flooding, land degradation, landscape, river related uses, settlement, water quality and wetlands. The specific principles have been considered during preparation of the concept design for the proposed activity and this REF as summarised in Table 4-3.

Part 5.3 identifies planning requirements and consultation requirements for various types of development. Consultation carried out during preparation of the concept design and REF is discussed in Section 5.

Table 4-3 Consistency of the proposed activity with the specific principles in clause 5.9 of the Biodiversity and Conservation SEPP

Specific principle	Consistency of the proposed activity with the specific principle
Access	
The waterway and much of the foreshore of the Murray River is a public resource. Alienation or obstruction of this resource by or for private purposes should not be supported.	The proposed replacement of Nestrons regulator would require the temporary closure of a section of Millewa River Road. This would limit the public's ability to access the Murray River in a vehicle along the temporarily closed section of Millewa River Road. However, this section of the river foreshore would remain accessible on foot or from the river. The proposed activity is not for a private purpose.
Development along the main channel of the Murray River should be for public purposes. Moorings in the main channel should be for the purposes of short stay occupation only.	The proposed activity does not include development along the main channel of the Murray River.

Specific principle	Consistency of the proposed activity with the specific principle
Human and stock access to the Murray River should be managed to minimise the adverse impacts of uncontrolled access on the stability of the bank and vegetation growth.	The proposed activity does not require human or stock access to the Murray River.

Bank disturbance

Disturbance to the shape of the bank and riparian vegetation should be kept to a minimum in any development of riverfront land.	The proposed activity would not disturb the banks of the Murray River or remove riparian vegetation from the riverbanks. The nearest works to the Murray River would occur at Pinchgut Creek. The replacement Pinchgut regulator is proposed to be built immediately downstream of the existing Pinchgut regulator, which is located about 20 metres downstream of where Pinchgut Creek joins the Murray River. The proposed construction footprint for these works is shown in Figure 3-10.

Flooding

Where land is subject to inundation by floodwater–		
(a)	the benefits to riverine ecosystems of periodic flooding,	The existing Pinchgut, Nestrons, Moira and Little Edward River offtake regulators are operated by the site environmental water managers to prevent unseasonal inundation of Millewa Forest and to achieve other ecological objectives. The proposed activity would replace or refurbish these regulators to extend their working lives. The replacement and refurbished regulators would be safer and easier to operate than the existing regulators. The replacement and refurbished regulators would have the same or greater discharge capacities than the existing regulators, which would enable the site environmental water managers to more efficiently achieve the same

Specific principle		Consistency of the proposed activity with the specific principle
		environmental watering of Millewa Forest that they perform with the existing regulators.
(b)	the hazard risks involved in developing that land,	The proposed activity would replace or refurbish existing regulators and, therefore, would not change the type of development in Millewa Forest. As the replacement and refurbished regulators would be safer and easier to operate and have the same or greater discharge capacities as the existing regulators, they would be more efficient for the site environmental water managers to operate and planned environmental watering outcomes could be achieved slightly faster if needed. The proposed removal of Pigsty culvert and recreation of an open channel at this location would substantially reduce development and any associated hazard risks where Pigsty Creek joins the Edward River.
(c)	the redistributive effect of the proposed development on floodwater,	The proposed activity would have a negligible redistributive effect on floodwaters because the replacement and refurbished regulators would be operated in the same way as the existing regulators to prevent unseasonal inundation of Millewa Forest. The proposed removal of Pigsty culvert would result in flows in Pigsty Creek and inundation of the surrounding forest being more directly influenced by high flows in the Edward River. The removal of the culvert would also enable runoff within the Pigsty Creek catchment to flow to the Edward River quicker. However, the overall distributive effect of removing the culvert would be small as Pigsty Creek is a flood runner that is just one of several unregulated outlets of Towrong Creek to the Edward River.
(d)	the availability of other suitable land in the locality not liable to flooding,	The proposed activity does not involve the development of new infrastructure where there is not previously infrastructure. The works proposed at Moira

Specific principle		Consistency of the proposed activity with the specific principle
		and Little Edward River offtake regulator would occur at the site of the existing regulators. The replacement Pinchgut regulator would be located immediately downstream of the existing Pinchgut regulator. The replacement Nestrons regulator would be built where there is currently a bridge over Nestrons Creek. There is no other suitable land for the proposed activity that is not liable to flooding.
(e)	the availability of flood free access for essential facilities and services,	The proposed activity would not impact access for essential facilities and services. The proposed replacement of Nestrons regulator would require the temporary closure of a section of Millewa River Road. The detours that would be put in place would be along access tracks that would be at no greater risk of inundation during a flood than Millewa River Road. If NPWS or any other authority required access to this section of Millewa River Road during the construction works for an essential purpose, this could be facilitated, with only passage across Nestrons Creek itself not being possible.
(f)	the pollution threat represented by any development in the event of a flood,	There is potential for pollution to occur if the construction work sites are flooded. Safeguards that will be implemented during the construction phase to manage this risk are presented in Table 6-2.
(g)	the cumulative effect of the proposed development on the behaviour of floodwater, and	Only the proposed removal of Pigsty culvert would result in a change to the behaviour of floodwater. At this location flooding behaviour would become more natural as a result of removal of the culvert. The operation of the replacement and refurbished regulators would not result in any change to the behaviour of floodwater.
(h)	the cost of providing emergency services and replacing infrastructure in the event of a flood.	The proposed activity would result in a change to the cost of providing emergency services and replacing infrastructure in the event of a flood.

Specific principle	Consistency of the proposed activity with the specific principle
Flood mitigation works constructed to protect new urban development should be designed and maintained to meet the technical specifications of the Department of Water Resources.	The proposed activity does not constitute flood mitigation works to protect new urban development.
Land degradation	
Development should seek to avoid land degradation processes such as erosion, native vegetation decline, pollution of ground or surface water, groundwater accession, salination and soil acidity, and adverse effects on the quality of terrestrial and aquatic habitats.	Safeguards will be implemented to avoid or minimise the impacts of the proposed activity on soils, vegetation and biodiversity, and ground and surface water. Refer to Table 9-1 for a complete list of the proposed safeguards.
Landscape	
Measures should be taken to protect and enhance the riverine landscape by maintaining native vegetation along the riverbank and adjacent land, rehabilitating degraded sites and stabilising and revegetating riverbanks with appropriate species.	The proposed activity would not disturb the banks of the Murray River or remove riparian vegetation from the riverbanks. The nearest works to the Murray River would occur at Pinchgut Creek. The replacement Pinchgut regulator is proposed to be built immediately downstream of the existing Pinchgut regulator, which is located about 20 metres downstream of where Pinchgut Creek joins the Murray River. The proposed construction footprint for these works is shown in Figure 3-10. A site rehabilitation plan will be prepared as part of the Contractor's construction environmental management plan (CEMP) and will detail how disturbed areas of the construction footprints not occupied by or needed to access the replacement and refurbished regulators will be stabilised and revegetated (refer to Table 6-14).
River related uses	

Specific principle	Consistency of the proposed activity with the specific principle
Only development which has a demonstrated, essential relationship with the Murray River should be located in or on land adjacent to the Murray River. Other development should be set well back from the bank of the Murray River.	The proposed activity does not include works in the Murray River or on the banks of the river. The nearest works to the Murray River would occur at Pinchgut Creek. The replacement Pinchgut regulator is proposed to be built immediately downstream of the existing Pinchgut regulator, which is located about 20 metres downstream of where Pinchgut Creek joins the Murray River. The proposed construction footprint for these works is shown in Figure 3-10.
Development which would intensify the use of riverside land should provide public access to the foreshore.	The proposed activity does not include works on the banks of the Murray River. The proposed activity would not alter public access to the foreshore of the river.
Settlement	
New or expanding settlements (including rural-residential subdivision, tourism and recreational development) should be located–	The proposed activity is not residential, tourism or recreational development.
(a) on flood free land,	
(b) close to existing services and facilities, and	
(c) on land that does not compromise the potential of prime crop and pasture land to produce food or fibre.	
Water quality	
All decisions affecting the use or management of riverine land should seek to reduce pollution caused by salts and nutrients entering the Murray River and otherwise improve the quality of water in the Murray River.	As noted above, no works are proposed within or on the banks of the Murray River. Safeguards to avoid or minimise the potential for water pollution are provided in Table 6-2.

Specific principle		Consistency of the proposed activity with the specific principle
Wetlands		
Wetlands are a natural resource which have ecological, recreational, economic, flood storage and nutrient and pollutant filtering values. Land use and management decisions affecting wetlands should–		
(a)	provide for a hydrological regime appropriate for the maintenance or restoration of the productive capacity of the wetland,	The proposed replacement and refurbishment of Pinchgut, Nestrons, Moira and Little Edward River offtake regulators would provide the site environmental water managers with regulators that are safer and easier to operate and can more efficiently achieve environmental watering outcomes. The regulators would be able to be used to achieve targeted ecological outcomes e.g. operating Pinchgut and Nestrons regulators to manage bird breeding at Douglas Swamp.
(b)	consider the potential impact of surrounding land uses and incorporate measures such as a vegetated buffer which mitigate against any adverse effects,	The proposed activity is located in Murray Valley National Park and Regional Park and Pinchgut, Nestrons, Moira and Little Edward River offtake regulators and Pigsty culvert are all surrounded by native vegetation including wetlands. The proposed activity includes clearing of vegetation to enable access to and construction of the replacement and refurbished regulators and removal of Pigsty culvert. The construction footprints have been made as small as feasible to minimise the ecological impacts of the required clearing. A site rehabilitation plan will be prepared as part of the Contractor's CEMP and will detail how disturbed areas of the construction footprints not occupied by or needed to access the replacement and refurbished regulators will be stabilised and revegetated (refer to Table 6-14).

Specific principle		Consistency of the proposed activity with the specific principle
(c)	control human and animal access, and	The proposed activity would have a negligible impact on human and animal access to wetlands.
(d)	conserve native plants and animals.	The proposed activity includes clearing of vegetation to enable access to and construction of the replacement and refurbished regulators and removal of Pigsty culvert. The construction footprints have been made as small as feasible to minimise the ecological impacts of the required clearing. A site rehabilitation plan will be prepared as part of the Contractor's CEMP and will detail how disturbed areas of the construction footprints not occupied by or needed to access the replacement and refurbished regulators will be stabilised and revegetated (refer to Table 6-14).

4.1.5 Strategic plans

4.1.5.1 NSW Water Strategy

The NSW Water Strategy (Department of Planning, Industry and Environment, 2021) is a 20-year State-wide strategy to improve the security, reliability and quality of NSW's water resources over the coming decades. The NSW Water Strategy addresses key challenges and opportunities for water management and service delivery across the State and sets the strategic direction for the NSW water sector over the long-term.

The strategy outlines key priorities. Priority 3 is to improve river, floodplain and aquifer ecosystem health, and system connectivity and is relevant to the proposed activity.

4.1.5.2 Murray-Lower Darling Long Term Water Plan

The *Murray-Lower Darling Long Term Water Plan* (Department of Planning, Industry and Environment, 2020a) contains ecological objectives and targets for priority environmental assets and ecosystem functions in the Murray-Lower Darling catchment. The objectives and targets have been identified for native fish, native vegetation, waterbirds and river connectivity. The broad environmental outcomes sought in the plan are to:

- Maintain the extent and improve the health of water-dependent native vegetation and wetlands
- Maintain the diversity of waterbird species and increase their numbers across the catchment

- Maintain the diversity and improve the population of native fish in the catchment
- Maintain and protect a variety of wetland habitats and support the movement of carbon and nutrients throughout the river system
- Maintain the number and type of water-dependent species throughout the catchment.

Implementation of the proposed activity would support these environmental outcomes by improving fish access to habitat at Toupna Creek, Douglas Swamp and Little Edward River, and making it easier to manage bird breeding at Douglas Swamp, as discussed in Section 3.2.

4.1.5.3 Barmah-Millewa Forest Environmental Water Management Plan

The *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012) consists of a long-term strategic plan that outlines the environmental water requirements of the Barmah-Millewa Forest and how to broadly achieve them with a combination of environmental water works and measures.

The plan provides context for water planning, delivery, monitoring and consultation processes at Barmah-Millewa Forest and provides a broad description of the proposed operating regimes to maximise ecological outcomes. An operating strategy is provided in Schedule 2 of the plan and it aims to achieve the ecological objectives set for the forests by providing the water requirements for key vegetation communities, including wetlands, giant rush, moira grass plains, River Red Gum Forest and woodland and black box communities. The operating strategy also includes specific flow recommendations to support breeding events of waterbirds, including colonial and non-colonial nesters.

Despite the operating strategy, annual water planning, and implementation are responsive to changing water resource conditions, opportunities and environmental priorities throughout the season and from year to year.

4.1.6 Local Environmental Planning Instruments

4.1.6.1 Murray Local Environmental Plan 2011

The proposed activity would be located within the Murray River Council local government area on land subject to the Murray Local Environmental Plan (LEP) 2011. The proposed activity would be located on land zoned C1 - National Parks and Nature Reserves under the LEP.

Under the LEP, development is only permitted without consent on land zoned C1 if it is a use authorised under the NPW Act. The proposed activity is permitted without consent subject to the LEP as it has been deemed authorised under the NPW Act.

The proposed activity is located within the flood planning area identified in clause 5.21 of the LEP. Clause 5.21(2) states that development consent must not be granted to development on land the

consent authority considers to be within the flood planning area unless the consent authority is satisfied the development:

a) Is compatible with the flood function and behaviour on the land, and

b) Will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

c) Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

d) Incorporates appropriate measures to manage risk to life in the event of a flood, and

e) Will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.

As outlined in Section 6.3, the proposed activity would not adversely impact flood behaviour and would be compatible with the current flood function and behaviour on the land given the proposed activity involves replacing existing infrastructure and, in the case of Pigsty culvert, removing an existing obstruction to flow. Due to the remoteness of the proposed work sites and large distances to the nearest residences, the proposed activity would not adversely affect the safe occupation and efficient evacuation of people, would not exceed the capacity of existing evacuation routes, and would not pose a risk to life in the event of a flood.

As outlined in Section 6.1, the potential temporary and short-term erosion and sedimentation impacts posed by the ground disturbance and vegetation clearance during construction of the proposed activity would be significantly reduced with the adoption of appropriate sedimentation and erosion controls in accordance with the Blue Book as detailed in Section 6.1.4. The typically flat terrain would further reduce the risk of soil instability. Therefore, the proposed activity would be consistent with clause 5.21(2) of the LEP.

4.2 Other NSW legislation

4.2.1 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) applies in relation to animals and plants. The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development.

The BC Act establishes procedures and criteria for the recognition of areas of outstanding biodiversity value and species and ecological communities that are threatened. Schedules 1 and 2 of

the Act list threatened species and ecological communities respectively. The Act also identifies processes that could adversely affect threatened species or ecological communities or cause species or ecological communities that are not threatened to become threatened. Key threatening processes are listed in Schedule 4 of the Act.

Part 7 of the BC Act identifies biodiversity assessment requirements for approvals under the EP&A Act. In accordance with section 7.2 of the BC Act, development that is an activity subject to environmental impact assessment under Part 5 of the EP&A Act is likely to significantly affect threatened species if it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3 of the BC Act or if it is carried out in a declared area of outstanding biodiversity value.

Section 7.8 of the BC Act requires that an environmental assessment under Part 5 of the EP&A Act of a proposed activity likely to significantly affect threatened species is to include or be accompanied by a species impact statement or, if the proponent so elects, a biodiversity development assessment report.

A biodiversity assessment of the proposed activity is provided in Attachment A and summarised in Section 6.4. The proposed activity would not have significant impact on threatened species or ecological communities, or their habitats, and is not in a declared area of outstanding biodiversity value (refer to Section 6.4 and Attachment A). Accordingly, neither a species impact statement nor biodiversity development assessment report is required.

The relevant requirements of the BC Act are addressed in the biodiversity assessment through:

- Desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality
- Identification, assessment and mapping of listed threatened communities and threatened species (or their habitat)
- Assessment of potential impacts on listed threatened species, populations and ecological communities, including identification of key threatening processes relevant to the construction areas
- Test of significance for potential impacts to threatened species or ecological communities, or their habitats, in accordance with section 7.3 of the BC Act
- Identification of suitable impact mitigation and environmental management measures for listed threatened species, where required.

4.2.2 Rural Fires Act 1977

The *Rural Fires Act 1997* provides for the prevention, mitigation and suppression of bush fires, and aims to protect environmental, cultural and community assets from damage arising from fires. The

Act establishes an organisational framework for bush fire management planning, with the creation of rural fire districts under section 6 of the Act and bush fire management committees for each of these districts under section 50 of the Act.

Section 52 of the Act requires each bush fire management committee is required to prepare a bush fire risk management plan for their district. The required contents of bush fire risk management plans are identified in section 54 of the Act and include schemes for the reduction of bush fire hazards and restrictions on the use of fire or other particular fire hazards reduction activities.

The proposed activity is located within the Mid Murray Zone Bush Fire Risk Management Committee area, which includes the Conargo, Deniliquin, Jerilderie, Murray and Wakool local government areas. The committee prepared a bush fire risk management plan for the area in 2009. Information in the plan that is relevant to proposed activity is summarised in Section 6.12.

Under section 3(d) of the Act, the protection of the environment through bush fire prevention activities is required to be carried out having regard to the principles of ecologically sustainable development described in section 6(2) of the *Protection of the Environment Administration Act 1991*.

Section 63 of the *Rural Fires Act 1997* provides that it is the duty of a public authority to prevent the occurrence of bush fires on any land under its ownership or occupancy and to take any steps that a bush fire coordinating committee advises it to take or which are included in an applicable bush fire risk management plan and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of a bush fire on or from:

a) Any land vested in or under its control or management, or

b) Any highway, road, street, land or thoroughfare, the maintenance of which is charged on the authority.

NPWS's approach to managing fires in parks and reserves is discussed in Section 6.12.

The Act declares the bush fire danger period to run from 1 October to 31 March in the following year (inclusive), which can be modified by the Commissioner of the NSW Rural Fire Service. Total fire bans may be issued by the Minister in the interests of public safety.

The proposed activity does not comprise development for which a bush fire safety authority under section 100B of the *Rural Fires Act 1997* would be required.

4.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) applies in relation to fish and marine vegetation. The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The Act is relevant as the proposed activity would directly and indirectly impact aquatic habitats and species.

The FM Act establishes mechanisms for:

- The listing of threatened species, populations and ecological communities or key threatening processes
- The declaration of critical habitat
- Issuing permits for certain works on 'water land'
- Consideration and assessment of threatened species impacts in the development assessment process.

Part 7 of the FM Act relates to the protection of aquatic habitats, including providing management of dredging and reclamation works within permanently or intermittently flowing watercourses, as well as the temporary or permanent blockage of fish passage within a watercourse.

Works associated with construction of the proposed activity would require 'dredging' (excavation of water land or removal of material from water land) or 'reclamation' (using material to fill/reclaim or depositing material to construct anything other than water land) as defined under section 198A of the FM Act. Section 199 of the FM Act identifies circumstances in which a public authority may carry out dredging or reclamation. Such works are required to be notified to the Minister for Agriculture administering the FM Act in writing. Any matters raised by the Minister require consideration. The proposed activity would require disturbance to the beds of the waterways where replacement and refurbishment of regulators is proposed and, therefore, notification to the Minister for Agriculture in accordance with section 199 of the FM Act.

Section 218(5) of the FM Act requires that a public authority that proposes to construct, alter or modify a reservoir (including a floodgate) on a waterway must notify the Minister for Agriculture administering the FM Act of the proposed action, and, if the Minister so requests, include as part of the works a suitable fishway or fish by-pass. The Department of Planning and Environment—Water notified the Department of Primary Industries Fisheries of the proposed action and fishways have been included in the concept designs for regulators proposed for replacement and refurbishment. The Department of Planning and Environment—Water has engaged with the Department of Primary Industries Fisheries about the design of the fishways (refer to Section 5.2.3).

Construction of the proposed activity would cause a 'temporary or permanent blockage of fish passage within watercourses' as defined under section 219 of the FM Act. A permit to obstruct the free passage of fish would therefore be required under this section of the FM Act. It is noted that the existing regulators prevent fish passage so the proposed construction works would result in no worsening of fish passage.

Additionally, any translocation of fish and aquatic vegetation that is are required as part of cofferdam establishment and instream work site dewatering and establishment would require a permit under section 37 of the FM Act.

Part 7A of the FM Act relates to threatened species conservation. It details the process for the recognition of threatened species, populations and ecological communities and key threatening processes and offences for harming threatened species, populations or ecological communities and damaging their habitat and critical habitat. Endangered species, populations and ecological communities are listed in Schedule 4 of the Act, critically endangered species and ecological communities are listed in Schedule 4A, vulnerable species and ecological communities are listed in Schedule 5 and key threatening processes are listed in Schedule 6. The proposed activity's potential impacts to threatened species, populations and ecological communities and inclusion of key threatening processes are assessed in Attachment B and summarised in Section 6.5.

4.2.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

Section 89 of the WM Act requires a water use approval for the use of water for a particular purpose at a particular location. A water use approval would be required to extract water for use during the construction phase of the proposed activity.

Section 90 of the WM Act requires an approval to undertake a water management work, which includes construction and use of water supply works. The definition of a water supply work includes any work that has, or could have, the effect of impounding water in a water source. The existing Pinchgut, Nestrons, Moira and Little Edward River offtake regulators are all subjects of the NSW Murray Lower Darling Water Supply Work Approval (approval number 50WA511767). Condition 1 of the approval authorises WaterNSW to construct and use various water supply works within the NSW Murray and Lower Darling Regulated Rivers Water Sources to capture, store and release water. Condition 1 of the approval lists a wide range of water supply works to which the approval applies, including Hume Dam and associated structures, Menindee Lakes and associated structures, and numerous weirs and regulators as well as fishways, locks, block banks, block dams and cuttings associated with these structures. Condition 1 includes Nestrons regulator (referred to in the approval as 'Nestron's Creek Weir'), Pinchgut regulator, Moira regulator, and Little Edward River offtake regulator (referred to in the approval as 'Little Edwards Offtake Regulator'). In accordance with the dictionary in the WM Act, an approval to 'construct a work' allows for the installation, maintenance, repair, alternation and extension of that work. However, Condition 2 of the approval prohibits anything being done to the authorised water supply works that would change the capacity of the works to affect the flow, volume, quality and behaviour of the water, without the written approval of the Minster for Water. Engagement is ongoing with the licencing section of the Department of Planning and Environment—Water regarding whether an amendment or renewal of

the existing water supply work approval is required in order to construct and operate the replacement and refurbished regulators.

Section 91 of the WM Act requires an 'activity approval' to carry out a 'controlled activity' in, on or under waterfront land or to carry out an aquifer interference activity. The definition of a controlled activity includes the carrying out of work, the removal of material or vegetation from land, the deposition of material on land and the carrying out of any other activity that affects the quality or flow of water in a water source. Waterfront land is defined as including the bed and banks of rivers as well as land that is 40 metres inland of the highest bank of the river. A river is defined river to include any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved. The proposed activity would be a controlled activity under the WM Act.

Section 41 of the Water Management (General) Regulation 2018 provides that a public authority is exempt from requiring a controlled activity approval to carry out a controlled activity in, on or under waterfront land. Therefore, as the Department of Planning and Environment—Water is the proponent of the proposed activity, a controlled activity approval is not required.

4.2.5 Heritage Act 1977

The *Heritage Act 1977* provides for the conservation of buildings, works, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State. Matters protected under the Act include items listed on the State Heritage Register, the heritage schedules of local environmental plans, and/or the conservation registers (or section 170 registers) of NSW government agencies, as well as items subject to an interim heritage order.

Under section 60 of the *Heritage Act 1977*, approval from the Heritage Council of NSW is required before carrying out any work or activities on items listed in the State Heritage Register. The proposed activity would not impact on any items listed on the State Heritage Register.

Section 139 of the *Heritage Act 1977* prohibits a person from disturbing or excavating any land on which the person has discovered or exposed a relic, except in accordance with an excavation permit or a notification granting exception for the permit.

Section 146 of the *Heritage Act 1977* requires that if a relic is discovered or located, the Heritage Council of NSW must be notified of the location of the relic.

Section 170 of the *Heritage Act 1977* requires NSW government agencies to maintain a heritage and conservation register of items of environmental heritage that are vested in, owned or occupied by, or subject to the control of, the agency. The Department of Planning and Environment maintains the Historic Heritage Information Management System to meets its obligations under section 170 of the *Heritage Act 1977*. The Historic Heritage Information Management System is a database of records

of heritage sites and items that exist in the NSW national parks system. A search of the Historic Heritage Information Management System was completed during preparation of this REF and no items were found within the vicinity of the proposed activity (refer to Section 6.7.1.1).Part 3C of the *Heritage Act 1977* protects historic shipwrecks. Shipwrecks that have been located in the coastal waters of NSW or any other waters within the limits of the State for 75 years or more are recognised as historic shipwrecks in accordance with section 47 of the Act. Movement , damage or destruction of historic shipwrecks is not permitted otherwise than in accordance with an historic shipwrecks permit. The proposed activity would not directly impact any maritime heritage items.

4.2.6 Crown Land Management Act 2016

The *Crown Land Management Act 2016* provides for the ownership, use and management of Crown land in NSW. Ministerial approval is generally required to grant a lease, licence, permit, easement or right of way over a Crown reserve. The Act requires environmental, social, cultural heritage and economic considerations to be taken into account in decision-making about Crown land, in accordance with the objects of the Act and the principles of Crown land management.

The proposed activity is not located on Crown land and does not involve any land acquisition or change in land use and does not require the granting of a lease, licence, permit, easement or right of way over a Crown reserve or changes to any existing lease, licence, permit, easement or right of way.

4.2.7 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) requires that an environment protection licence be held to undertake a scheduled activity or scheduled development work. The proposed activity is not of a kind listed in Schedule 1 of the POEO Act and would not require an environment protection licence under this Act.

Section 43(d) of the POEO Act permits (but does not require) the issue of an environment protection licence for non-scheduled activities. However, compliance with the conditions of such a licence provides a defence to the offence of polluting waters under section 120 of the Act.

Construction activities must comply with the requirements of the POEO Act. Section 139 of the Act relates to the operation of plant and noise pollution and requires that plant be operated in a proper and efficient manner and maintained in an efficient condition.

4.3 Commonwealth legislation

4.3.1 Environment Protection Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, populations and communities and heritage items.

The approval of the Commonwealth Minister for the Environment and Water is required for an action which has, would have, or is likely to have, a significant impact on matters of national environmental significance.

Any potential to significantly impact on matters of national environmental significance is likely to require a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water for a decision as to whether it is a controlled action requiring approval under the EPBC Act.

The expected impact of the proposed activity on matters of national environmental significance is discussed in Chapter 7. The proposed activity is located within the NSW Central Murray Forests Ramsar site and there are records of, or suitable habitat for, threatened species and migratory species listed under the EPBC Act in the vicinity of the proposed activity. The proposed activity is not expected to have a significant impact on these matters of national environmental significance.

The Department of Planning and Environment—Water referred the proposed activity to the Department of Climate Change, Energy, the Environment and Water (EPBC number 2023/09517) and it was determined to not be a controlled action on 27 July 2023.

4.3.2 Native Title Act 1993

Native title is the recognition that Aboriginal and Torres Strait Islander people have rights and interests to land and waters according to their traditional law and customs as set out in Australian Law. Native title is governed by the *Native Title Act 1993* (NT Act).

An indigenous land use agreement, established under the NT Act, is a voluntary agreement between native title parties and other people or bodies about the use and management of areas of land and/or waters. It can be made over areas where native title has been determined to exist in at least part of the area, where a native title claim has been made or no native title claim has been made.

A search of the National Native Title Register established under section 192 of the NT Act was carried out on 16 December 2022 shows that Native Title Determination VCD1998/001 (Federal Court file number VID6001/1995) applies to the proposed activity sites. The claim was lodged by members of the Yorta Aboriginal Community. A determination was given on 18/12/1998 determining that native

title does not exist on the land. There are no current native title claims lodged in relation to land within or adjacent to the proposed activity sites and no indigenous land use agreements cover the proposed activity site.

4.4 Consistency with relevant NSW Government policy

Table 4-4 Consistency of the proposed activity with NSW Government policy

Policy name	How proposed activity is consistent
NPWS – People and Wildlife Policy	As per section 47 of the *People and Wildlife Policy*, the protection of wildlife is considered in Section 6.4 and Section 6.5 of this REF. Safeguards that will be implemented to avoid, minimise or manage potential terrestrial and aquatic biodiversity impacts as a result of the proposed activity are outlined in Section 6.4.3 and Section 6.5.4respectively. The proposed activity is consistent with this policy.
NPWS – Vehicle Access Policy	No new roads are proposed as part of the proposed activity. Vehicle access would be undertaken in accordance with the *Vehicle Access Policy*. As discussed in Section 3.4, construction vehicles would access the construction work sites as follows from the Cobb Highway: • Pinchgut regulator — Jones Street, Picnic Point Road, Millewa Road, Millewa River Road, unnamed access track to Pinchgut regulator • Nestrons regulator — Jones Street, Picnic Point Road, Millewa Road, Millewa River Road, unnamed access track to Nestrons regulator • Moira regulator (west side) — Coolamon Road, Dora Road, unnamed access track along the northern side of Moira channel • Moira regulator (east side) — Poverty Point Road, Porters Creek Road, Narrows Road, unnamed access track to Moir regulator (east side) • Little Edward River offtake regulator — Jones Street, Picnic Point Road, Millewa Road, Little Edwards Road • Pigsty culvert — Jones Street, Gulpa Creek Road, Teds Road, Taylors Bridge Road, Tuppal Road, unnamed access track to Pigsty culvert.

Policy name	How proposed activity is consistent
	A construction traffic management plan will be prepared to manage the movement of construction vehicles to and from the proposed activity sites. The proposed activity is consistent with this policy. Refer to Section 6.10 for further details on vehicle access and potential traffic impacts.
DPE – Cultural Heritage Community Consultation Policy	Consultation for the Aboriginal cultural heritage assessment component of the proposed activity has been undertaken in line with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, which is understood to supersede this policy.
DPI Fisheries – Policy and Guidelines for Fish Habitat Conservation and Management	Aquatic habitat condition has been assessed against criteria outlined in the *Policy and Guidelines for Fish Habitat Conservation and Management* as detailed in Section 6.5. The proposed activity is consistent with this policy

4.5 Summary of licences and approvals

Licences and approvals required for the proposed activity are summarised in Table 4-5.

Table 4-5 Licences and approvals required by the proposed activity

Legislation	Licence/approval required
EP&A Act	Planning approval under Part 5 Division 5.1 of the EP&A Act is required. This REF has been prepared to fulfil the requirements of section 5.5 of the EP&A Act.
WM Act	A water use approval under section 89 of the WM Act would be obtained if it is proposed to extract water for use during the construction phase of the proposed activity. An amendment or renewal of WaterNSW's existing water supply work approval number 50WA511767 may be required to construct and/or operate the replacement and refurbished regulators.
NPW Act	Approval from NPWS is required to construct and operate the proposed activity: • The Department of Planning and Environment–Water will seek consent from NPWS to carry out the proposed construction works • WaterNSW will negotiate with NPWS for the establishment of an easement to operate the replacement and refurbished regulators under section 153 of the NPW Act.

Legislation	Licence/approval required
NPW Regulation	Consent is required from NPWS to construct the proposed activity. Specifically, consent is required for construction plant and equipment to enter, drive through, and operate within Murray Valley National Park and Regional Park, and to carry out the construction works.
FM Act	The following notifications would occur and approvals and permits obtained prior to construction starting: • A permit to translocate fish and aquatic vegetation under section 37 of the FM Act • Notification of dredging or reclamation work under section 199 of the FM Act • Approval of the fishway design from DPI Fisheries under section 218 of the FM Act • A permit to block fish passage during construction under section 219 of the FM Act.

4.5.1 Publication triggers

An REF must be published following determination if the proposed activity it assesses requires an approval or permit identified in section 171(4) of the EP&A Regulation before it may be carried out. These triggers are summarised in Table 4-6 in relation to the proposed activity and show that the REF will need to be published because it requires a permit under section 219 of the FM Act to block fish passage during construction. The REF will be published on the Department of Planning and Environment—Water's website. The published REF will conform with the Web Content Accessibility Guidelines (WCAG) 2.0 Level AA.

Table 4-6 Triggers for publication of the REF

Permit or approval	Applicability
FM Act, sections 144, 201, 205 or 219	Applicable – As noted in Section 4.2.3, construction of the proposed activity would result in the temporary blockage of fish passage and would require a permit under section 219 of the FM Act.
***Heritage Act 1977*, section 57 (commonly known as a section 60)**	Not applicable – The proposed activity would not disturb any items on the State Heritage Register (refer to Section 6.7).
NPW Act, section 90 (Aboriginal heritage impact permit)	Not applicable – The proposed activity would not disturb any known Aboriginal heritage items (refer to Section 6.6).
POEO Act, sections 47–49 or 122	Not applicable – The proposed activity is not a scheduled development work or a scheduled activity and, therefore, does not require an environment protection licence.

5 Consultation

5.1 Community and stakeholder consultation

The Department of Planning and Environment—Water has developed a Communication and Stakeholders Engagement Plan for the Millewa Forest Supply Project. The plan identifies the following project stakeholders that are relevant to the proposed activity:

- NPWS, as the park authority responsible for managing Murray Valley National Park and Regional Park and delivery of The Living Murray program at Millewa Forest
- DPI Fisheries, as the agency responsible for the administration of the FM Act, which is the principal piece of NSW legislation for managing the State's fishery resource (refer to Section 4.2.3)
- The Biodiversity, Conservation and Science Directorate of the Environment and Heritage Group, a part of the NSW Department of Planning and Environment
- Yorta Yorta Nation and Bangerang Nation, the traditional custodians of Millewa Forest, as well as other representatives of the local Aboriginal community including the Cummeragunja and Moama Local Aboriginal Land Councils
- Adjoining landholders to Millewa Forest
- Department of Climate Change, Energy, the Environment and Water, as the Commonwealth agency responsible for administering the EPBC Act including ensuring the protection of Ramsar sites.

The Department of Planning and Environment—Water has engaged with all of the above stakeholders since it commenced optioneering and preparation of concept designs for the Millewa Forest Supply Project works in early 2021. It has established a stakeholder advisory group as a mechanism to engage with key stakeholders about the progress of the Millewa Forest Supply Project, with representatives of recreational fishers, Murray Tourism Board, NPWS West Branch Regional Advisory Committee, Murray Darling Wetlands Working Group, Cummeragunja Local Aboriginal Land Council and Bullatale Creek Water Trust participating in the group. It has also established a technical advisory group to receive feedback and advice from certain stakeholders on the optioneering and concept design development, with NPWS, Water NSW, DPI Fisheries, the Biodiversity, Conservation and Science Directorate, the Commonwealth Environmental Water Office and the Murray-Darling Basin Authority all participating in this group.

Stakeholder consultation activities for the Millewa Forest Supply Project relevant to the proposed action include:

- Stakeholder advisory group meetings held on 20 May 2021, 21 July 2021, 28 September 2021 and 11 November 2021 to describe the proposed activity and provide updates on the optioneering and concept design development. The Department of Planning and Environment–Water hosted a site visit on 8 March 2022 to show the group the sites where works are proposed and discuss the concept designs. Cummeragunja Local Aboriginal Land Council and Bangerang and Yorta traditional custodians were also invited to this site visit
- Cummeragunja Local Aboriginal Land Council and Bangerang Aboriginal Corporation meetings held on 25 August 2021, 22 September 2021 and 11 November 2021 to describe the proposed activity and provide updates on the optioneering and concept design development
- Yorta Nation Aboriginal Corporation meetings held on 22 September 2021 and 11 November 2021 to describe the proposed activity and provide updates on the optioneering and concept design development
- Technical advisory group meetings held on 27 April 2021, 1 June 2021, 13 July 2021, 24 August 2021 and 23 February 2022 to discuss the objectives and purpose of the project, discuss and evaluate design options, and discuss the findings of the hydrology modelling prepared for the project. A site visit was hosted on 9 March 2022 to show the group the sites where works are proposed and discuss the concept designs
- A basis of design workshop held on 29 October 2021 and attended by NPWS, DPI Fisheries, Biodiversity, Conservation and Science Directorate and the Murray-Darling Basin Authority. Matters discussed at the workshop included the objectives of the Millewa Forest Supply Project and the functional requirements of proposed new infrastructure
- A fish movement modelling workshop held on 10 March 2022 and attended by representatives of NPWS, DPI Fisheries and the Biodiversity, Conservation and Science Directorate. The workshop was held in Mathoura and included a site visit. A follow-up meeting to progress the fish movement model was held in Buronga on 18 August 2022.

In addition to the above stakeholder engagement activities, a pre-referral meeting for the proposed activity was held with the Department of Climate Change, Energy, the Environment and Water on 11 August 2022. This was followed by a site visit on 16 August 2022 that was attended by representatives of the Department of Climate Change, Energy, the Environment and Water and NSW Department of Planning and Environment.

The Department of Planning and Environment—Water will continue to consult with these stakeholders during the detailed design and construction phases of the proposed activity.

5.2 Statutory consultation – NSW legislation

5.2.1 Transport and Infrastructure SEPP consultation

Part 2.2, Division 1 of the Transport and Infrastructure SEPP contains provisions for consultation with public authorities prior to the commencement of certain types of development. Table 5-1 lists the consultation requirements under the Transport and Infrastructure SEPP and identifies whether they apply to the proposed activity.

NOTE: All consultation periods listed below require a 21-day notification period.
For each row, if the response is 'yes', consultation with the relevant agency will be required and evidence of that consultation submitted as part of the REF.

Table 5-1 Transport and Infrastructure SEPP consultation

Is consultation required under the Transport and Infrastructure SEPP?	Yes	No
Will the proposed activity have a substantial impact on stormwater management services provided by a council? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity likely to generate traffic to an extent that will strain the capacity of the road system in a local government area? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the *Roads Act 1993* (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath)? If 'yes', notification to Council is required.	☐	☒

Is consultation required under the Transport and Infrastructure SEPP?	Yes	No
Is the proposed activity likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity located on flood liable land? If so, will the works change flooding patterns to more than a minor extent? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program that applies to that land? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity located on flood liable land and permissible without development consent under the following provision of Part 2.3 of the Transport and Infrastructure SEPP: (a) Division 1 (Air transport facilities), (b) Division 2 (Correctional centres and correctional complexes), (c) Division 6 (Emergency services facilities and bush fire hazard reduction), (d) Division 10 (Health services facilities), (e) Division 14 (Public administration buildings and buildings of the Crown), (f) Division 15 (Railways), (g) Division 16 (Research and monitoring stations), (h) Division 17 (Roads and traffic), (i) Division 20 (Stormwater management systems). * This section does not apply in relation to the carrying out of minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance. If 'yes', consultation with the State Emergency Service is required.	☐	☒
Is the proposed activity located adjacent to a national park, nature reserve or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act? If 'yes', consultation with NPWS is required.	☐	☒
Is the proposed activity located on land in Zone E1 National Parks and Nature Reserves? If 'yes', consultation with the National Parks is required.	☒	☐
Does the proposed activity include a fixed or floating structure in or over navigable waters? If 'yes', notification to Transport for NSW is required.	☐	☒
Will the proposed activity increase the amount of artificial light in the night sky within the dark sky region as identified on the dark sky region map? If 'yes', notification to the Director of the Observatory is required.	☐	☒

Is consultation required under the Transport and Infrastructure SEPP?	Yes	No
Is the proposed activity located on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument? If 'yes', notification to the Secretary of the Commonwealth Department of Defence is required.	☐	☒
Is the proposed activity within a mine subsidence district within the meaning of the Coal Mine Subsidence Compensation Act 2017? If 'yes', notification to Subsidence Advisory is required.	☐	☒
Is the proposed activity traffic-generating development as listed in Schedule 3 of the SEPP? If 'yes', notification to Traffic for NSW is required.	☐	☒

It is noted that clause 2.17(1)(a) provides an exception to consultation in that the Department of Planning and Environment—Water as the proponent must notify NPWS as a public authority from whom an approval is required in order for the activity (as development) to be carried out lawfully. As discussed in Section 4.1, approval to carry out the proposed activity is required from NPWS under the NPW Act and, therefore, the requirement to consult with NPWS under clause 2.15(2)(b) of the TISEPP does not apply.

The Department of Planning and Environment—Water has involved the NPWS West Branch Regional Advisory Committee in consultation for the proposed activity through their participating in technical advisory group and stakeholder advisory group meetings and other consultation activities. NPWS has been closely involved with all aspects of the planning, design, consultation and impact-mitigation of the proposed activity since its inception.

The Department of Planning and Environment—Water provided NPWS with a draft copy of this REF for their comment and has taken into consideration comments provided by NPWS.

The Department of Planning and Environment—Water will continue to liaise with NPWS as the proposed activity progresses.

5.2.2 Biodiversity and Conservation SEPP consultation

Clause 5.10(1) of the Biodiversity and Conservation SEPP provides that, for activities proposed within the riverine land of the Murray River, consultation must be carried out as follows:

a. *If development consent is required by the consent authority before determining the development application, or*

b. *If development consent is not required by the public authority or person carrying out the development, before carrying out the development.*

Clause 5.10(2) provides that consultation by an authority or person with a listed agency must be carried out as follows:

a. *The authority or person must write to the listed agency giving a description of the proposed development*

b. *The authority or person must request the listed agency to comment on the proposed development within 21 days from the date the agency receives the notice*

c. *The authority or person must consider any comments made on the proposed development by the listed agency within those 21 days.*

Clause 5.11(1) defines the general provisions for consultation under the Biodiversity and Conservation SEPP. The applicability of these provisions to the proposed activity is outlined in Table 5-2.

Table 5-2 Biodiversity and Conservation SEPP consultation

Consultation under Biodiversity and Conservation SEPP (clause 5.11(1))	Response
(a) Where development is contrary to the aims, objectives or principles of this Chapter and may have a significant environmental effect along the Murray River—the P&D (Vic), C&NR (Vic) and the adjacent local Council in Victoria must be consulted.	Not applicable – The proposed activity is considered to be consistent with the aims and objectives of Chapter 5 of the Biodiversity and Conservation SEPP and is not expected to have a significant environmental effect along the Murray River.
(b) Where development may affect boating safety—Transport for NSW must be consulted.	Not applicable – The proposed activity would not affect boating safety.

As outlined in Table 5-2, consultation under the Biodiversity and Conservation SEPP is not required for the proposed activity.

5.2.3 Fisheries Management Act 1994

Ongoing consultation with DPI Fisheries regarding the proposed activity has occurred in accordance with the requirements of the FM Act (refer to Section 4.2.3). DPI Fisheries has reviewed the Upper Millewa Forest Works Package – Draft Concept Design Report (3Rivers, 2023). Feedback from DPI Fisheries has ensured that key objectives of the proposed activity are implemented with appropriate consideration of regulations for providing suitable fish passage.

In addition, representative of DPI Fisheries have attended the following:

- Technical advisory group meetings
- Basis of design workshop
- Fish movement modelling workshop and field visit
- Operational plan workshops.

As the proposed activity involves instream works including excavation, dredging and temporary blockage of fish passage, notification and/or approval from DPI Fisheries is required under sections 199, 218 and 219 of the FM Act as detailed in Section 4.5.

5.2.4 National Parks and Wildlife Act 1974

The proposed activity is located on land gazette as national park or regional park in accordance with section 30A of the NPW Act.

Construction and operation of the proposed activity requires authorisation under the NPW Act. The Department of Planning and Environment—Water is engaging with NPWS to provide the information required to receive an authorisation to construct the proposed activity (refer to Section 4.1.2), and is facilitating negotiation between NPWS and WaterNSW for the establishment of easements under section 153 of the NPW Act to enable WaterNSW to operate the replacement and refurbished regulators (refer to Section 4.1.1.4).

Consultation with Aboriginal stakeholders has occurred during preparation of the Aboriginal cultural heritage assessment report in accordance with section 60 of the NPW Regulation and is described in Attachment C and summarised in Section 5.3 below.

5.3 Consultation with Aboriginal communities

The proposed activity is located within the traditional lands of the Yorta and Bangerang Aboriginal communities (Tindale, 1974). The land, water, plants and animals within a landscape are central to Aboriginal spirituality and contribute to Aboriginal identity.

Stakeholder and community engagement amongst Aboriginal traditional owners and communities for the proposed activity to date has been guided by the First Nations community and stakeholder engagement plan prepared for the project. The Department of Planning and Environment—Water is committed to supporting close involvement and participation of Aboriginal people in water infrastructure, research, and management. To date, consultations with the First Nations communities have shown positive outcomes for Aboriginal and Torres Strait Islander communities, who have been provided opportunities for input during the development of the proposed activity.

In order to facilitate ongoing community consultation and communication in the plan's delivery, Aboriginal community representatives are invited to participate in the project's stakeholder advisory group, including representatives from the Cummeragunja Local Aboriginal Land Council. This group supports the proposed activity regarding consultation and communication with various community stakeholders.

The Department of Planning and Environment—Water also has a dedicated First Nations engagement team who have engaged with the project's Aboriginal stakeholders through 'one-on-one' conversations, in-person meetings and site visits to provide more comprehensive engagement than is possible through the more formal stakeholder advisory group meetings. Engagement with Aboriginal stakeholders regarding the potential Aboriginal heritage impacts of the proposed activity has also followed the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010) required as part of the Aboriginal cultural heritage assessment process in NSW.

A search of the National Native Title Tribunal online register was undertaken in December 2022 and indicated:

- Native Title Determination VCD1998/001 (Federal Court file number VID6001/1995) applies to the proposed activity site. The claim was lodged by members of the Yorta Aboriginal community. A determination was given on 18/12/1998 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 proposed activity site
- No Indigenous Land Use Agreements cover the proposed activity site.

As a result, notification requirements under the Native Title Act 1993 do not apply to the proposed activity. However, ongoing consultation with relevant Aboriginal communities will be undertaken to assist with the identification of Aboriginal cultural values, improve proposed activity outcomes and to inform the assessment of impacts on Aboriginal cultural heritage for the proposed activity.

5.4 Ongoing stakeholder and community consultation

The Department of Planning and Environment—Water will continue to consult with stakeholders during the detailed design and construction phases of the proposed activity as required. Stakeholders including the local community will be kept informed of any changes to the proposed activity resulting from future consultation process or detailed design. Once determined, this REF will be placed on public display for information via the Department of Planning and Environment—Water website.

The joint operations working group, including WaterNSW, NPWS and the Murray-Darling Basin Authority, will be notified at least two weeks before construction work begins. The notification will outline the proposed duration of the work and any access changes. Contact details to request further information or ask questions will be included in the notification.

The Department of Planning and Environment—Water and the joint operations working group intend on entering into a delivery deed for management of and access to Pinchgut, Nestrons, Moira and Little Edward River offtake regulators prior to, during and after the construction works at each site.

6 Environmental assessment

6.1 Topography, geology and soils

6.1.1 Existing environment

The proposed activity is located in the Riverina bioregion which is dominated by river channels, floodplains, backplains, swamps, lakes and lunettes that are all of Quaternary age. Characteristic landforms of the Murray Fans Interim Biogeographic Regionalisation of Australia (IBRA) sub-region include gently undulating landscapes on recent unconsolidated sediments with evidence of former stream channels, braided old river meanders and palaeochannels and broad floodplain areas associated with major river systems and prior steams. Topography in the area of the proposed activity is relatively flat and characterised by natural and modified creeks surrounded by floodplains and bushland areas.

The Murray River at Barmah Choke is characterised by a large volume of deposited sediment, dominated by coarse sand. This contrasts with historical records that describe this location as having a clay bed with sandy point-bars (Grove, 2020). It is hypothesised that the sand slug at Barmah Choke is due to a large pulse of sediment from upstream gold mining and land use changes from the late 1800s to early 1900s (Gower et al., 2020). Bed aggradation over the last 30 years is estimated to be 70 centimetres for the most downstream section of Barmah Choke, compared to 1.9 metres at the upstream end. Bed aggradation in non-flood years is estimated to be as much as five to six centimetres per year in the widest upstream parts of Barmah Choke, compared to about two centimetres per year for the narrowest downstream sections. In large flood years this is predicted to increase to nine centimetres per year upstream and 4.5 centimetres per year in the downstream narrows (Gower et al., 2020).

Geotechnical investigations of the Pinchgut regulator, Nestrons regulator, Moira regulator and Little Edward River offtake regulator construction footprints were undertaken in May 2022. Boreholes were drilled within or near each construction footprint. The results of the geotechnical investigations are provided in Appendix G of the *Millewa Forest Consolidated Concept Design Report* (3Rivers, 2023) and summarised below:

Pinchgut regulator

- *Borehole details* — Borehole BH140-RR, immediately west of the existing Pinchgut regulator, to a depth of 8 metres

- *Groundwater* — Not encountered
- *Soil description* — Alluvium comprising a top layer of silty clay to a depth of about 3.8 metres, overlaying silty clay with sand from about 3.8 metres to the end of the bore.

Nestrons regulator

- *Borehole details* — Borehole BH143-RR, immediately south of Millewa River Road on the western bank of Nestrons Creek, to a depth of 8 metres
- *Groundwater* — Not encountered
- *Soil description* — Alluvium comprising a top layer of sandy clay to a depth of about 0.6 metres, overlaying silty clay from about 0.6 metres to the end of the bore.

Moira regulator

- *Borehole details* — Borehole BH180-MO, eastern side of the existing Moira regulator, to a depth of 12 metres
- *Groundwater* — Static water level at a depth of 11.5 metres
- *Soil description* — Alluvium comprising a top layer of sandy clay fill material to a depth of about 0.5 metres, overlaying silty clay (0.5 to 1.25 metres), silty sand (1.25 to 1.8 metres), silty clay (1.8 to 6.5 metres), sandy clay (6.5 to 8.0 metres) and sand from about 8.0 metres to the end of the bore.

Little Edward River offtake regulator

- *Borehole details* — Borehole BH160-ED and BH161-ED, southern bank of the Little Edward River, immediately upstream and downstream respectively of the existing Little Edward River offtake regulator, both to a depth of 7.5 metres. BH161-ED was located further from the riverbank than BH-160-ED
- *Groundwater* — Static water level at a depth of 3.5 metres in both boreholes
- *Soil description (upstream)* — Alluvium comprising a top layer of silty clay with sand to a depth of about 0.4 metres, overlaying silty clay (0.4 to 1.8 metres), sandy clay (1.8 to 3.2 metres) and sand from about 3.2 metres to the end of the bore
- *Soil description (downstream)* — Alluvium comprising a top layer of silty clay fill to a depth of about 0.4 metres, overlaying silty clay (0.4 to 1.7 metres), clayey sand with silt (1.7 to 2.4 metres), clayey sand (2.4 to 2.8 metres), sand (2.8 to 6.5 metres) and clayey sand from 6.5 metres to the end of the bore.

A search of the Australian Soil Resource Information System database carried out on 27 March 2023 did not identify any acid sulfate soils in the proposed construction footprints.

6.1.2 Impacts

The construction of the proposed activity would result in localised ground disturbance and the excavation of surface and subsurface soils adjoining the proposed infrastructure. Surface soils would also be disturbed within construction laydown areas from the movement of plant and vehicles and storage of equipment.

The proposed activity has the potential to cause erosion (including wind erosion from stockpiles), and sedimentation due to localised temporary removal of groundcover and the disturbance of the soil profile. The associated increases in turbidity and suspended sediments in receiving watercourses can lead to reductions in water quality at the site and downstream.

The reuse of clean won site material onsite would minimise disturbance of in-situ soil resources within the construction footprint and avoid the need for borrow pits.

The proposed activity would generate surplus spoil, particularly as a result of the removal of Pigsty culvert. Spoil would be classified in accordance with the *Waste Classification Guidelines, Part 1: Classifying Waste* (Environment Protection Authority, 2014). Surplus spoil would be transported outside Murray Valley National Park (and the NSW Central Murray Forests Ramsar site) for either reuse (if classified as virgin excavated natural material or excavated natural material) or disposal at a suitably licensed waste facility.

The potential temporary and short-term erosion and sedimentation impacts posed by the ground disturbance and vegetation clearance during construction would be significantly reduced with the adoption of appropriate sedimentation and erosion controls in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) ('the Blue Book'). As described in Section 6.1.3, site-specific controls are to be developed in the form of an erosion and sediment control plan and incorporated into the Contractor's CEMP. The typically flat terrain and absence of highly erosive soils would further reduce the risk of soil instability and the subsequent dispersal of sediment during construction. With implementation of suitable controls, the potential for negative erosion and sedimentation impacts would be low.

Ground compaction

There is also the potential for ground compaction and loss of soil structure from vegetation removal and construction plant and vehicles traversing over the site and/or construction laydown area resulting in low infiltration rates and increased run-off. The proposed activity has low potential for negative ground compaction impacts due to the short duration of the construction works, small number of plant and vehicles required and small area of the work sites, previous disturbance and proximity of the work sites to existing access roads.

Streambed and bank disturbance

Disturbance of the streambed and banks of the channel would be required within the construction footprint for operation of an excavator. As a result, there is potential for soil erosion and sedimentation downstream if a significant flow event occurred during construction. The removal of riparian vegetation would also increase the potential for erosion of the banks and streambed. However, the likelihood of erosion from flows is considered low as the proposed activity would be scheduled for dry and/or low flow conditions, with cofferdams to be used to stop flows from entering the in-stream construction area. As a result, the potential for riverbank erosion and a loss of bank stability due to flowing water is considered unlikely except in the event of a sufficiently large flood that overtops the cofferdams.

Contamination

Fuels and lubricants would be used on site during construction activities and these chemicals may pose a potential contamination risk to soils in the event of a spill. Spilt chemicals may alter soil properties and can impact negatively on soil health and consequently plant growth or if absorbed by plants/animals could potentially enter the food chain with adverse impacts. Contaminants in the soil can be mobilised during high rainfall events and surface water runoff which may potentially spread such contamination through the soil profile, or into surface or groundwater potentially impacting aquatic habitats. The potential contamination risk during construction is considered low with further discussion and safeguards detailed in Section 6.15 and Table 6-17.

Salinity

Salinity impacts occur when salts naturally present in soil or groundwater are concentrated at the surface or in shallow soils generally through transport by rising groundwater. No saline soils have been identified from the publicly available data and geotechnical investigations undertaken for the proposed activity showed low levels of electrical conductivity and chloride and low aggressivity soils. Should saline soils exist at the proposed activity work site, they have the potential to impact on surface water and structures associated with the proposed activity if not correctly managed. These risks are further addressed in Sections 6.2.2 and 6.3.2.

6.1.3 Operation

Operation of the project would not impact topography, geology or soils, outside any potential hydrology and erosion impacts assessed in Section 6.3.

6.1.4 Safeguards

Measures proposed to avoid, minimise or manage potential topography, geology and soils impacts as a result of the proposed activity are detailed in Table 6-1.

Table 6-1 Safeguards for topography, geology and soil impacts

Impact	Safeguard	Responsibility	Timing
Erosion and sediment	An erosion and sediment control plan will be prepared as part of the Contractor's CEMP. Site specific erosion and sediment control measures will be designed, implemented and maintained in accordance with relevant sections of *Managing Urban Stormwater: Soil and Construction Volume 1* (Landcom, 2004) (the Blue Book). The erosion and sediment control plan will provide details of the cofferdams to be installed upstream and downstream of instream work sites and the strategies that will be implemented to stabilise soils during the construction phase.	Contractor	Construction

6.1.5 Residual impacts

The potential temporary and short-term erosion and sedimentation impacts of the ground disturbance and vegetation clearance during construction would be significantly reduced with the adoption of appropriate sedimentation and erosion controls in accordance with the Blue Book as detailed in Section 6.1.3. The typically flat terrain would further reduce the risk of soil instability and the subsequent dispersal of sediment during construction. There is also the potential for hydraulic leaks and localised soil and water contamination during construction, if not adequately managed. However, given the works would occur in dry waterways and quantities of earthworks are anticipated to be minimal, this not considered to be a significant risk.

Therefore, potential soil impacts associated with the construction of the proposed activity are considered likely to have a low impact due to the localised nature of the proposed works and safeguards detailed above.

6.2 Surface water and drainage

6.2.1 Existing environment

6.2.1.1 Catchment overview

The proposed activity is located within the central portion of the Murray River catchment, known as Central River Murray catchment. The Central River Murray catchment extends from the Hume Dam in the east, upstream of Albury, to the confluence of the Murray and Darling rivers at Wentworth. Elevations range from about 150 metres at the Hume Dam to less than 50 metres at the confluence of the Murray and Darling rivers. Average annual rainfall is about 700 millimetres at the eastern end of the central catchment, but mostly ranges from 500 millimetres to 300 millimetres from east to west respectively, where rainfall is received predominantly in winter and spring (Murray-Darling Basin Authority, 2022).

The Murray River and the Edward-Wakool river system are heavily managed, with up to 87 per cent of the total inflows into Dartmouth and Hume dams being stored for later use. This has changed local and regional natural hydrology. River regulation has resulted in less flow variability, reduced frequency of floods, reduced areas of flooding, and flows occurring in spring-summer rather than winter-spring. Small and mid-sized flows that once connected the rivers and creeks to the floodplain are now captured in dams. This has reduced the environmental watering period for the environment, as well as the timing and duration of flows for many creeks and wetlands. Another consequence of reducing the frequency and duration of small to mid-sized flow events is that many of the wetlands that are away from the river channel or higher on the floodplain are stranded and do not receive adequate watering events. As a result, these areas are undergoing changes in native vegetation structure and composition, and a reduced abundance of fauna species (Murray-Darling Basin Authority, 2015).

6.2.1.2 Barmah Choke

The Murray River at Murray Valley National Park and Regional Park is characterised by the Barmah Choke, an 80-kilometre stretch of the Murray River along which channel depth and width progressively decreases. While it is generally referred to as the Barmah Choke, it actually comprises three key flow constriction points, namely the Tocumwal Choke, the Barmah Choke and the Edward Choke. Recent investigations have identified that excessive deposits of coarse sand in the river channel downstream of Yarrawonga Weir are most likely to be the major contributing factor to the loss of capacity (Gower et al., 2020). Choke capacity has reduced from 11,500 megalitres per day in the 1980s to a current capacity of about 9,200 megalitres per day (Lauchlan Arrowsmith et al., 2021), being the greatest flow restriction in the Murray River.

Barmah Choke restricts the flow of the Murray River to about 7,000 megalitres per day, estimated at Picnic Point. This is the lowest channel flow capacity of any stretch of the Murray River. Because the Murray River is so narrow at Murray Valley National Park, flows often spill over onto the floodplain. Barmah Choke results in flooding of the park commencing above flows of about 9,000 megalitres per day at Yarrawonga (Jones et al., 2022).

Before major water resources development, water moved onto the floodplain once the river channel capacity constraint was breached, usually in winter, spring and early summer (Murray-Darling Basin Authority, 2012). Water then moved across the floodplain via a network of braided floodrunner channels, some of which terminate in lakes or swamps.

6.2.1.3 Flow regulation at Murray Valley National Park

Murray River flows are diverted at Yarrawonga Weir to supply several irrigation districts in NSW (Berriquin, Deniboota, Bullatale Creek, Moira, West Corurgan, Denimein and Wakool) and the Murray Valley Irrigation Area in Victoria. The Murray River continues to carry regulated flows destined for irrigation districts further downstream, some of which is passed via the Edward River and Gulpa Creek (Ecological Associates and SKM, 2011).

Regulated flow release in the Murray River downstream of Yarrawonga is currently limited in any given year to a maximum of 18,000 megalitres per day until the end of September and 15,000 megalitres per day for the remainder of the year to prevent third party impacts adjacent to the Bullatale Creek system. This provides an upper limit on the volume of environmental water that can be delivered to Millewa Forest (noting potential future project works such as the Reconnecting River Program and choke enhancement works my lead to a change in the current operating rules).

WaterNSW diverts from the Murray River into the Edward River (at the Edward River offtake regulator) and Gulpa Creek (at the Gulpa Creek offtake regulator) to meet downstream consumptive demands and environmental flow requirements. The Edward River and Gulpa Creek bisect Millewa Forest in a north-south direction. Floodplain flows, and diversions through secondary regulators, ultimately outfall to the Edward River. Floodplain flows also contribute to flow in the Edward River.

The Murray River is operated during the irrigation season to keep flows within the river channel through Barmah Choke to avoid delivery forfeit and adverse environmental impacts associated with unseasonal overbank flooding into Barmah-Millewa Forest. At flow rates of up to 10,600 megalitres per day downstream of Yarrawonga, flows remain in channel through Barmah-Millewa Forest with the forest flow regulators closed. This represents the normal maximum channel capacity for regulated river operations. At this flow rate, 8,500 megalitres per day passes through Barmah Choke and 2,100 megalitres per day is diverted via the Edward River and Gulpa Creek (Ecological Associates and SKM, 2011).

Existing hydrology is described below for the proposed work sites near Toupna Creek/Douglas Swamp, Moira Lake, Little Edward River and Towrong Creek.

6.2.1.4 Toupna Creek/Douglas Swamp

Pinchgut and Nestrons regulators are located on waterways that flow in a northerly direction from the Murray River to Toupna Creek as shown in Figure 2-2. Pinchgut and Nestrons regulators are two of seven regulators on these waterways, with Nestrons regulator being the furthest downstream. The Mary Ada regulator is the largest of the seven regulators (refer to Photo 6-1 and Photo 6-2). Toupna Creek flows in an easterly direction and a branch of the creek provides flows to Douglas Swamp.

Douglas Swamp is a wetland mosaic of open water, swamp, rush and reed land that provides important habitat, breeding and feeding opportunities for aquatic fauna and birds. Douglas Swamp is a known waterbird breeding area, one of the criterion for the site's Ramsar status. Existing hydrology concerns at Douglas Swamp are:

- Water levels in the swamp need to be maintained in late spring and early summer to ensure successful completion of bird breeding events
- Persistently high-water levels are extending the margins of the swamp further into the River Red Gum Forest.

Douglas Swamp is bisected by Wild Dog Creek, a distributary channel of Toupna Creek, which conveys water to the swamp (refer to Figure 2-2).

As discussed in Section 2.2.1, the site environmental water managers currently use the regulators on the waterways connecting the Murray River to Toupna Creek to manage flows in Toupna Creek and downstream to Douglas Swamp as well as environmental watering of Millewa Forest.

Photo 6-1 Mary Ada regulator, upstream end

Photo 6-2 Mary Ada regulator, downstream end

6.2.1.5 Moira Lake

The natural ecology of Moira Lake is a regular cycle of submergence in winter and spring and desiccation in summer and autumn that corresponds to the natural flood and recession patterns of the Murray River. Since the completion of the Hume Dam in 1936, Moira Lake has been subjected to a hydrological regime far different to that which existed naturally and one that is the result of management goals other than for nature conservation. These factors include a reduction in the frequency, extent and duration of winter and spring flood events, and the total loss of a regular periodic drying phase in summer and autumn. Leslie (1995) found that regulation of the water supplies of the Murray River has been the most significant agency responsible for the deterioration of the ecology of Moira Lake and that the deterioration in fish species richness and abundance that has occurred at Moira Lake correlates with the escalation of irrigation developments in the 1960s.

By 1992, structures had been built on three of the four inlets to Moira Lake from the Murray River to try and reinstate more natural wetting and drying phases. However, without the fourth regulator, the years of inundation over summer and autumn allowed the environment to continue declining, impacting on waterbird and fish breeding (Wells, 2018).

The existing Moira regulator was constructed in 1994. Its purpose is to isolate Moira Lake from the Murray River to allow the independent management of the water level. The hydrological management plan prepared for the lake aims to:

- Flood the system during the spring breeding season
- Provide gradually receding water levels at the end of the breeding season
- Provide unrestricted access for fish during spawning and juvenile development periods
- Minimise disruption to consumptive users
- Completely dry the system for three months in two out of every three years (Leslie and Lugg, 1994).

A managed seasonal drying of the lake not only provides ecological benefits but also provides a water saving benefit of about two gigalitres per annum.

6.2.1.6 Little Edward River

Inflow to the Little Edward River from the Edward River is controlled by the Little Edward River offtake regulator. WaterNSW installed and operates this regulator to isolate the Little Edward River under summer/autumn regulated flow conditions. The Little Edward River offtake regulator is currently operated in either the fully open or fully closed position. It is generally fully open in winter, spring and for flows exceeding the regulated capacity of the Edward River. It is an obstruction to fish passage except when it is fully opened.

The Edward River starts at the Murray River about 400 metres upstream of Picnic Point and flows in a northerly direction, bisecting Millewa Forest (refer to Figure 2-2). WaterNSW diverts from the Murray River into the Edward River (at the Edward River offtake regulator) to meet downstream consumptive demands and environmental flow requirements. Flow in the Edward River is regulated up to a flow of about 1,600 megalitres per day, at which the channel capacity is exceeded, as noted in clause 33(2)(d) of the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016. Floodplain flows and diversions through secondary regulators also contribute to flow in the Edward River.

The Little Edward River is an anabranch of the Edward River that starts about 7.6 kilometres downstream of the Murray River, and ends about seven kilometres further downstream. Wild Dog Creek flows into the Edward River about 1.5 kilometres upstream of where the Little Edward River starts.

The range of water levels over which regulation at the Little Edward River offtake regulator is required is narrow but they span the most frequent summer operating levels. The commence to flow rate in the Little Edward River is about 1,200 megalitres per day in the Edward River, although at this flow rate the flow only extends to the deep pool habitat in the upper reaches of the river. A flow of about 1,300 to 1,400 megalitres per day is required in the Edward River to establish a flow that can pass along the length of the river and enables the Little Edward River offtake regulator to operate. As noted above, the gates of the offtake regulator are typically open when flows exceed the regulating capacity of the Edward River, which at Little Edward River is about 1,800 megalitres per day. This flow rate is greater than the 1,600 megalitre per day at which flow in the Edward River ceases to be regulated, which reflects inflows from Wild Dog Creek to the Edward River upstream of the Little Edward River during high Murray River flows.

The Little Edward River offtake regulator is operated in combination with other regulators on the Edward River west bank (Corey's, Bonners, Dwyer's and Hussey's) to prevent unseasonal inundation of the adjoining floodplain.

The commence to flow level from the Little Edward River onto the adjoining floodplain is critical as the fishway would provide an opportunity for the site environmental water managers to pass a flow of about 25 megalitres per day while the gates are closed. A key point of flow trials delivered through May to June 2022 was to identify the flow rate through the Little Edward River offtake regulator at which the river's banks were overtopped. No overtopping of the banks was occurring on the date of the WaterNSW flow test when 50 megalitres per day was flowing through the Little Edward River offtake regulator which gives confidence that operating the fishway without causing undesirable inundation of the floodplain is feasible.

6.2.1.7 Towrong Creek

Towrong Creek is a tributary of the Edward River. The purpose of Pigsty culvert is unknown. Historically, the culvert was gated, and it is possible that its function was to:

- Isolate the Edward River from the Towrong Creek to prevent loss of water from Edward River, or
- Retain water in the forest for River Red Gum watering.

6.2.1.8 Allocation of environmental water

Environmental watering of Barmah-Millewa Forest occurs using water held in the Barmah-Millewa Forest Environmental Water Account. The account was established by the NSW and Victorian governments in the early 1990s with an agreed crediting of 100 gigalitres of water annually to water the Barmah-Millewa Forest. In 1997 this credit was increased to 150 gigalitres annually, unused credit allowed to be carried over to following years, and future credit brought forward (Department of Environment, Land, Water and Planning, 2015). NSW's contribution to the account and the rule governing crediting to and taking from the account are legislated in Division 1 of Part 6 (clauses 26 to 30) of the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016.

The site environmental water managers plan environmental watering events at Barmah-Millewa Forest in accordance with the environmental water objectives and targets, water delivery options and regimes for the site detailed in the *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012). The plan establishes priorities for the use of The Living Murray water within the icon site and specifies the water requirements of key vegetation communities and biota including the timing, duration, frequency and depth of inundation, the maximum time between floods, and the flow rate required in the Murray River at Yarrawonga Weir to achieve the level of flooding specified.

Decisions on environmental watering at The Living Murray icon sites including Barmah-Millewa Forest are facilitated through The Living Murray annual watering plan. Icon site environmental watering proposals are developed by icon site managers and considered for approval by the Murray-Darling Basin Authority. Decisions are based on the annual watering plan and the volume of water available in The Living Murray environmental water portfolio.

Sites are prioritised for watering in the Barmah-Millewa icon site using a numeric scoring system based on a site's departure from an 'ideal' flood history (Bren 1988). Under this method, Barmah-Millewa Forest is divided into water management areas that are each assigned an annual flood score that is compared to an ideal flooding score based on the ideal long-term flooding frequency for the dominant vegetation type in the area.

Current priorities for the site environmental water managers include:

- Translucent regulators: Implementing a translucent regulator strategy whereby forest regulators are left open in winter-spring and then closed by mid-December
- Murray Cod (*Maccullochella peelii*) breeding: Maintaining flow within the main river channel at or above 8,500 megalitres per day in late August through to December to support Murray Cod (*Maccullochella peelii*) nesting, survival and dispersal
- Perch spawning pulses: Providing flow variability within the main river channel in mid-October through to December to encourage the spawning of native fish species, primarily Silver Perch (*Bidyanus bidyanus*)
- Critical drought refuge: Maintaining critical drought refuge areas within Barmah-Millewa waterways, without return flow connectivity to the river system
- General drought refuge: Maintaining general drought refuge areas within Barmah-Millewa waterways, with return flow connectivity to the river system
- Waterbird breeding (dry): Sustaining a waterbird (colonial-nesting species and bitterns) breeding event in Reed Beds Swamp or Moira Lake or Boals Deadwoods if a breeding event initiates following natural flooding and other required cues
- Waterbird breeding (moderate/near average): As per 'dry' but with both Barmah and Millewa wetlands
- Waterbird breeding (wet): As per 'moderate/near average' but with additional wetlands
- Floodplain Marsh: Building on natural flow cues to enhance conditions to promote growth of Floodplain Marsh vegetation species (including Moira Grass (*Pseudoraphis spinescens*)) on treeless plains in Millewa Forest
- Autumn-winter perennial flows: Maintaining river releases from Yarrawonga above 4,000 megalitres per day in autumn-winter for large-bodied native in perennially flowing habitats but exit (or attempt to exit) the seasonal habitat when flows cease (Goulburn Broken Catchment Management Authority, 2022).

6.2.1.9 Existing water quality

Water quality in Millewa Forest has been monitored at various locations and frequencies by NPWS as part of intervention monitoring undertaken during watering events. Intervention monitoring, which comprises water quality and depth monitoring, was implemented following a wide scale blackwater event in the Murray in 2010-11 which affected a 2000-kilometre stretch of river. The event occurred after a long period of drought where large loads of leaf litter had accumulated on the floodplain which was followed by a large flooding event and warm temperatures. Since this event, measures have been taken to reduce the risk which has included delivering water in cooler months to flush excess leaf litter from the forest floor. Monitoring of water quality is then undertaken during the portion of the monitoring event when the environmental water returns back

to the main river channels to ensure the quality of water being discharged from the Millewa forest floodplain into the main river channels is of suitable quality (Borrell and Liefting, 2017). As part of the intervention monitoring water quality was recorded for temperature, dissolved oxygen (DO), conductivity and pH. Data collected as part of the intervention monitoring is summarised in Table 3-1 of Attachment B. Water quality monitoring results in the vicinity of the proposed activity that are outside the recommended limits for protection of aquatic ecosystems:

- Dissolved oxygen in the Edward River is low to very low with median concentrations below the lower recommended limit of 90 percent saturation for protection of aquatic ecosystems
- Moira Lake showed elevated pH which exceeded the upper limit Basin Plan target of 7.5 and dissolved oxygen that fell below the lower recommended limit. Moira Creek however had lower pH that is within the target range, but dissolved oxygen concentrations were concentrations below the lower recommended limit
- Dissolved oxygen at Pigsty culvert was also below the lower recommended limit.

3Rivers carried out spot water quality sampling in April 2022 at the construction footprints and recorded the following results that are outside the recommended limits:

- Water quality at Pinchgut and Nestrons regulators was good with all indicators (turbidity, dissolved oxygen, electrical conductivity and pH) complying with the respective guidelines for protection of aquatic ecosystems upstream and downstream of the regulator on Nestrons Creek and upstream of the regulator on Pinchgut Creek. Water quality downstream of Pinchgut Creek regulator was still good, however, dissolved oxygen concentrations were slightly lower (about 81 percent) and therefore failed to meet the lower guideline limit of 90 per cent saturation. The visual amenity of the sites at the time of sampling was fair at Nestrons regulator and good at Pinchgut regulator. The slightly poorer visual amenity rating at Nestrons regulator was due to the presence of algae and aquatic weeds and slightly turbid water
- Water quality at the Moira regulator was poor with elevated turbidity and low dissolved oxygen and pH, all of which did not meet respective guideline criteria for protection of aquatic ecosystems upstream or downstream of the regulator. Only electrical conductivity, which was low, complied with the basin targets. The visual amenity at Moira regulator at the time of inspections was rated fair to good with the site exhibiting good aquatic features, but did have some frothing and floating debris and was slightly turbid
- Water quality at Little Edward River offtake regulator was poor with turbidity, dissolved oxygen and pH failing to meet the recommended limits for protection of aquatic ecosystems. Turbidity levels were elevated upstream and downstream of the Little Edward River regulator exceeding the basin target of 15NTU and both dissolved oxygen and pH were below the recommended lower limits of 90 percent saturation and 6.5 pH units respectively. Electrical conductivity was low and the only indicator to comply with the target. Despite the slightly turbid water, the visual

amenity of the site could be classified as fair to good with no apparent signs of algae, scum, oily films or debris

- Water quality at Pigsty culvert was varied with low conductivity and neutral pH, both of which complied with the respective basin targets. However, turbidity was elevated and dissolved oxygen low, with both indicators outside their respected recommended ranges. Water at the culvert at the time of sampling was visually turbid water and algae and scum were present

6.2.2 Impacts

6.2.2.1 Construction

Dry in-stream work sites would need to be created within Pinchgut Creek, Nestrons Creek, Moira Creek, Little Edward River and Pigsty Creek to enable the construction works to occur. This is expected to be achieved by installing temporary cofferdams upstream and downstream of each work site and discharging any water ponded between the cofferdams. Where feasible, the existing regulators would be used to create an upstream or downstream cofferdam as applicable.

The construction works would be carried out during a dry period to minimise the potential for in-stream work sites to be flooded and to avoid interruption to environmental water deliveries. Carrying out the works during a dry period would also minimise the impact of any temporary cofferdams on flows downstream of the works sites.

The proposed construction works have the potential to indirectly impact surface water quality if not appropriately managed. Risks to surface water quality include:

- Erosion and sedimentation at the work sites leading to sediment-laden runoff entering waterways causing elevated turbidity. This includes stormwater runoff from material stockpiles, laydown areas, concrete washouts and loose sediment associated with riparian vegetation clearing and earthworks
- Dust, litter and other pollutants being blown by the wind from construction sites and entering waterways
- Accidental spills, leaks and pollution from construction sites which may result in runoff of hydrocarbons, heavy metals and gross pollutants (rubbish)into downstream waterways. This includes accidental spills or leaks of fuels and/or oils from the maintenance, refuelling and use of construction plant and equipment, vehicle movement travelling to and from work sites, and transportation of cement dust, concrete slurries or washout water.

These risks to surface water quality are typical for construction works carried out near waterways and there are a range of commonly applied controls to mitigate and manage these risks. Safeguards that will be implemented at the work sites to manage risks to surface water quality are detailed in Section 6.2.3.

6.2.2.2 Operation

Broadly, the operating regime for the replacement and refurbished regulators would be the same as that for the existing regulators as described in Sections 2.3 and 6.2.1. Broadly, the replacement and refurbished regulators would be operated to mimic the inundation of the forest that would have occurred but for the Murray River and Edward River being operated to deliver water from the Hume Dam to downstream customers. To best replicate the natural seasonality of inundation of the forest, the gates of the regulators would be closed during the irrigation season (about September to April) and open at other times. The actual operating regime would be more nuanced and would reflect climatic conditions, water availability and site-specific environmental water objectives.

The replacement and refurbished environmental regulators would be easier to operate than the existing structures and this improved efficiency of operation is expected to use less water to deliver the same environmental outcomes that the site environmental water managers are currently aiming to achieve through operation of the existing regulators.

The inclusion of fishways at the replacement and refurbished regulators would enable the site environmental water managers to better manage risks to native fish associated with the operation of the regulators at Millewa Forest. The flow velocities through the regulators, including the fishways, have been designed to minimise sediment build-up during operations.

Specific hydraulic considerations at each of the waterways where works are proposed are discussed in the following sections.

Pinchgut Creek

Replacing the existing Pinchgut regulator with a modern environmental regulator that includes a fishway would make it a preferred structure for the site environmental water managers to use to pass a flow from the Murray River to Toupna Creek. It is envisaged that during an environmental watering event the replacement Pinchgut regulator would be opened first and closed last among the seven environmental regulators on creeks that flow from the Murray River to Toupna Creek. This would provide a safe pathway for fish to pass into and out of the forest and minimise stranding of fish within the forest when high flows recede and at the end of environmental watering events.

The replacement Pinchgut regulator is expected to be the preferred regulator for the site environmental water managers to use to provide drought top-up flows to the upper reach of Toupna Creek.

The management of flows in Toupna Creek and the waterways that connect the Murray River to Toupna Creek would continue to occur in accordance with the *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012) and *Murray-Lower Darling Long Term Water Plan* (Department of Planning, Industry and Environment, 2020a). The operation of the replacement Pinchgut regulator would be entirely at the discretion of the site environmental water

managers. The site environmental water managers are likely to consider a range of environmental and other factors when deciding which regulators to operate and the size and duration of the flows passed through those regulators.

Nestrons Creek

Replacing the existing Nestrons regulator with a modern environmental regulator that includes a fishway would make it the preferred structure for the site environmental water managers to deliver a regulated flow from the Murray River to Douglas Swamp in late spring and early summer to ensure successful completion of bird breeding events. The replacement Nestrons regulator would be operated to extend the period of inundation of Douglas Swamp to ensure successful completion of bird breeding events when required. This would involve establishing an environmental flow past the regulator in late spring and early summer. The critical hydraulic issue to achieve this outcome is determining the discharge required from Nestrons regulator to create an environmental flow to Toupna Creek that then spills into the Douglas Swamp-Wild Dog Creek complex and surcharges to an appropriate water level. Preliminary hydraulic modelling suggests that the flow could be anywhere of the order of 10 to 100 megalitres per day. Key factors that influence the size of the environmental flow required to achieve this outcome are the small size of Nestrons Creek relative to Toupna Creek and the geometry of Toupna Creek as it degrades and branches into Douglas Swamp. Modelling of this flow is difficult due to the creek lines being poorly defined and the heavy influence of vegetation. Flow testing is therefore proposed to confirm the hydraulic behaviour of Nestrons Creek and flow paths to Douglas Swamp.

The replacement Nestrons regulator would be able to deliver environmental flows in several ways. The fishway would be able to deliver up to about 15 megalitres per day when the gates are closed. Environmental flows higher than this would need to be passed over the regulating gates. Fish passage during environmental flows would be provided via the fishway.

The replacement Nestrons regulator would also be a preferred structure for providing drought top-up flows to the lower reaches of Toupna Creek.

The management of flows in Nestrons Creek and onward to Toupna Creek, Douglas Swamp and Wild Dog Creek currently occurs in accordance with the *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012) and *Murray-Lower Darling Long Term Water Plan* (Department of Planning, Industry and Environment, 2020a) and these plans would continue to form the basis for managing these waterways and environmental watering of Millewa Forest. The operation of the replacement Nestrons regulator would be entirely at the discretion of the site environmental water managers. The site environmental water managers are likely to consider a range of environmental and other factors when deciding which regulators to operate and the size and duration of the flows passed through those regulators.

Moira Creek

The refurbished Moira regulator and new fishway would be operated to achieve the hydrological aims listed in Section 6.2.1.5 subject to seasonal water availability and prevailing flows in the Murray River. In a typical year with normal water availably the regulator and fishway would be operated as follows:

- The regulator would be fully opened in August, at a time when the water level in the Murray River is low
- Moira Lake would fill as the Murray River rises during late winter and spring
- Fish passage into Moira Lake would occur through both the fishway and the open regulator gates
- The regulator would remain full open during high (overbank) river levels
- The regulator would be closed in late November and early December, subject to flows in the Murray River being less than the capacity of Barmah Choke
- The water level in Moira Lake would drawdown over summer and autumn through evaporation. The regulator gates could be used to provide a managed drawdown if required
- The fishway would be operated to provide outflow when the water level in Moira Lake is higher than or equalised with the water level in the Murray River.

Various alternative operational scenarios would need to be followed in atypical seasons. These responses could involve operating Moira regulator and fishway in combination with Swifts and Bunnydigger regulators (refer to Figure 2-2).

The above operating regime is the same as that implemented at the existing Moira regulator, but would be more efficient and safer to implement as a result of the refurbishment work. It would also provide the site environmental water managers with additional flexibility by enabling fish passage between Moira Lake and the Murray River via the fishway when the regulator gates are closed which is not possible at the existing regulator.

Little Edward River

The operating regime of the Little Edward River offtake regulator is not proposed to change following the installation of a fishway at the structure. The primary benefit of the proposed fishway under the current operating regime is that it could be used to provide fish passage from the upper reach of the Little Edward River back to the Edward River when flow in the Edward River is dropping through 1,800 megalitres per day i.e. when a high flow event is receding and the gates of the Little Edward River offtake regulator have been changed from open to closed.

Although it is not proposed for the fishway to be open when flows in the Edward River at the Little Edward River are between about 1,300 and 1,800 megalitres per day other than when a high flow is receding as described above, the hydraulic capacity of the fishway has been designed with

consideration of the maximum flow that it could deliver to the Little Edward River when the gates of the offtake regulator are closed without causing undesirable spills to the broader floodplain. It is expected that the proposed fishway capacity of 25 megalitres per day would either not result in surcharging of the floodplain at Edward Lagoon, or the potential for surcharging could be prevented with minor earthworks and vegetation control.

Pigsty Creek

The removal of Pigsty culvert would mean flow in Pigsty Creek is unimpeded and would just be a function of rainfall, runoff and overland flows in the upstream catchment and any backwater effect or overland flow from high flows in the Edward River downstream.

6.2.3 Safeguards

Measures proposed to avoid, minimise or manage potential surface water and drainage impacts as a result of the proposed activity are detailed in Table 6-2.

Table 6-2 Safeguards for surface water and drainage impacts

Impact	Safeguard	Responsibility	Timing
Impact of construction activities and mobilising sediment	Erosion and sediment control measures will be implemented to stabilise ground surfaces disturbed during the construction phase and will include but not be limited to: • Sediment fences along clearing boundaries • Stockpiling materials on site for the shortest time feasible • Contouring disturbed areas of waterway beds and banks to reinstate natural contours or otherwise in accordance with the design drawings • Covers on truck loads when transporting loose material • Covers on (or watering of) stockpiles. Where feasible, these control measures will be in place before any vegetation clearing or earthwork starts and will remain in place throughout the construction phase until the site rehabilitation plan has been fully implemented.	Contractor	Detailed design Construction
Instream works	The construction soil and water management plan will include contingency measures in the event of high flows in the Murray River during the construction works.	Contractor	Construction
	Control measures to manage potential pollution or sedimentation impacts from instream works will include but not be limited to: • Floating silt fences • Cofferdams to create dry sites for instream works	Contractor	Detailed design Construction

Impact	Safeguard	Responsibility	Timing
	• Undertake work when flows are low/dry for a suitable duration to complete work • Develop contingencies for unexpected moderate to high flows in the Murray River during instream works. Control measures will be in place prior to commencement of any instream works.		
Spills and leaks	• An emergency spill response procedure will be prepared in accordance with the Department of Planning and Environment–Water's incident management protocols to minimise the impact of accidental spillages of fuels, chemicals and fluids during construction • Hazardous materials such as oils, chemicals and refuelling activities will occur in bunded areas and as far from waterways as feasible.	Contractor	Detailed design Construction
Concrete works	• Bunded receptacles for concrete waste including concrete slurries and washout water will be provided at the work sites to capture, contain and appropriately dispose of any concrete waste at a suitably licensed waste facility. These will be located as far from waterways as feasible • Concrete elements of the replacement and refurbished regulators will be prefabricated, where practicable.	Contractor	Detailed design Construction
Dewatering of in-stream work areas	A construction soil and water management plan will be prepared as part of the CEMP and will outline procedures and water quality standards (ANZG, 2018) to be achieved prior	Contractor	Detailed design Construction

Impact	Safeguard	Responsibility	Timing
	to dewatering within the cofferdam areas (dry work areas), if required.		
Water release from water quality controls during construction	The construction soil and water management plan will outline procedures (as per the Blue Book) and water quality standards (ANZG, 2018) to be achieved prior to discharging water to waterways.	Contractor	Detailed design Construction
Water quality monitoring	Visual monitoring of local water quality (e.g. turbidity, hydrocarbon spills/slicks) will be carried out daily during construction to identify any potential spills or deficient erosion and sediment controls. Should a change in water quality appear evident samples will be collected and analysed.	Contactor	Construction

6.2.4 Water quality monitoring

The frequency for monitoring water quality during construction will be confirmed during detailed design however as a minimum, visual monitoring should occur daily during construction to identify any change in water quality as a result of construction. During visual inspection where there is potential for release of construction water runoff and visible oil and grease water quality samples should be collected.

Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional mitigation measures will be identified and implemented as required.

6.2.5 Residual impacts

Implementation of the safeguards identified in Section 6.2.3 would significantly reduce the potential for mobilisation of sediments and other contaminants during construction. Implementation of the safeguards, together with the small construction footprints and short duration of the works, means there is a low potential for adverse impacts to water quality during the construction phase of the proposed activity.

As the proposed replacement and refurbished regulators are expected to be operated in a manner consistent with the existing regulators, no adverse impacts to water quality are expected during the operational phase of the proposed activity.

6.3 Groundwater

6.3.1 Existing environment

Groundwater in the Central River Murray catchment is mainly found in the extensive alluvial groundwater systems on the New South Wales side of the Murray River (Murray-Darling Basin Authority, 2022). Groundwater systems are highly connected to surface water throughout the Central River Murray catchment.

As discussed in Section 6.1.1, geotechnical investigations of the Pinchgut regulator, Nestrons regulator, Moira regulator and Little Edward River offtake regulator construction footprints were undertaken in May 2022. Groundwater was encountered in some of the boreholes drilled as detailed below:

- Pinchgut regulator — Borehole BH140-RR, drilled immediately west of the existing Pinchgut regulator, did not encountered groundwater before drilling ceased at a depth of 8 metres
- Nestrons regulator — Borehole BH143-RR, drilled immediately south of Millewa River Road on the western bank of Nestrons Creek, did not encounter groundwater before drilling ceased at a depth of 8 metres
- Moira regulator — Borehole BH180-MO, drilled on the eastern side of the existing Moira regulator, encountered static water at a depth of 11.5 metres
- Little Edward River offtake regulator —Boreholes BH160-ED and BH161-ED, on the southern bank of the Little Edward River, immediately upstream and downstream respectively, both encountered static water at a depth of 3.5 metres.

6.3.2 Impacts

The results of the boreholes drilled at the Pinchgut regulator, Nestrons regulator, Moira regulator and Little Edward River offtake regulator construction footprints indicate that groundwater is at depths greater than the likely maximum depth of excavation required to carry out the proposed works. The works proposed at Pigsty culvert mostly comprise demolition works and would only occur to the depth of the existing culvert and are unlikely to encounter groundwater.

If the construction works do not result in direct interaction with groundwater the potential for impacts to groundwater would be low.

The replacement Pinchgut and Nestrons regulators are expected to become preferred structures for managing flows in Toupna Creek, water levels in Douglas Swamp and environmental watering of this part of Millewa Forest, which would result in more frequent flows in Pinchgut Creek and Nestrons Creek and therefore the potential for increased losses to groundwater along these creeks. However, as no change to the overarching environmental watering regime at Millewa Forest is proposed, there is potential for reduced losses to groundwater at waterways that but for the proposed activity would have been preferred for passing environmental flows, meaning that the overall impact on groundwater in the vicinity of Toupna Creek is likely to be negligible.

The operating regime of the refurbished or replaced Moira regulator would be the same as the existing regulator and, therefore, no changes to groundwater are expected due to the operation of this structure. Similarly, the operating regime of the refurbished Little Edward River offtake regulator would be the same as the existing structure, with the only likely change being the passing of a small flow through the fishway when flow in the Edward River is dropping through 1,800 megalitres per day i.e. when a high flow event is receding and the gates of the Little Edward River offtake regulator have been changed from open to closed. While the fishway is open it would reduce the volume of water in the upper reach of the Little Edward River and, therefore, create the potential for a slight reduction in losses to groundwater in this reach of the river at these times.

The removal of Pigsty culvert would improve flow in Pigsty Creek and cause a very localised reduction in losses to groundwater immediately upstream of where the structure was located at times when the structure would have otherwise impeded a high flow and cause water to temporarily pond upstream of the structure. The removal of the culvert would create a more natural interaction between surface and groundwater at this location.

6.3.3 Safeguards

One measure is proposed to avoid, minimise or manage potential groundwater impacts as a result of the proposed activity and is detailed in Table 6-3.

Table 6-3 Safeguards for groundwater impacts

Impact	Safeguard	Responsibility	Timing
Groundwater ingress into the work sites during construction	Any groundwater that enters excavations within the work sites will be tested and, if suitable, pumped into nearby waterways or otherwise pumped into a treatment pond and treated before being discharged into nearby waterways. If treatment ponds are proposed they must be located within the construction footprints and their location, size and proposed uses must be documented in the construction soil and water management plan. The construction soil and water management plan will include water quality criteria for any water to be discharged into nearby waterways.	Contractor	Construction

6.3.4 Residual impacts

With implementation of the measure detailed in Table 6-3 the proposed activity is expected to have minimal impact on groundwater.

6.4 Terrestrial biodiversity

The *Millewa Forest Supply Project Biodiversity Assessment Report* (refer to Attachment A) assesses the potential terrestrial biodiversity impacts of the proposed activity. The assessment details the findings of a field survey of the study areas that includes the construction footprints and a 500-metre buffer. The key findings of the assessment are summarised in the following sections.

6.4.1 Existing environment

River regulation has led to the deterioration of the Millewa wetland system (Gawne et al., 2011). Altered water regimes are considered to have had a significant impact on water-dependant flora and fauna, particularly on colonial nesting waterbirds (Leslie, 2001) and native fish (King et al., 2009). There is strong evidence of a continuing decline in the Barmah-Millewa Forest ecosystem condition (Gawne et al. 2011), as evidenced through multiple studies over recent decades (Raymond

et al., 2016; Sharpe, 2018; Suarez et al., 2018; Raymond et al., 2018; NPWS, 2018). Ground and aerial surveys of waterbirds conducted annually over the past 40 years continue to show significant declines since monitoring commenced in 1983 (Porter et al., 2021).

Previous research in Millewa Forest has found that insufficient inundation of floodplain habitat has resulted in reduced frog species richness via a reduction in habitat quality and availability (Howard et al., 2021). Disease such as chytridiomycosis - present within Millewa Forest - and shifts in climate can also be influential (Howard et al., 2012).

In addition to the pressures of ongoing river regulation, altered flow regimes and periods of drought, Millewa Forest has also been used as a working forest for timber harvesting and grazing (Harrington and Hale, 2011). Agricultural production is a dominant land use in the area immediately surrounding Millewa Forest with substantial clearing and modification of the landscape. This has resulted in increased pressure from introduced plant and animal species in the system, with a high proportion of exotic plant cover in terrestrial areas (up to 60 per cent in some years) and highly invasive aquatic weeds present in the forest's wetlands and waterways (Ward, 2016).

The pressures on Millewa Forest are reflected in the findings of the Murray-Darling Basin Authority's standard condition assessment of tree health which has been monitored repeatedly since 2009. The 2015 surveys found only 17.5 per cent of the forest to be in good condition, with most of the forest described as being in moderate condition (71.3 per cent). The remainder of the forest was described as being in poor condition (9.2 per cent), degraded (1.0 per cent) or severely degraded (1.0 per cent) (Murray-Darling Basin Authority, 2016). Past logging practices and changes to flooding patterns have resulted in high tree densities, with one third of the forest mapped as high stem density stands when the park was gazetted in 2010 (OEH, 2018). This results in competition for resources, particularly water, and results in slow growth rates (and replacement of habitat value trees) and reduced resilience to changing climatic patterns (OEH, 2018).

The rivers, anabranches and wetlands of Millewa Forest are important habitats for native fish populations. Despite this, connectivity among habitats has been a long-standing issue in the Barmah-Millewa Forest (Cadwallader 1977 in Stuart et al., 2020). Major floodplain regulators, particularly the Mary Ada regulator located on Toupna Creek, can entrap native fish moving between flowing anabranches, floodplains and the Murray River. For fish trapped on floodplains, the lack of connectivity back to riverine habitats can exacerbate mortality during periodic hypoxic blackwater events (King et al., 2012).

6.4.1.1 NSW Central Murray Forest Ramsar site

The proposed activity is located within the approximately 84,000-hectare NSW Central Murray Forests Ramsar site, which comprises three geographically discrete but interrelated areas: Millewa Forest (comprising approximately 38,000 hectares), Werai Forest, and Koondrook-Perricoota Forest.

The proposed activity is also within 10 kilometres of the Barmah Forest Ramsar site, which is located in Victoria on the southern side of the Murray River opposite Millewa Forest. Barmah-Millewa Forest is part of the largest complex of tree-dominated floodplain wetlands in southern Australia. And is nationally the largest continuous stand of River Red Gum Forest (Murray-Darling Basin Commission, 2006). The size and intact nature of this forested floodplain makes it one of the best representatives of the wetland type Xf (freshwater tree-dominated wetlands) in the bioregion. In addition, the site forms an extensive area of intact floodplain and is one of the few such areas with native vegetation in the bioregion (Hale and Butcher, 2011).

The Central Murray Forests Ramsar site has two critical wetland vegetation categories: River Red Gum Forests and Floodplain Marshes. More than 90 percent of the Millewa Forest component of the Ramsar site is covered in inundation dependent forest and woodland. Inundation of Millewa Forest is driven largely by flows within the Murray River. Large scale floods that inundate the forests are generally the result of catchment rainfall events that generate flows in upstream tributaries (such as the Kiewa and Ovens rivers), and spills or pre-releases from Hume Dam.

An ecological character description of the Central Murray Forests Ramsar site (Harrington and Hale, 2011) was prepared based on the state of the site at the time of its listing in 2003 and it recognised the following important or unique values:

- The NSW Central Murray Forests are the largest complex of tree-dominated floodplain wetlands in southern Australia, making them a good representative of this wetland type in the Murray-Darling Basin bioregion
- There are eight threatened species, listed at the national and / or international scale supported by the wetlands within the Ramsar site, including: Australasian Bittern (*Botaurus poiciloptilus*), Australian Painted Snipe (*Rostratula benghalensis*), Murray Hardyhead (*Craterocephalus fluviatilis*), Superb Parrot (*Polytelis swainsonii*), River Swamp Wallaby-grass (*Amphibromus fluitans*), Trout Cod (*Maccullochella macquariensis*), Silver Perch (*Bidyanus bidyanus*), and Murray Cod (*Maccullochella peelii*)
- The Ramsar site provides habitat for 11 species of wetland bird listed under international migratory agreements (JAMBA, CAMBA and ROKAMBA) and is important for colonial nesting waterbirds, supporting breeding of thousands of birds during times of inundation. It is also important for breeding of native fish. In addition, the permanent rivers and wetlands within the site are recognised as drought refuge for native fauna in the semi-arid region
- The Ramsar site provides migratory routes between habitat in the Murray River, anabranches and floodplains and is considered important for recruitment of native fish (King et al., 2007).

Millewa Forest is also listed on the Directory of Important Wetlands in Australia, where it is recognised as being a good example of the River Red Gum floodplain forests of inland NSW.

6.4.1.2 Threatened fauna species

Twenty-seven threatened fauna species have been previously recorded or highlighted as having potential to occur within about 10 kilometres of the proposed activity. This includes 18 birds, six mammals, two frogs and one insect. Of these, 17 threatened fauna species are considered as having a moderate to high likelihood of occurring within 500 metres of the construction footprints (refer to Table 4-2 in Attachment A).

Site surveys at Millewa Forest in March and April 2021 and August 2022 recorded six threatened species within and near the construction footprints:

- Koala (*Phascolarctos cinereus*) — Listed as vulnerable under the BC Act and endangered under the EPBC Act. It has potential habitat at all construction footprints and scats were found in the vicinity of Pinchgut and Nestrons regulators
- Superb Parrot (*Polytelis swainsonii*) — Listed as vulnerable under both the BC Act and EPBC Act. It was observed and heard near the Little Edward River with suitable habitat across most of Millewa Forest, particularly where hollows of five to 30 centimetres are in high density such as along the Little Edward River
- Australasian Bittern (*Botaurus poiciloptilus*) — Listed as endangered under both the BC Act and EPBC Act. It was observed roosting in exposed roots of regrowth River Red Gum on the block bank of Pigsty culvert and was heard calling at dusk near sedge wetland near the Little Edward River offtake regulator. Suitable habitat for Australasian Bittern occurs throughout the wetland and flooded forest areas, including breeding habitat in sedge dominated wetlands outside the construction footprints
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) — Listed as vulnerable under the BC Act. It is generally widespread, particularly in areas with high log densities. It was heard and observed mostly in the northern parts of Millewa Forest
- Scarlet Robin (*Petroica boodang*) — Listed as vulnerable under the BC Act. It has suitable habitat at all the construction footprints. It was heard and observed near Pinchgut regulator and along Millewa River Road
- Black Falcon (*Falco subniger*) — Listed as vulnerable under the BC Act. It has suitable habitat at all the construction footprints. It was observed flying at the western end of Moira Creek.

6.4.1.3 Non-threatened fauna species

The vegetation identified for removal may provide foraging and nesting habitat for non-threatened fauna species including arboreal mammals, birds and reptiles. Common species of the area would face the same impacts as threatened fauna (refer to Section 6.4.1.2). While non-threatened species were not the subject of targeted surveys, species such as the Common wombat (*Vombatus ursinus*) and Echidna (*Tachyglossus aculeatus*) are known to occur in the study area. Platypuses

(*Ornithorhynchus anatinus*) and Water Rats (*Hydromys chrysogaster*) may occur in the study area, particularly within and along the waterways. Native freshwater turtles may be found within the waterways or nesting in the riparian zone. There would be a minor loss of foraging habitat for common fauna species, including minor indirect impacts such as noise/vibration disturbance. The greatest risk is displaced sediment entering waterways during construction. This could result in impacts to aquatic habitat for common freshwater species. However, the construction footprints are small and ground cover vegetation would eventually recover in the early operational phase.

6.4.1.4 Threatened flora species

Thirteen listed threatened flora species have been previously recorded or having potential to occur within about 10 kilometres of the of the proposed activity. The only one of these species considered to have potential to occur within the construction footprints is Floating Swamp Wallaby-grass (*Amphibromus fluitans*), which is listed as vulnerable under the EPBC Act and BC Act. Floating Swamp Wallaby-grass is known to occur in swamp margins within the Murray Valley National Park and Regional Park. Only small portions of the construction footprints were considered to support suitable habitat for this species. A specimen was observed at a known reference site to confirm its growth activity and life history at time of survey. Dedicated searches were carried out for Floating Swamp Wallaby-grass but no plants were identified.

There was a lack of suitable habitat present within the construction footprints for the other threatened flora species previously recorded or having potential to occur in the vicinity of the proposed activity, and therefore these species were assigned a low likelihood of occurrence.

6.4.1.5 Migratory species

Twelve migratory bird species are predicted to occur within about 10 kilometres of the proposed activity based on the EPBC Act PMST (DCCEEW, 2022) and NSW BioNet Atlas database (Department of Planning and Environment, 2022b). No migratory species were detected during the field surveys carried out for the proposed activity.

While some migratory bird species would use the construction footprints and surrounding areas on occasion, such as the Sharp-tailed Sandpiper (*Calidris acuminata*), the construction footprints are not recognised as 'important habitat' as defined under the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013), in that the construction footprints do not contain:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

Based on the above considerations, the proposed activity is unlikely to impose a significant effect on any of the listed migratory species predicted to occur within or near to the construction footprints.

6.4.1.6 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value within or near the construction footprints.

6.4.1.7 Native vegetation

Field surveys of the construction footprints and surrounding areas were undertaken over two survey events in autumn (29-31 March 2021 and 11 April 2022, four days), and one survey event in late winter (2-4 August 2022, three days). The surveys identified two plant community types (PCTs) at the construction footprints:

- PCT 2, River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW. PCT 2 occurs on black to grey silty-loam-clay alluvial (often self-mulching) soils in frequently flooded sites bordering stream channels, oxbows and in nearby low-lying areas including intermittent lakes. Characteristically it is a very tall open forest dominated by River Red Gum (*Eucalyptus camaldulensis*) in the upper stratum. Shrubs within the middle stratum are typically absent. The ground stratum may be sparse though is usually dominated by sedges
- PCT 5, River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion. PCT 5 occurs on silty-sandy loam-clay soils on levees or other raised landform elements adjacent to rivers and wetlands. The vegetation structure is a very tall open forest dominated by River Red Gum (*Eucalyptus camaldulensis*). The shrub layer is sparse or absent. The ground cover may be mid-dense or dense and is dominated by grass species.

PCT 2 and PCT 5 are potentially representative of terrestrial groundwater-dependent ecosystems (GDEs), although they are likely to be opportunistic facultative GDEs that may depend on the subsurface presence of groundwater in some locations but not in others.

Table 6-3 provides details of the condition and area of each PCT within the construction footprints.

Table 6-4 Plant community types and vegetation zones in each construction footprint

Vegetation zone	Zone condition	Location	Area (hectares)
PCT 2	**River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW**		
1	Good	Pinchgut regulator	0.13

Vegetation zone	Zone condition	Location	Area (hectares)
		Moira regulator	0.50
		Pigsty culvert	0.11
		Sub-total	*0.74*
2	Low to moderate	Pinchgut regulator	0.06
		PCT 2 total	**0.80**
PCT 5	**River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion**		
3	Good	Little Edward River offtake regulator	0.06
4	Low to moderate	Nestrons regulator	0.09
		PCT 5 total	**0.15**
		TOTAL (PCTs 2 and 5)	**0.95**

The vegetation at each construction footprint is described in the following sections and mapped in Figure 6-1 to Figure 6-5. All vegetation within the construction footprints would require removal to carry out the construction works.

Pinchgut regulator

Vegetation in the vicinity of Pinchgut regulator is PCT 2 and was observed to be in low to moderate condition on the embankment at the regulator and in good condition elsewhere in the vicinity (refer to Figure 6-1).

The vegetation in good condition had a canopy with River Red Gum (*Eucalyptus camaldulensis*). The understorey and groundcover layers were generally sparse with scattered patches of Common Reed (*Phragmites australis*), Cotton Fireweed (*Senecio quadridentatus*), Swamp Dock (*Rumex brownii*), Common Rush (*Juncus amabilis*) and Yellow Rush (*Juncus flavidus*). There were occasional stands of River Cooba (*Acacia stenophylla*) and Mountain Cedar Wattle (*Acacia dealbata*). There were

occasional occurrences of exotic plant species Batthurst Burr (*Xanthium spinosum*) and St John's Wort (*Hypericum perforatum*).

The vegetation in low to moderate condition had a canopy with River Red Gum (*Eucalyptus camaldulensis*) but the understorey and groundcover layers were generally disturbed with exotic annual plant species as a result of past construction and operation activities of the regulator with bare ground and leaf litter. There were occasional patches of Common Reed (*Phragmites australis*) in Pinchgut Creek and occasional stands of Mountain Cedar Wattle (*Acacia dealbata*). There were also occasional occurrences of exotic plant species St John's Wort (*Hypericum perforatum*).

Three hollowing bearing trees were observed within the construction footprint and a further three hollow bearing trees were observed nearby (refer to Figure 6-1). These tree hollows would provide suitable habitat for Superb Parrot (*Polytelis swainsonii*) and Barking Owl (*Ninox connivens*).

Figure 6-1 Pinchgut regulator - terrestrial biodiversity constraints

Nestrons regulator

Vegetation in the vicinity of Nestrons regulator is PCT 5 and was observed to be in low to moderate condition (refer to Figure 6-2).

The vegetation had a canopy with River Red Gum (*Eucalyptus camaldulensis*). The understorey and groundcover layers were generally sparse with native species with Common Reed (*Phragmites australis*) in the narrow creek. The remaining groundcover was dominated by exotic plant species, including a dense cover of Horehound (*Marrubium vulgare*), Blue Heliotrope (*Heliotropium amplexicaule*) and St John's Wort (*Hypericum perforatum*). There was also occurrence of annual weeds such as Conyza spp. In the creek there was also occurrences of Arrowhead (*Sagittaria platyphylla*), a weed of national significance listed in the *Australian Weeds Strategy 2017 to 2027* (Invasive Plants and Animals Committee, 2016).

Two hollowing bearing trees were observed within the construction footprint and there was a further one hollow bearing tree observed nearby (refer to Figure 6-2). These hollows would provide suitable habitat for Superb Parrot (*Polytelis swainsonii*) and Barking Owl (*Ninox connivens*).

Figure 6-2 Nestrons regulator – terrestrial biodiversity constraints

Moira regulator

Vegetation in the vicinity of the Moira regulator is PCT 2 and was observed to be in good condition (refer to Figure 6-3).

The vegetation had a canopy with River Red Gum (*Eucalyptus camaldulensis*). The understorey and groundcover layers were generally sparse with scattered patches of Common Reed (*Phragmites australis*), Cotton Fireweed (*Senecio quadridentatus*), Swamp Dock (*Rumex brownii*), Common Rush (*Juncus amabilis*) and Yellow Rush (*Juncus flavidus*). There were occasional stands of River Cooba (*Acacia stenophylla*) and Mountain Cedar Wattle (*Acacia dealbata*). There were occasional occurrences of exotic plant species Batthurst Burr (*Xanthium spinosum*) and St John's Wort (*Hypericum perforatum*).

One hollow bearing tree was observed within the construction footprint (refer to Figure 6-3). This hollow would provide suitable habitat for Superb Parrot (*Polytelis swainsonii*) and Barking Owl (*Ninox connivens*).

Figure 6-3 Moira regulator - terrestrial biodiversity constraints

Little Edward River offtake regulator

Vegetation in the vicinity of the Little Edward River offtake regulator is PCT 5 and was observed to be in good condition with limited weeds (refer to Figure 6-4).

The vegetation had a canopy with River Red Gum (*Eucalyptus camaldulensis*). The understorey and groundcover layers were generally dense with grass and sedges, as well as scattered patches of Common Reed (*Phragmites australis*), Cotton Fireweed (*Senecio quadridentatus*), Swamp Dock (*Rumex brownie*), Common Rush (*Juncus amabilis*) and Yellow Rush (*Juncus flavidus*). There were occasional stands of River Cooba (*Acacia stenophylla*) and Mountain Cedar Wattle (*Acacia dealbata*). There were also occasional occurrences of exotic plant species Bathurst Burr (*Xanthium spinosum*) and St John's Wort (*Hypericum perforatum*).

No hollowing bearing trees were observed within the construction footprint although there were four hollow bearing trees observed nearby (refer to Figure 6-4). These hollows would provide suitable habitat for Superb Parrot (*Polytelis swainsonii*) and Barking Owl (*Ninox connivens*). Superb Parrot (*Polytelis swainsonii*) was observed and heard around the Little Edward River, and a high density of suitable hollows were observed along the river.

An Australasian Bittern (*Botaurus poiciloptilus*) was heard calling at dusk near sedge wetland near the Little Edward River offtake regulator.

Figure 6-4 Little Edward River offtake regulator - terrestrial biodiversity constraints

Pigsty culvert

Vegetation in the vicinity of Pigsty culvert is PCT 2 and was observed to be in good condition (refer to Figure 6-5).

The vegetation had a canopy with River Red Gum (*Eucalyptus camaldulensis*). The understorey and groundcover layers were generally sparse with scattered patches of Common Reed (*Phragmites australis*), Cotton Fireweed (*Senecio quadridentatus*), Swamp Dock (*Rumex brownii*), Common Rush (*Juncus amabilis*) and Yellow Rush (*Juncus flavidus*). There were occasional stands of River Cooba (*Acacia stenophylla*) and Mountain Cedar Wattle (*Acacia dealbata*). There were occasional occurrences of exotic plant species Bathurst Burr (*Xanthium spinosum*) and St John's Wort (*Hypericum perforatum*).

One hollow bearing tree was observed within the construction footprint (refer to Figure 6-5). This hollow would provide suitable habitat for Superb Parrot (*Polytelis swainsonii*) and Barking Owl (*Ninox connivens*). An Australasian Bittern (*Botaurus poiciloptilus*) was observed roosting in exposed tree roots above the culvert. This would be a temporary roosting location, and not a breeding location.

Figure 6-5 Pigsty culvert - terrestrial biodiversity constraints

6.4.2 Impacts

6.4.2.1 Loss of vegetation and habitat

The proposed activity would involve clearing of vegetation within the construction footprints and would result in the removal of up to 0.95 hectares of native vegetation comprising 0.80 hectares of PCT 2 and 0.15 hectares of PCT 5, as detailed in Table 6-4. This loss of vegetation is considered a worst case outcome as the contractor would be required to limit the area of vegetation cleared within the construction footprints to only that required to carry out the proposed works. An additional area of about 0.04 hectares would also potentially be disturbed at the Little Edward River offtake regulator construction footprint, which is bare ground comprising an existing access track and camp ground.

The construction footprints are located next to existing infrastructure including regulators, access tracks and bridges, and therefore include previously disturbed areas, which is preferable to directly impacting habitat on ground that is not previously disturbed.

The proposed vegetation to be impacted currently provides suitable foraging and nesting habitat for various fauna species, particularly woodland birds. The canopy species (River Red Gums and Silver Wattle), generally provide summer food resources, however, can flower opportunistically throughout the year. Due to minimal habitat being removed and the adjacent contiguous riparian vegetation, it is unlikely the vegetation being removed would be important or preferred habitat for local or migratory species.

Any species using the trees and habitat to be removed would be displaced. However, with extensive preferred habitat in the adjacent contiguous riparian vegetation and the connected Murray Valley National Park and Regional Park, the impact of the proposed vegetation removal is considered minor.

6.4.2.2 Threatened biodiversity

The predicted impacts on threatened biodiversity would be minimal considering the following:

- The proposed activity would remove vegetation that may represent a dispersal or foraging resource from within areas containing large contiguous patches of similar habitat
- The vegetation to be removed has been previously disturbed and is unlikely to contain suitable habitat for any threatened flora species
- While the vegetation identified for removal may provide foraging and nesting habitat for species including arboreal mammals, birds and reptiles, the extent of the vegetation removal in the context of the broader area would not significantly disrupt the lifecycle of threatened species due to the available similar surrounding habitat

- Some of the threatened species potentially present readily move through the landscape and undertake seasonal migration, while others are sedentary but capable of short distance dispersal
- The construction footprints exist largely within currently disturbed areas, therefore the works would not further fragment or isolate habitat, species or populations
- While the habitat to be removed is considered important to threatened species, the area of vegetation to be removed is not considered important to the survival or recovery of any identified species
- The proposed activity does not significantly contribute to a key threatening process for the threatened terrestrial species that potentially occur within or use the construction footprints
- Indirect impacts on fauna such as noise/vibration disturbance during construction may occur
- While the predicted impacts could be considered part of a key threatening process for threatened species, the proposed activity is considered unlikely to result in significant impacts, given the limited extent and short duration of the construction works and the aim to improve the overall riparian and aquatic habitat in the long-term.

Overall, impacts to ecological communities and species, as a result of the proposed activity, are considered to be temporary and relatively minor in relation to extensive areas of suitable adjacent habitat.

6.4.2.3 Ramsar wetlands and nationally important wetlands

The proposed activity would not cause a significant impact to the NSW Central Murray Forests and Barmah Ramsar sites.

A limit of acceptable change has been set for the NSW Central Murray Forests Ramsar site based on conditions at the time of listing which was during a long drought (Harrington and Hale, 2011). The limit of acceptable change for River Red Gum Forests in the Millewa Forest Group is to be no less than 20,000 hectares. The 0.95 hectares of impact to PCT 2 and PCT 5 is a very small portion of the River Red Gum Forests in the Millewa Forest Group, and does not trigger the prescribed limit of acceptable change.

6.4.2.4 Other impacts

Other potential impacts to terrestrial biodiversity include:

- Wildlife connectivity and habitat fragmentation — The extent of vegetation clearing is generally minor and isolated to the discrete locations of the existing structures. As this clearing is isolated, it would not separate the existing woodland into two patches or impact existing vegetation connectivity. The extent of the clearing is considered minor and would not impact the mobility of resident or migratory fauna within the patch and into the adjacent riparian vegetation within Murray Valley National Park and Regional Park

- Edge effects — Edge effects refer to the impact of increased exposure of vegetation due to the clearing of adjacent vegetation. Impacts can include changes to microclimate, vegetation composition, weed spread and distribution, hydrology, dieback, soils, and fauna. Increased prevalence of weeds is predicted to be the greatest edge effect as a result of the proposed activity because invasive weed species are already present within the construction footprints
- Fauna injury and mortality — Fauna injury or death could occur during vegetation clearing. Some mobile species, such as birds, would be able to move away from the path of clearing and may not be greatly affected unless they are nesting. However, other species that are less mobile (e.g. ground dwelling reptiles and mammals), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and micro bat species), may find it difficult to move rapidly when disturbed. Fauna could also be struck by construction vehicles, plant and equipment performing other tasks or become trapped in equipment and excavations. While this could result in injury and death, the likelihood of this occurring is considered negligible as the construction footprints are small and within existing disturbed areas
- Proliferation of weeds —Proliferation of weed species is likely to occur as vegetation is removed, soil is disturbed, and machinery moves about the work sites. During construction there is potential to disperse weed seeds and plant material into adjoining areas of moderate to high quality native vegetation where weed species do not currently occur in high density. Areas of bare soil created at the construction footprints would provide opportunities for weed establishment. The impacts from weed invasion would likely commence a few months after construction and gradually increase over months and seasons. Proliferation of weed species has the potential to impact on the quality and integrity of the native vegetation within and surrounding the construction footprints including habitat for threatened species
- Pests — The movement of plant and equipment has the potential to transfer pests within Millewa Forest and alter their abundance. The construction footprints are likely to provide habitat for a range of pest species including rabbits, foxes and cats. Construction activities have the potential to disperse pest species across the surrounding landscape due to habitat removal, noise, and human presence during construction and operation. However, the proposed activity is unlikely to significantly increase the value of the habitat for pest species in the study areas over the long-term. Rabbits tend to colonise more disturbed and modified open habitats, such as the agricultural landscape surrounding Murray Valley National Park and Regional Park, and the proposed activity is unlikely to contribute to increased levels of predation on native fauna from foxes and cats as the construction footprints are mostly limited to existing disturbed areas
- Pathogens — The movement of plant and equipment has the potential to transfer pathogens within Millewa Forest. The most likely causes of pathogen dispersal and importation associated with the proposed activity include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery. The potential for pathogens to occur will be treated as a risk during construction
- Noise — Construction noise may result in fauna temporarily avoiding habitats adjacent to the construction footprints. The impacts from noise emissions would be localised to the construction footprints and adjacent areas and are not considered likely to have a significant, long-term impact on wildlife populations. No nightworks are proposed, which would avoid disturbance to fauna at dawn, dusk and at night.

- Dust — Dust generated during construction may be deposited onto the foliage of vegetation adjacent to the construction footprints. This has the potential to reduce photosynthesis and transpiration and cause abrasion and radioactive heating resulting in reduced growth rates and decreases in overall health of the vegetation. Deposition of dust on foliage is likely to be highly localised.

6.4.3 Safeguards

Measures proposed to avoid, minimise or manage potential terrestrial biodiversity impacts as a result of the proposed activity are detailed in Table 6-5.

Table 6-5 Safeguards for terrestrial biodiversity impacts

Impact	Safeguard	Responsibility	Timing
Impact to surrounding vegetation	The approved construction footprints will be accurately and clearly marked out by a surveyor using flagging tape and signage prior to the start of works. The signage will prohibit any access or construction work outside the construction footprints. The biodiversity management plan will specify the type of flagging and signage required to delineate the approved construction footprints.	Contractor	Prior to construction
	The vegetation clearing boundary at each work site will be accurately and clearly marked out using flagging tape prior to the start of works. The clearing boundaries must not extend outside the approved construction footprints. The biodiversity management plan will specify the type of flagging required to delineate the clearing boundaries. If there are opportunities to not clear the entire approved construction footprints, preference should be given to avoiding clearing of areas containing established trees (including hollow-bearing trees) and good quality native vegetation and instead concentrate clearing to areas of the	Contractor	Prior to construction

Impact	Safeguard	Responsibility	Timing
	footprints that are subject to previous disturbance. To assist in this process, the biodiversity management plan will include figures of the approved construction footprints showing the locations of hollow-bearing trees, vegetation communities; important flora and fauna habitat areas; and locations where threatened species, populations or ecological communities have been recorded.		
	Materials, plant, equipment, work vehicles and stockpiles will be stored, parked or placed as applicable within the clearing boundaries or on existing access tracks at or leading to the works sites that are temporarily closed to traffic and as a result are available for the sole use of the contractor.	Contractor	Construction
	Where feasible, materials, plant, equipment, work vehicles and stockpiles will be stored, parked or placed as applicable away from the driplines of trees that are outside the clearing boundaries or that are within the clearing boundaries but proposed for retention.	Contractor	Construction
	If any damage occurs to vegetation outside the approved construction footprints it is to be reported and managed as an environmental incident in accordance with the environmental incident management procedure contained in the CEMP. The Department of Planning and Environment–Water and NPWS will be notified so that appropriate remediation strategies can be developed and implemented.	Contractor, Department of Planning and Environment–Water	Construction

Impact	Safeguard	Responsibility	Timing
Impact to native plants and animals including threatened species	A pre-clearing inspection will be undertaken 48 hours prior to any native vegetation clearing by a suitably qualified ecologist and the Contractor's Environmental Manager (or delegate). The pre-clearing inspection at each work site will include, as a minimum: • A check of the physical demarcation of the clearing boundary and construction footprint • Identification of trees that are just outside the marked clearing boundary that require protection to avoid unintended damage during the clearing and subsequent construction works • Identification of hollow bearing trees that need to be removed in accordance with the hollow-bearing tree removal procedure (see below) • Identification of other habitat features that may need to be relocated outside the clearing boundary • Identification of any threatened flora and fauna • Implementation of the erosion and sediment control plan for the work site, including erosion control structures. The completion of the pre-clearing inspection will form a hold point requiring sign-off from The Department of Planning and Environment–Water.	Contractor	Construction
	Trees within the clearing boundary that are proposed to be retained will be protected during the construction phase in accordance with Australian Standard 4970-2009 *Protection of Trees on Development Sites*.	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
	Trees located just outside the clearing boundary that are identified during the pre-clearing inspection as being at risk of damage during the construction phase will also be protected in accordance with AS 4970-2009.		
	The biodiversity management plan will include a procedure for the removal of hollow-bearing trees. The procedure will include the following steps: • Non-hollow bearing trees and vegetation surround a hollow-bearing tree will be removed first. Trees should be felled into the construction footprint to avoid damaging adjacent vegetation • Leave the hollow-bearing tree standing for at least one night after other clearing to allow any fauna using the hollows to leave • An NPWS ranger or suitably qualified ecologist is to be present during felling of hollow-bearing trees • Before felling a hollow-bearing tree, tap along the trunk using an excavator or loader to scare fauna from the hollows. Repeat several times • After felling a hollow-bearing tree check its hollows and surrounds to ensure no fauna have become trapped or injured. Any fauna found should be safely located to nearby habitat by the attending NPWS ranger or ecologist • If a hollow-bearing tree is removed in stages the non-hollow-bearing branches	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
	should be removed before the hollow-bearing branches are removed • In consultation with NPWS, felled hollow-bearing trees should be cut into sections and the sections with hollows prioritised for placement into the surround forest to provide additional potential habitat for ground dwelling fauna such as reptiles and small mammals.		
	The biodiversity management plan will include a procedure for dealing with the presence of native fauna species within the construction footprints during the construction works. The procedure will require construction work at the site of the find to immediately cease and the subject animal allowed to leave the construction footprint without being harassed. If an animal needs to be relocated outside a construction footprint, the contractor is to notify the Department of Planning and Environment–Water and they will in turn notify NPWS to agree on appropriate mitigation measures including relocation measures. The contractor will only restart work at the subject site when authorised by the Department of Planning and Environment–Water.	Contractor	Construction
	Construction and worker vehicles and machinery will be checked at the start and end of each workday to ensure fauna are not entrapped.	Contractor	Construction
	Construction during the Superb Parrot breeding period (September to January) will be avoided if possible. If this cannot be	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
	achieved, this species will be considered during pre-clearing surveys to ensure that no impacts will occur.		
Impacts to habitat features	Relocation of habitat features (e.g. fallen timber, hollow logs) outside the construction footprints will occur in accordance with an approved project-specific procedure to be included in the biodiversity management plan.	Contractor	Construction
Impacts from introduction and spread of weeds	Weed management will be undertaken in consultation with NPWS in areas affected by construction prior to any clearing works in accordance with the *Biosecurity Act 2015* to minimise the risk of weeds being spread to the surrounding environment; including during transport of waste off-site to a licensed waste disposal facility.	Contractor	Construction
	All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules will be treated on site or bagged, removed from site, and disposed of at a suitably licensed waste facility. If pesticide use is proposed it must occur in accordance with NPWS's requirements including the *Pesticide Use Notification Plan* (NPWS, 2022).	Contractor	Construction
Impacts from introduction and spread of plant pathogens	All vehicles and machinery engaged in earthworks and vegetation clearance activities will follow the Myrtle Rust hygiene protocol for vehicles and heavy machinery in Table 5 of the *Hygiene Guidelines* (Department of Planning, Industry and Environment, 2020).	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
Wildlife impacts from vehicle strike	Drivers must stay vigilant for fauna during machinery operation and vehicle movements.	Contractor	Construction

6.4.4 Residual impacts

Overall, the temporary short-term impacts on terrestrial biodiversity are low, while the long-term impacts would include easier and more efficient environmental watering of Millewa Forest using the replacement and refurbished environmental regulators.

There is potential for the proposed activity to impact seven hollow bearing trees, however all efforts would be made to avoid these trees where possible.

Seventeen threatened fauna species have the potential to occur based on background research and the presence of suitable habitat within and surrounding the construction footprints. Assessments of significance have been prepared for these species and these conclude that the proposed activity would not have a significant impact on these species (refer to Appendices B and C of Attachment A).

6.5 Aquatic biodiversity

The *Millewa Forest Supply Project Water Quality and Aquatic Ecology Impact Assessment* (refer to Attachment B) assesses potential aquatic biodiversity impacts of the proposed activity. The assessment details the findings of a field survey of a study area that includes each construction and operational footprint and the waterways 500 metres downstream of these footprints. The key findings of the assessment are summarised in the following sections.

6.5.1 Existing environment

The rivers, anabranches and wetlands of Millewa Forest are important habitats for native fish populations. Despite this, connectivity among habitats has been a long-standing issue in the Barmah-Millewa Forest (Cadwallader, 1977, in Stuart et al., 2020) and ongoing declines in species diversity have been recorded in the forest. Existing floodplain regulators were not designed with fish passage considerations, or consideration of the need for native fish moving between flowing anabranches, floodplains and the Murray River (Sharpe, 2018). Tracking studies of large bodied native fish identified that during periods of hydrological connection between the river and creek habitats (at Murray River flows greater than 8,000 megalitres per day), large bodied native fish, particularly flow-dependent species such as Murray Cod (*Maccullochella peelii*), Trout Cod

(*Maccullochella macquariensis*), Golden Perch (*Macquaria ambigua ambigua*) and Silver Perch (*Bidyanus bidyanus*), move from the main river channel into Millewa Forest creeks (Jones, 2008; Jones and Stuart, 2008; Sharpe, 2018; Jones et al., 2022).

Tracked fish occupied creek habitats until river flows begin to recede, upon which they move back to the Murray River (in unregulated creeks). However, they were stranded in regulated creeks, unable to pass flow regulation structures back to the Murray River, but they persistently attempted to move back to the river, undertaking searching movements up to impassable regulators (Jones et al., 2022). Impassable barriers at creek/river effluent points can strand very high numbers of large and small bodied fish on the floodplain when high river flows recede (Jones and Stuart 2008; Sharpe, 2018). Restoring native fish pathways between the Millewa Forest floodplain and the Murray River is a priority for the recovery of fish populations (Sharpe, 2018; Stuart et al., 2020).

6.5.1.1 Aquatic species diversity

Historically, 28 species of fish have been recorded at Barmah-Millewa Forest (18 native, 10 exotic) (Lyon et al. 2002). This number has declined over past decades, with 19 species recorded between 2007 and 2009 (McKinnon, 1997; Jones and Stuart, 2008; Raymond et al., 2011; Sharpe and Wilson, 2012). Since 2009, species diversity has declined further, with most recent assessments of species diversity at Barmah-Millewa Forest reporting 11 native and five non-native fish species (Raymond, et al., 2021). These include the native large bodied Murray Cod (*Maccullochella peelii*), Trout Cod (*Maccullochella macquariensis*), Golden Perch (*Macquaria ambigua ambigua*) and Silver Perch (*Bidyanus bidyanus*), and small bodied species such as Carp Gudgeon (*Hypseleotris* spp), Australian Smelt (*Retropinna semoni*), Un-specked Hardyhead (*Craterocephalus stercusmuscarum fulvus*), Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*) amongst others, and exotic species including Common Carp (*Cyprinus carpio*), Goldfish (*Carassius auratus*), Oriental Weatherloach (*Misgurnus anguillicaudatus*), Eastern Gambusia (*Gambusia holbrooki*) and Redfin Perch (*Perca fluviatilis*). Other notable aquatic and semi-aquatic species which have been recorded in the Barmah-Millewa Forest include Murray Crayfish (*Euastacus armatus*), Platypus (*Ornithorhynchus anatinus*), Broad-shelled Turtle (*Chelodina expansa*), Eastern Long-necked Turtle (*Chelodina longicollis*) and Murray River Turtle (*Emydura macquarii*) (Department of Planning and Environment, 2022b; ALA, 2022).

One threatened species is thought to have become locally extinct — the endangered Southern Pygmy Perch (*Nannoperca australis*), which has not been recorded in Barmah-Millewa Forest since 2009 (Sharpe and Wilson, 2012; Raymond et al., 2021). Flathead Galaxias (*Galaxias rostratus*) has also never been recorded within the Barmah-Millewa Forest complex, despite its predicted distribution in the Murray River and major tributaries (including Lower Toupna Creek) within the area (DPI, 2022). Other notable species which were historically present in the Barmah-Millewa Forest complex and are now considered locally extinct include the Freshwater Catfish (*Tandanus tandanus*), River Blackfish (*Gadopsis marmoratus*), Macquarie Perch (*Macquaria australasica*), Murray Hardyhead

(*Craterocephalus fluviatilis*), Mountain Galaxias (*Galaxius olidus*) and Olive Perchlet (*Ambassis agassizii*) (Raymond et al., 2021).

6.5.1.2 Threatened and important aquatic species and communities

The following threatened aquatic fauna were identified as either being present or as being likely to occur within Bullatale supply channel, inlet channel or the construction footprint based on field survey evidence, database searches, predicted habitat and the predicted distribution maps for threatened species listed under the FM Act. These are outlined in Table 6-6 and include:

- One endangered ecological community (EEC)
- Four Commonwealth and State-listed threatened aquatic species
- Five other important aquatic species.

Table 6-6Likelihood of occurrence of threatened and important aquatic species and communities

Common name	Species	EPBC Act	FM Act	Likelihood of occurrence	Preferred habitat and comments
Threatened ecological communities					
Lowland Murray River Drainage System	—	—	—	Present	The proposed activity is situated wholly within the endangered ecological community (EEC) known as the ‘Lowland Murray River Drainage System’ (Lowland Murray River EEC). Lowland rivers provide a wide range of habitats for fish and invertebrate. Floodplains also provide a mosaic of habitat types, including permanent and temporary wetland, as well as terrestrial habitats (DPI, 2007). In Murray Valley National Park, diverse habitats are representative of this EEC, including permanent and intermittent river channels, intermittent swamps, and billabongs.
Threatened species					
Murray Cod	*Maccullochella peelii*	V	—	Present	Murray Cod has patchy distribution across the lower and mid-altitude

Common name	Species	EPBC Act	FM Act	Likelihood of occurrence	Preferred habitat and comments
					reaches of the Murray-Darling Basin (Lintermans, 2007). Preferred habitat generally consists of deep holes in slow-flowing rivers, and particularly around instream rocks, woody debris, fallen trees or undercut banks which provide shelter and protection from predators (Lintermans, 2007).
Silver Perch	*Bidyanus*	CE	V	Present	The current distribution of Silver Perch is likely to be limited to a portion of the mid-Murray River below Yarrawonga Weir, as well as several of its anabranches and tributaries including the Edward River, an anabranch of the Murray River that flows through Deniliquin, and the Murrumbidgee River. Preferred habitat is generally found in fast-flowing, more open sections of river (DPI, 2017a) but they can also be found in lowland, turbid and slow-flowing rivers (Lintermans, 2007).
Trout Cod	*Maccullochella macquariensis*	E	E	Present	Trout Cod are endemic to the southern Murray-Darling system. There are only three known self-sustaining populations left in the wild. The largest is in the Murray River below Yarrawonga Weir and small translocated populations in Cataract Dam and upper reaches of Sevens Creek (Lintermans, 2007). The species prefers deep pools and instream cover such as large boulders,

Common name	Species	EPBC Act	FM Act	Likelihood of occurrence	Preferred habitat and comments
					fallen trees and woody debris (DPI, 2017b).
Murray Crayfish	*Euastacus armatus*	—	V	Present	Murray Crayfish are endemic to the southern tributaries of the Murray-Darling Basin. The species is known to occupy parts of the Murray River upstream of Mildura, in the Murrumbidgee River and in some dams, and is the only species in the Euastacus genus that lives in both cold and warm water habitats. Murray Crayfish can be found in a variety of habitats ranging from pasture lands to forests. Their preferred habitat is cool, flowing water that is well oxygenated (DPI, 2019). They can tolerate water temperatures up to 27˚C and moderate salinity. They create burrows that vary in complexity.
Important species					
Golden Perch	*Macquaria ambigua*	—	—	Present	Golden Perch naturally inhabit the Murray-Darling River system (except at high elevations) and exist in the internal drainage systems of Lake Eyre and the Bulloo River. The abundance of Golden Perch has dramatically decreased in the Murray-Darling due to migration obstruction, the alteration of flow regimes and temperature stratification. Golden Perch have been translocated into other rivers of NSW, Queensland and

Common name	Species	EPBC Act	FM Act	Likelihood of occurrence	Preferred habitat and comments
					the Northern Territory. They prefer warm, slow moving, turbid streams.
Platypus	*Ornithorhynchus anatinus*	—	—	Likely	Platypuses are known to live in the rivers, streams and lakes of eastern Australia. They are found in the major permanent river systems in the south of NSW, west of the Great Dividing Range, and occasionally in South Australia. Out of the water, platypuses spend most of their time in burrows which have been dug into the riverbank, with their entrances usually above water level. The animals use a number of short resting burrows (3-5 metres in length) as protection from predators and temperature extremes. Burrows used for nesting tend to be more elaborate, with many side branches.
Broad-shelled Turtle	*Chelodina expansa*	—	—	Likely	Broad-shelled Turtles are mostly found in turbid waters of depths greater than three metres. It is mostly a riverine turtle, generally inhabiting permanent streams but is also found in oxbows, ponds in floodplains, backwaters, and swamps across its distributed region. The Broad-shelled Turtle will tend to inhabit environments that are undisturbed and have moderate vegetation cover for nest construction. The turtle has shown a preference for aquatic habitats in structured environments,

Common name	Species	EPBC Act	FM Act	Likelihood of occurrence	Preferred habitat and comments
					where submerged logs, root systems and dead trees occur.
Eastern Long-necked Turtle	*Chelodina longicollis*	—	—	Present	Eastern Long-necked Turtles are the most widespread species of freshwater turtle in Australia. It lives in slow-moving rivers, lakes and waterways across most of NSW, but is often found on land.
Murray River Turtle	*Emydura macquarii*	—	—	Present	Murray River Turtles occur primarily in rivers and waterbodies associated with rivers such as backwaters, oxbows, anabranches and deep, permanent waterholes on the floodplains in the Murray-Darling Basin. This species appears to avoid shallow water.

[1]Status: V = Vulnerable species, E = Endangered species, CE = Critically endangered species.

6.5.1.3 Aquatic habitats

A visual assessment of aquatic habitats at the construction footprints was undertaken by 3Rivers environmental scientists on 11-14 April 2022. Aquatic habitat condition was assessed against criteria outlined in the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). A summary of the visual assessment is provided in the following sections for each proposed work site.

Pinchgut regulator

Pinchgut Creek is a tenth order, regulated floodrunner of the Murray River. Pinchgut regulator is located about 10 metres downstream of the Murray River and about 250 metres upstream of Pinchgut Lagoon. There is rip rap and bed stabilisation (sheet pilling) within the channel both upstream and downstream of the regulator. The creek has a well-defined channel and the bank slopes are moderate. Erosion potential is considered moderate, with evidence of erosion in the form

of undercutting exposing tree roots in some areas. A sand bar is also present within the channel at the downstream extent of the site.

Native macrophytes line the riparian zone, comprising stands of Common Reed (*Phragmites australis*) as well as Poison Pratia (*Lobelia concolor*), Yellow Rush (*Juncus flavidus*), Lesser Joyweed (*Alternanthera denticulata*), Giant Sedge (*Cyperus exaltatus*) and Common Spike Sedge (*Eleocharis acuta*). One weed species was identified, Spear Thistle (*Cirsium vulgare*). River Red Gum (*Eucalyptus camaldulensis*), dominated the overstorey vegetation, with juvenile to large growth forms.

The creek has an abundance of submerged large woody debris, pool/riffle habitat, undercut banks, exposed root mass, overhanging vegetation and an intact riparian zone. The riparian vegetation is continuous with Millewa Forest.

Pinchgut Creek is key fish habitat and is predicted habitat for the threatened Trout Cod (*Maccullochella macquariensis*), Murray Crayfish (*Euastacus armatus*) and Silver Perch (*Bidyanus bidyanus*) (DPI, 2022). Murray Cod (*Maccullochella peelii*) are also predicted / likely to inhabit this area (DCCEEW, 2022).

Nestrons regulator

Nestrons Creek is a tenth order, artificial, regulated flood runner, which forms a meandering channel from the Murray River toward Toupna Creek. The creek had a well-defined, incised channel with a moderately steep slope. There are undercut banks and exposed root mass present along the length of the channel.

Some good aquatic habitat features were present at the site, including an abundance of large woody debris, pool and riffle habitat, overhanging vegetation, undercutting, exposed root mass and instream macrophytes. There was an abundance of native and exotic fish species observed within Nestrons Creek during the inspection.

The riparian zone, both upstream and downstream, mostly consisted of River Red Gums (*Eucalyptus camaldulensis*) of varying age classes, with some overhanging vegetation along the creek. Native macrophytes were situated along the riparian edge of the creek including Yellow Rush (*Juncus flavidus*), Common Spike Sedge (*Eleocharis acuta*), Warrego Grass (*Paspalidium jubiflorum*), Water Pepper (*Persicaria hydropiper*) and Water Primrose (*Ludwigia peploides*). Dense stands of Common Reed (*Phragmites australis*) were also present both instream and on the creek banks. Additionally, the riparian vegetation also contained a low to moderate density of weed species including Horehound (*Marrubium vulgare*), Blackberry Nightshade (*Solanum nigrum*) and Fleabane (*Conyza bonariensis*).

Arrowhead (S*agittaria platyphylla*), a weed of national significance, was present in the channel downstream of the regulator.

Nestrons Creek is not mapped as key fish habitat and no threatened species have predicted habitat within the waterway (DPI, 2022), however during flood flows when the regulator is over topped and/or when the regulator is open, the creek is connected to the Murray River and is usually connected to Toupna Creek when water is present. Toupna Creek and Murray River are predicted habitat for several threatened aquatic species.

Moira regulator

In the Murray-Darling Basin, the only aquatic grasslands known are of Moira Grass (*Pseudoraphis spinescens*), also known as Spiny Mud Grass, occurring in lowland reaches of the Murray and Murrumbidgee Rivers, as well as in small patches fringing billabongs, lakes and creeks. These aquatic grasslands are most extensive in the Barmah-Millewa Forest where they form a distinctive wetland type known as Moira Grass plains (Colloff et al., 2014). Moira Grass is known to occur around the Moira Lake area and can be considered a keystone species of floodplain grassy wetlands, providing food and habitat for waterfowl and other aquatic organisms though high primary productivity and nutrient cycling.

Growth of Moira Grass follows an annual cycle with two phases, wet (or inundated) and dry (or stranded), driven by flood peak and recession. Roberts and Marston (2011) considered that Moira Grass in the Barmah Forest requires a flood of at least 0.5 metres depth and five to seven months duration, ideally in late winter or early spring. Prior to river regulation in the 1930s, Moira Grass formed extensive grasslands across the area, with Giant Rush (*Juncus ingens*) limited in its distribution (Chesterfield, 1986). Changes to the natural flood regime have resulted in the gradual loss of Moira Grass and the expansion of Giant Rush (*Juncus ingens*) (Vivian and Godfree, 2012) The Moira Grass plains of Barmah-Millewa Forest no longer flood annually but are inundated in 70 per cent of years or less (Leitch, 1989). Average flood duration is just 4.4 months, indicating a general drying trend. Monthly flows are less variable and the strong seasonal amplitude is severely reduced and slightly shifted. The protection, restoration and maintenance of good condition Moira Grass plains are major objectives of the management of the Barmah-Millewa Forest (Murray-Darling Basin Authority, 2010).

Moira Creek is an intermittent, first order stream that is an anabranch of the Murray River about 1 kilometre upstream. Moira Creek flows to Moira Lake and wetland downstream. Moira Creek had a well-defined channel and gradual sloping banks. The riverbed substrate consists of silt and clay. Rip rap is present along the banks next to the regulator.

Moira Lake is known to have supported a diverse and abundant native fish community, with accounts from the 1860's describing sophisticated Aboriginal fishing techniques and then the commercial harvesting of large quantities of native fish by the Lake Moira Fishing Company, taking Murray Cod (*Maccullochella peelii*), Trout Cod (*Maccullochella macquariensis*), Golden Perch (*Macquaria ambigua ambigua*) and Silver Perch (*Bidyanus bidyanus*) from about 1860 to 1900 (Leslie 1995; Trueman 2007).

Now, Moira Lake is an area with declining value for native fish because of ongoing sedimentation causing shallowing of the lake system. Moira Lake and the broader river region no longer support a commercial fishery and the lake does not even support detectible populations of those native species that were once commonly harvested (Raymond et al., 2018).

Since 2007, Moira Lake has been surveyed for fish under the Murray-Darling Basin Authority's The Living Murray Annual Fish Condition Monitoring Program. Like other wetlands throughout Barmah-Millewa Forest, the native fish community at Moira Lake has suffered dramatic declines in species diversity and abundance, especially since the Millennium drought (Rourke and Tonkin, 2009; Sharpe and Wilson, 2012; Raymond et al., 2018; Pearce et al., 2018; Sharpe, 2018). Now, only two native species are regularly recorded in the lake and always at very low abundance: Carp Gudgeon (*Hypseleotris spp*) and Australian Smelt (*Retropinna semoni*). The 2018 The Living Murray survey of the Moira Lake fish community only collected five Carp Gudgeon and 15 Australian Smelt (Raymond et al., 2018). Exotic species diversity and abundance is however consistently higher with Goldfish (*Casuras auratus*), Common Carp (*Cyprinus carpio*), Eastern Gambusia (*Gambusia holbrookii*) and Oriental Weatherloach (*Misgurnus anguillicaudatus*) all regularly recorded (Rourke and Tonkin, 2009; Raymond et al., 2018).

Moira Lake, like Barmah Lake, is a prolific breeding ground for Common Carp (*Cyprinus carpio*). Throughout the 1990's and 2000's, carp have been commercially harvested from Moira Lake as a management tool to reduce their impact on the wetland's ecological values, particularly vegetation, and to reduce the movement of new recruits and adults back to the Murray River (Jones and Stuart 2008). In 2018, 42.8 tons of carp were removed from the lake (Tim O'Kelly, NSW NPWS pers. Comm.), while zero large bodied native fish were recorded in The Living Murray surveys undertaken during the same period (Raymond et al., 2018).

Aquatic features include riparian vegetation, overhanging vegetation, instream and floating macrophytes, submerged large woody debris and some exposed root mass. The embankments contained large and juvenile River Red Gum (*Eucalyptus camaldulensis*) with mostly native mid-storey and groundcover vegetation. Native ground layer vegetation was dominant along the embankments including Lesser Joyweed (*Alternanthera denticulata*), Common Sneezeweed (*Centipeda cunninghamii*), Common Rush *(Juncus amabilis*), Giant Rush (*Juncus ingens*), and Tall Flat-sedge (*Cyperus exaltatus*).

Moira Creek is key fish habitat but is not predicted threatened species habitat (DPI, 2022). Murray Cod (*Maccullochella peelii*) is also likely to be present in Moira Creek (DCCEEW, 2022).

Little Edward River offtake regulator

Little Edward River is a perennial, tenth order stream which forms an anabranch of the Edward River. Little Edward River had a well-defined channel, with a shallow depth and gradual sloping banks. The

riverbed substrate consisted of silt and clay. Minor undercutting is present along meander bends. There is rip rap and stream bed stabilisation present at the base of the regulator.

Aquatic features include riparian vegetation, ranging from five to 30 metres wide, overhanging vegetation, instream macrophytes, an abundance of submerged large woody debris and undercut banks with some exposed root mass. The embankments contained large and juvenile River Red Gum (*Eucalyptus camaldulensis*) with mostly native mid-storey and groundcover vegetation. Instream macrophytes are also present in small densities. Native groundcover vegetation is dominant along the embankments including Lesser Joyweed (*Alternanthera denticulata*), Common Sneezeweed (*Centipeda cunninghamii*), Water Primrose (*Ludwigia peploides*), Common Rush (*Juncus amabilis*), Giant Rush (*Juncus ingens*), Common Spike Hedge (*Eleocharis acuta*) and Common Reed (*Phragmites australis*).

Little Edward River is key fish habitat and predicted habitat for the threatened Flathead Galaxias (*Galaxias rostratus*), Murray Crayfish (*Euastacus armatus*), Trout Cod (*Maccullochella macquariensis*) and Silver Perch (*Bidyanus bidyanus*) (DPI, 2022). Murray Cod (*Maccullochella peelii*) is also highly likely to be present in Little Edward River (DCCEEW, 2022).

Pigsty culvert

Pigsty Creek is a third order, intermittent creek / swamp environment that is part of a complex network of floodplain wetlands in the north of Millewa Forest.

Some good aquatic habitat features are present at the site, including an abundance of large woody debris, overhanging riparian vegetation and exposed root mass. The riparian zone, both upstream and downstream of the culvert, mostly consists of River Red Gum (*Eucalyptus camaldulensis*) of varying age classes, with some overhanging vegetation along the creek. There is minimum understorey except for a few scattered plants including Yellow Rush (*Juncus flavidus*), Common Rush (*Juncus amabilis*), Common Spikerush (*Eleocharis acuta*), and Lesser Joyweed (*Alternanthera denticulata*).

Pigsty Creek has been mapped as key fish habitat, but no threatened species have predicted habitat within the waterway (DPI, 2022). However during flood flows, the creek becomes connected to the Edward River and other floodplain wetland environments within Millewa Forest. Edward River is predicted habitat for several threatened species.

6.5.2 Impacts

6.5.2.1 Construction

Construction of the proposed activity has the potential to impact aquatic ecosystems directly and indirectly if control measures are not implemented, monitored and maintained throughout the

construction phase. The key potential risk to aquatic ecology during the construction phase if safeguards are not implemented are described in the following sections. Safeguards that will be implemented to avoid and mitigate these risks are identified in Table 6-8 and the expected residual impacts with implementation of these safeguards are discussed in Section 6.5.4.

Direct harm to native fauna

Instream works would be required at each work site and would require dewatering once upstream and downstream cofferdams are established. During dewatering, species that are present in water ponded between the cofferdams may be harmed through entrainment into pumps without implementation of appropriate safeguards. Further, aquatic species may be smothered (e.g. clogging fish gills) if highly turbid water is allowed to enter a receiving waterway without adequate treatment.

Construction runoff from temporary construction compounds and access tracks may indirectly result in harm or mortality of aquatic fauna if poor water quality and sediment are mobilised to downstream receivers. Mobilised sediment would increase turbidity which can clog fish gills or decrease trophic interactions for aquatic species due to reduced visibility.

Loss or degradation of instream habitat features and aquatic vegetation

The construction works at each in-stream work site would require clearing of instream vegetation and/or displacement of aquatic habitat features, particularly stands of emergent macrophytes (i.e. Cumbungi, Spike-rushes or Common Reed) and large woody debris (snags).

Snags are often used as breeding habitat and provide protection for juveniles. As described in Table 6-6, adult and juvenile Golden Perch, Murray Cod and Trout Cod could live within or around these features, particularly in the inlet channel. Other important native species such as Platypus, Broad-shelled Turtle, Eastern Long-necked Turtle and Murray River Turtle are also known to use these features for their habitat. Removal of aquatic vegetation and aquatic habitat features therefore has the potential to result in habitat loss, reduced reproductivity or direct mortality of adults, larvae and young-of-year native species.

Temporary barriers to fish passage

Cofferdams and silt curtains used at in-stream work sites would temporarily block fish passage past each work site.

It is noted that if in-stream works are carried out when the waterways have no flow or when the gates of the regulator being replaced or refurbished would otherwise have been closed, then fish passage past the regulators would not have been possible. In these instances the proposed works would not result in any worsening of fish passage.

Proliferation of pest species

Mobilisation of sediment from construction activities can favour the proliferation of pest species (i.e. Common Carp) that may be able to tolerate poorer water quality than native species. This has the potential to impact native aquatic species as invasive species have been found to out-compete native species for food and habitat (Marshall et al., 2019).

6.5.2.2 Operation

Provision of fish passage

Currently, the existing regulators do not enable fish passage when they are closed, which can lead to native fish becoming stranded in the forest when high flows recede and at the end of environmental watering events. The fishways that would be provided at the replacement and refurbished regulators would create an opportunity to leave the fishway gates open when high flows are receding and the regulators would ordinarily be closed so that fish can return to the Murray River.

The inclusion of fishway gates also provides the site environmental water managers with the flexibility to operate the regulators to optimise fish movement across the floodplain.

Proliferation of aquatic pest species

According to recent monitoring, there are five non-native species present across the Barmah-Millewa Forest complex: Common Carp, Goldfish, Redfin Perch, Eastern Gambusia, and Oriental Weatherloach. Research effort has been placed on the potential effects of Common Carp due to their confirmed occurrence and high abundance found during aquatic fauna surveys in the forest, and ability to exploit wetlands and other inundated habitats which are available during environmental watering events.

As the replacement and refurbished regulators would not alter the current flow or inundation regime of environmental water delivery onto the floodplain, it is expected that there would be no additional risk of providing preferred habitat for Carp spawning and recruitment. Carp could, however, benefit from increased fish passage past the replacement and refurbished regulators. As such, Carp may indirectly impact native aquatic species as they outcompete them for food and other resources and may contribute to degradation of water quality and habitat conditions which habitat specialists may not be able to tolerate.

Spread of aquatic weeds

Although minor, there is potential for any additional flow through the replacement inlet regulator to exacerbate the spread of aquatic weeds by providing improved connectivity for dispersal of propagules (e.g. seeds or vegetative parts) within the waterway.

Importantly, the existing aquatic weed community of the Millewa Forest is the product of the current hydrology and interactions with morphological, physiological and life history characteristics of the plants as well as a potential dispersal vectors. Since there are no proposed changes to the operating regime of the replacement and refurbished regulators, potential changes to the aquatic weed community composition from hydrological influences are not anticipated.

6.5.3 Significance tests for threatened aquatic species and communities

The potential for construction and operation of the proposed activity to have a significant impact to threatened aquatic species, populations and ecological communities has been assessed in accordance with State and Commonwealth significant impact criteria (refer to Attachment B). The assessments determined that the proposed activity is unlikely to have a significant impact on threatened aquatic species, populations or communities. Table 6-7 provides a summary of key considerations and the outcomes of the significance tests.

Table 6-7 Summary of the tests of significance for impacts to threatened and important aquatic species, populations and ecological communities

Common name	Species	Assessment	Determination of significance
Lowland Murray River Aquatic Endangered Ecological Community	—	The proposed construction works would require the removal of small areas of aquatic vegetation and woody debris. However, as they would be reinstated the proposed activity is unlikely to fragment, or impact on the long-term survival of the ecological community in the locality.	The proposed activity is not likely to significantly impact on Lowland Murray River EEC.
Silver Perch	*Bidyanus*	The proposed construction works would require the removal of small areas of aquatic vegetation and woody debris and may disturb overhanging riparian vegetation. Fish passage would not be possible past temporary in-stream work sites during construction, and the upstream cofferdam would create temporary lentic habitat. During operation, there would be improved fish passage past the structures and flow conditions may also be improved.	The proposed activity is not likely to significantly impact on Silver Perch.

Common name	Species	Assessment	Determination of significance
Murray Cod	*Maccullochella peelii*	The proposed construction works would require the removal of small areas of aquatic vegetation and woody debris and may disturb overhanging riparian vegetation. Fish passage would not be possible past temporary in-stream work sites during construction, and the upstream cofferdam would create temporary lentic habitat. During operation, there would be improved fish passage past the structures and flow conditions may also be improved.	The proposed activity is not likely to significantly impact on Murray Cod.
Trout Cod	*Maccullochella macquariensis*	The proposed construction works would require the removal of small areas of aquatic vegetation and woody debris and may disturb overhanging riparian vegetation. Fish passage would not be possible past temporary in-stream work sites during con, and the upstream cofferdam would create temporary lentic habitat. During operation, there would be improved fish passage past the structures and flow conditions may also be improved.	The proposed activity is not likely to significantly impact on Trout Cod.
Murray Crayfish	*Euastacus armatus*	The proposed construction works would require the removal of small areas of aquatic vegetation and woody debris and may disturb overhanging riparian vegetation. Fish passage would not be possible past temporary in-stream work sites during construction, and the upstream cofferdam would create temporary lentic habitat. During operation, there would be improved fish passage past the structures and flow conditions may also be improved.	The proposed activity is not likely to significantly impact on Murray Crayfish.

6.5.4 Safeguards

Measures proposed to avoid, minimise or manage potential aquatic biodiversity impacts as a result of the proposed activity are detailed in Table 6-8.

Table 6-8 Safeguards for aquatic biodiversity impacts

Impact	Safeguard	Responsibility	Timing
Interactions with fauna during construction	A pre-construction survey will be undertaken in areas that will be enclosed by cofferdams.	Contractor	Prior to construction
	A fish screen will be installed on pumps to prevent entrainment of fish into pumps during dewatering.	Contractor	Construction
	The biodiversity management plan will include a procedure for dealing with the presence of native fauna species within the construction footprints during the construction works. The procedure will require construction work at the site of the find to immediately cease and the subject animal allowed to leave the construction footprint without being harassed. Where assistance is required to relocate an animal, the contractor is to notify the Department of Planning and Environment–Water and they will in turn notify NPWS to agree on appropriate mitigation measures (including relocation measures). The contractor will only restart work at the subject site when authorised by the Department of Planning and Environment–Water.	Contractor	Prior to construction

Impact	Safeguard	Responsibility	Timing
Removal of snags, riparian and instream vegetation	Large woody debris, snags and native aquatic vegetation will be relocated (where possible outside the breeding season of spring and summer) from instream work sites (including at cofferdams if required) to suitable locations upstream and/or downstream in consultation with a qualified ecologist, NPWS and WaterNSW. Relocation of these aquatic habitat features from dry in-stream work sites will occur after aquatic fauna salvage and dewatering.	The Department of Planning and Environment–Water, Contractor	Construction
	Rehabilitation of disturbed areas of riparian and instream vegetation will be undertaken as soon as practicable, progressively and in accordance with a site rehabilitation plan prepared as part of the CEMP and in consultation with NPWS and WaterNSW. Where possible, woody debris, snags and native instream vegetation that was removed to make way for instream work sites will be used in the rehabilitation works.	Contractor	Construction
	Rehabilitation of the construction footprints will involve replacing and stabilising topsoil and re-planting native trees and plants.	Contractor	Construction
Sediment build-up in the fishways	Inspections and maintenance of the fishways will be carried out on a regular basis to ensure that fish passage is not obstructed.	WaterNSW	Operation
Ongoing monitoring of fishways and nearby waterways	Existing aquatic species monitoring at Millewa Forest as part of The Living Murray initiative will document impacts/benefits on the aquatic ecosystem due to the replacement and refurbished regulators.	NPWS, in liaison with Arthur Rylah Institute for Environmental Research	Operation

Impact	Safeguard	Responsibility	Timing
Invasive species	An ongoing management response should be adopted to mitigate movement and proliferation of invasive aquatic species in the floodplain environments.	NPWS	Operation

6.5.4.1 Aquatic fauna monitoring

The on-going annual fish community surveys at Millewa Forest led by the Arthur Rylah Institute for Environmental Research as part of The Living Murray program are expected to identify whether predicted operational impacts of the proposed activity on fish are realised. It is recommended that NPWS engage with the Arthur Rylah Institute for Environmental Research to consider whether any changes to the monitoring program are needed as a result of the proposed activity.

In addition to operational aquatic fauna surveys, it is recommended that a spotter / catcher be available on-site during key instream construction works, particularly during dewatering, riparian and instream vegetation clearance, removal of large woody debris and channel bed excavation.

6.5.5 Residual impacts

With implementation of the safeguards and management measures in Table 6-8, aquatic ecosystem values within the construction and operational footprints would be low. Any residual impacts are not expected to significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within assemblages of biota.

6.6 Aboriginal heritage

The *Millewa Forest Supply Project Aboriginal Cultural Heritage Assessment* (Austral Archaeology, 2023) assesses the potential for Aboriginal archaeological material to occur within the construction footprint. The assessment is provided in Attachment C and is summarised below.

6.6.1 Existing environment

6.6.1.1 Landscape context

The works associated with construction of the existing regulators and culvert included large-scale earthworks that have significantly impacted the ground in the immediate vicinity of the infrastructure. The introduction of cattle and sheep to the area from as early as 1843 would have harmed any surface cultural heritage and the introduction of timber cutting to the area from the

1880s may have harmed any culturally modified trees present due to large-scale removal of trees through ringbarking, cutting, and felling.

The geological formation associated with the construction footprints is the alluvial channel deposits - meander plain facies. The classification of the soil that is associated with this geological unit is Vertosols soil.

6.6.1.2 Ethnographic context

The proposed activity is located within the traditional lands of the Yorta and Bangerang Aboriginal groups (Tindale, 1974). The Murray River catchment has an extensive history of human habitation with evidence of human occupation in the Central Murray Valley for at least 15,000 to 9,000 years before present (Macumber and Thorne, 1975).

The Murray River was able to support large populations of Aboriginal people due to the river's permanence and provision of multiple resources. With the large variety of food resources available, human groups could be semi-sedentary along the river in addition to pursuing a hunter gatherer lifestyle that resulted in reliance on seasonally available food resources (Craib, 1991; Atkinson and Berryman, 1983; Greenwood, 2003). Resources along the river included materials that were used for the creation of canoes, nets, stone tools, and other items for the collection and transportation of goods (Atkinson and Berryman, 1983).

For eight to nine months of the year, groups could rely on the resources that the Murray River provided. These resources were collected through a variety of methods including netting, spearing, and trapping with stone weirs along drainage channels. Meat and roots were cooked either on an open fire or in an earthen oven. Over time, repeated use of a location would see the creation of large mounds (Greenwood, 2003).

Before the first explorers arrived in the area, an epidemic of smallpox had already spread throughout the Aboriginal population and caused an estimated 50 per cent decrease in the Aboriginal population about 50 years before the first Europeans arrived in Murray Valley (Atkinson and Berryman, 1983; Curr, 1883). Curr believed that there was an Aboriginal population of about 1200 in the region in 1841. After colonial contact, the Aboriginal population continued to decline and was forcibly relocated to several missions and reserves in Victoria and New South Wales.

6.6.1.3 Previous archaeological work

A previous report on an archaeological survey in the Murray Valley recorded Aboriginal sites at five locations along the northern bank of the Murray River, between Albury and Mildura (Bucan, 1974). Bucan observed that nearly half of the sites located within the survey were oven mounds associated with water sources. Scarred trees were the second most common site recorded.

The NSW National Estate Grants Program 1987/88 (State Forests of NSW): Murray-Murrumbidgee Aboriginal Survey – Lake Victoria and Koondrook State Forests identified six archaeologically sensitive landforms which included floodplains, levees/point bars, ephemeral creeks, lagoons, river margins and sand dunes. The study also provides a description of the types of Aboriginal archaeological sites that are located within the Murray River Valley. Surface artefact scatter, shell middens, fish weirs, oven mounds, scarred trees, pathways (native tracks), burials, ceremonial grounds, natural sacred sites, and contact/historical sites were all identified as sites that are found within the Central Murray region. Dates for the Central Murray have been assessed at multiple locations within the region as being between 13,000 years before present at Kow Swamp and 1,100 years before present at Algabohnyah.

Another report which focused on burials associated with sand dunes on the Riverine Plain found that burial grounds are reported more in the west than in the east of the Riverine Plain, with isolated burial being common in the east (Bonhomme, 1990). Burial locations are dependent on the topography of the area, with sand dunes being locations of 'cemeteries' and artificial mounds being constructed in areas where there are no or few sand dunes. Sand dunes become more favoured as burial sites in the western portion of the Riverine Plain than in the east. Burial grounds in sand dunes will also contain multiple burials with isolated individual burials not being overly common throughout the region.

A report by Littleton (1999) compared burial practices between the Lower Murray, Central Murray, Upper Murray and Lower Darling. The Upper Murray, which is the closest region studied to the proposed activity, had the highest number of sites with 164 sites that contain 739 burials. The Upper Murray had a lower number of burials per site than the Central Murray and Lower Darling.

6.6.1.4 Search of heritage registers

A search of the Heritage NSW Aboriginal Heritage Information Management System (AHIMS) database identified 155 previously recorded sites within a 5-kilometre radius of each of the study areas. Isolated modified trees are the most common site type recorded (35 per cent of all sites). The balance of the sites are a range of earth mounds, resource and gathering sites, hearths, burial sites and artefacts. There is also one ceremony and dreaming site, one potential archaeological deposit and one shell deposit. Many of the sites comprise two or more types of items.

None of the AHIMS sites were located within the construction footprints of the proposed activity. The nearest AHIMS site to the construction footprints is about 300 metres from the construction footprint for the works proposed to Little Edward River offtake regulator.

6.6.1.5 Archaeological survey

Archaeological surveys of the construction footprints were conducted on 6, 16, 17 and 20 June 2022, 22 July 2022 and 14 to 17 March 2023. The surveys were carried out by qualified archaeologists who

were accompanied by registered Aboriginal parties to determine the presence of surface and subsurface heritage items. The archaeological survey identified no Aboriginal cultural heritage and it was determined that there was low archaeological potential based on the significant ground disturbance that occurred for the development of the existing regulators, culvert and bridge over Nestrons Creek.

6.6.1.6 Assessment of significance

The construction and operational footprints are considered to have low aesthetic significance values due to the development of the regulators and culvert. The footprints are also considered to have low potential for any further research value.

The construction footprints are considered to have moderate historic significance values due to their proximity to the Murray River and its association with both tangible and intangible aspects of Aboriginal life, and to hold high educational because they provide a connecting link to the cultural past of Aboriginal stakeholders.

As noted above, the Murray River would have been a highly valuable resource to Aboriginal people and the proposed construction and operational footprints therefore have moderate historic significance values due to their proximity to the river. Historic values refers to associations with particular places in Aboriginal history and includes physical values as well as intangible elements such as memories, stories or experiences.

6.6.2 Impacts

The proposed activity would avoid harm to existing Aboriginal cultural heritage or values during the construction phase due to the heavy modification of the original landscape during previous works within the construction footprints. Accordingly, an Aboriginal heritage impact permit is not required to carry out the construction works.

The replacement and refurbished regulators would be operated in the same way as the existing regulators at most times. If the replacement and refurbished regulators are used to achieve environmental watering outcomes, they would achieve the same outcomes as occur when the site environmental water managers use existing regulators for environmental watering, but are expected to achieve these outcomes more efficiently due to the ease of operation and greater hydraulic capacity of the new structures due to their larger flow areas and, in some cases, lower invert levels. Therefore, the operation of the proposed activity would avoid harm to existing Aboriginal cultural heritage or values and an Aboriginal heritage impact permit is not required to operate the replacement and refurbished regulators

6.6.3 Safeguards

Measures proposed to avoid, minimise or manage potential historic heritage impacts as a result of the proposed activity are detailed in Table 6-9.

Table 6-9 Safeguards for Aboriginal heritage impacts

Impact	Safeguard	Responsibility	Timing
Unexpected finds	Unexpected Aboriginal cultural heritage finds will be managed in accordance with NPWS's Unexpected Finds Protocol – Aboriginal Cultural Heritage, which is provided as an appendix to Attachment C and summarised below. **Aboriginal objects** If an Aboriginal object is discovered during construction, all works in this location must stop and no further harm must occur to the area. The find must be left in place and protected from any further harm. Notify the Department of Planning and Environment–Water Project Manager of the find, who in turn will notify NPWS, WaterNSW's heritage officer, Heritage NSW, and the Environment Line (13 15 55) and arrange for a qualified archaeologist and representatives of the registered Aboriginal parties to inspect the find. If they confirm that the find is an Aboriginal object, the item will be recorded on AHIMS, agreement reached on its management, and an application made for an Aboriginal heritage impact permit. **Aboriginal human/ancestral skeletal remains** If Aboriginal human/ancestral skeletal remains are discovered, all work in the vicinity of the remains must stop. Notify the Department of Planning and Environment–Water Project Manager of the find, who in	Contractor, Department of Planning and Environment–Water	Construction

Impact	Safeguard	Responsibility	Timing
	turn will notify NSW Police if the material is determined to be of human origin and less than 100 years old, or NPWS Aboriginal Partnerships and Heritage Unit, WaterNSW's heritage officer, and Heritage NSW if the remains are believed to be Aboriginal. If in doubt or required by NSW Police, the Department of Planning and Environment–Water will obtain specialist advice from a forensic anthropologist or bioarchaeologist to confirm that the bones are human, their age and whether they are Aboriginal or not. The remains must be left in place and protected from further harm or damage or unauthorised access until further advice states otherwise. If the remains are confirmed to be Aboriginal, the Department of Planning and Environment–Water will notify the RAPs. Aboriginal ancestral remains will be recorded in a culturally appropriate manner in collaboration with Heritage NSW and the registered Aboriginal parties. Work will not recommence at the location until authorised in writing by Heritage NSW if the remains are considered by the NSW Police and Heritage NSW to be Aboriginal.		

6.6.4 Residual impacts

Given there are no previously recorded sites located within the construction footprints, no Aboriginal cultural heritage was identified during archaeological surveys, it is anticipated that impacts to Aboriginal heritage as a result of the proposed activity would be negligible. If unexpected finds occur during the proposed activity, the processes identified in Section 6.6.3 would be implemented.

6.7 Historic heritage

A historical heritage assessment of the proposed activity is provided in Attachment D. The assessment identifies that the existing Pinchgut, Nestrons, Moira and Little Edward offtake regulators and Pigsty culvert have no heritage significance. The details of the assessment are summarised in the following sections.

6.7.1 Existing environment

6.7.1.1 Desktop searches

Relevant statutory and non-statutory heritage registers were searched, and the construction footprints were found to not be included on the World Heritage List, Commonwealth Heritage List, National Heritage List, NSW State Heritage Register, Murray Local Environmental Plan 2011, Murray Development Control Plan 2012 or the Historic Heritage Information Management System.

The construction footprints are within the area of the 'Barmah and Millewa Forests' listing on the Register of the National Estate, which is a non-statutory archive. The register entry for Barmah and Millewa Forests notes that the area contains a rich cultural landscape related to historical activities in the area.

6.7.1.2 Historical context

European settlement of the area surrounding the constructions footprints occurred from the early 1850s, when steamboats began trading along the Murray River. The trade along the Murray supported the establishment and growth of towns along the river and enabled new industries, such as timber-getting, to become more viable (Joss, n.d.; Discover Murray, n.d.).

The quick growth of logging and agriculture in the region lead to the reservation of land under the *Crown Lands Alienation Act of 1861* for water and forestry purposes, which was superseded by the *Lands Acts Amendment Act of 1875*. Where land was reserved for timber, the government was able to sell logging licences to private companies (Joss, n.d.). These licences also came with regulations on the quantity and type of timber that could be harvested, mainly focusing on the harvesting of red gum.

In 1884, with the implementation of the *Crown Lands Act 1884*, the land surrounding the construction footprints was classified as leasehold meaning it was let through leases and could be subject to various forms of 'alienation' (Hanson, 1889). Such alienation started to occur at the construction footprints from 1898 as land was declared as forest reserves or amalgamated into existing forest reserves.

The *Water Rights Act 1896*, transferred the control of waterways and water flow to the crown, which prevented private landholders from constructing dams and weirs without the prior consent of the government and a licence (Austral Archaeology, 2003).

From 1914, modifications started being made to the Murray River and its tributaries as part of the 1914 River Murray Waters Agreement, which sought to ensure that water levels within the river were maintained so that it was navigable while also providing water for irrigation (Mead, 1915). This agreement came about due to the effects of the Federation Drought that lasted from 1895 to 1902, drastically reducing the water levels within the Murray River. As a part of the plan, locks, reservoirs and dams were built the length of the Murray to ensure large quantities of water could be stored in the river system to maintain suitable water levels (Mead, 1915; Murray Darling Basin Authority, 2022). In NSW, this agreement was enforced by the *River Murray Waters Act 1915*, which established the Murray River Commission to oversee the construction and maintenance of infrastructure that was outlined in the Act. In 1987, this agreement was superseded by the first Murray-Darling Basin Agreement.

In 1917, the construction footprints and surrounding areas were proclaimed as part of the Millewa State Forest, which was re-dedicated on 4 April 1919.

In 1938, the Forestry Commission applied to the Water Conservation and Irrigation Commission for multiple works along the Murray River including the construction of embankments either side of Pinchgut creek and the channel connecting Pinchgut Lagoon to the creek (Government Gazette, 16 September 1938).

Austral Archaeology (2003) estimated that Pinchgut and Nestrons regulators were built in the 1950s by the Water Conservation and Irrigation Commission based of their similarities to nearby structures of known construction date e.g. Nine Panel regulator built in 1957. There have been no major upgrades conducted to the regulators since construction.

Moira regulator was installed in 1994 as part of the Lake Moira Hydrological Management Plan (Gippel, 2003). The plan involved the drying of the Moira Lake system for three months in two out of every three years and the flooding of the system during the spring breeding season. This plan was implemented to rejuvenate the natural ecosystem that had been degraded due to hydrological alteration (Gippel, 2003).

Little Edward River offtake regulator was built in the early 21st century and did not replace an earlier structure.

The access track leading to Pigsty culvert first appears in historic aerial images in 1990, and this is assumed to be when the culvert was constructed.

6.7.1.3 Site inspection

An inspection of the construction footprints that were considered to have potential for archaeological value was carried out by archaeologists on 20 June 2022 (Pinchgut regulator), 15 March 2023 (Moira regulator) and 17 March 2023 (Nestrons regulator). The inspection did not identify any evidence of structures other than the existing regulators and culvert.

Based on the historical heritage background research undertaken as part of the investigations for this REF it was determined that the Little Edward River offtake regulator and Pigsty culvert sites had no potential for archaeological value and accordingly were not inspected.

6.7.2 Impacts

The heritage significance of the existing structures and the proposed construction footprints were assessed against the heritage significance criteria in the *NSW Heritage Manual, Assessing Heritage Significance* (NSW Heritage Office, 2001). The structures were found to have no heritage significance. In particular, they are not important to the cultural or natural history of the area, do not have a strong or special association with any community or cultural group, do not embody any aesthetic characteristics, and they have no rare or uncommon features.

As the existing structures and the proposed construction footprints have no identified heritage values, the proposed activity is not expected to have any non-Aboriginal heritage impacts.

6.7.3 Safeguards

Measures proposed to avoid, minimise or manage potential historic heritage impacts as a result of the proposed activity are detailed in Table 6-10.

Table 6-10 Safeguards for non-Aboriginal heritage impacts

Impact	Safeguard	Responsibility	Timing
Unexpected finds	If historical archaeological relics are discovered during construction, all work will cease in the area. The contractor will notify the Department of Planning and Environment–Water Project Manager, who in turn will notify NPWS and the WaterNSW heritage officer. A historical archaeologist will be engaged to assess the item's significance.	Contractor, Department of Planning and Environment–Water	Construction

6.7.4 Residual impacts

There are no listed historical heritage items identified within the construction footprints. Construction and operation of the proposed activity is unlikely to affect any historical heritage item.

6.8 Air quality

6.8.1 Existing environment

Air quality at the construction footprints is characteristic of a bushland environment. The main contributors to air quality in the environment surrounding the proposed activity would include emissions from motor vehicles and machinery used for park operations. Existing air quality would also be impacted during periods of high wind, bushfires, other forms of fires, or dust storm events.

A search of the National Pollutant Inventory in December 2022 did not identify any sources for air polluting substances near the proposed activity.

Sensitive receivers located within one kilometre of the proposed activity include:

- Barmah Lakes camping and picnic ground, which is located in Barmah National Park, on the Victorian side of the Murray River, about 800 metres south-east of Moira regulator
- Kingfisher Cruises, which is located in Barmah National Park, on the Victorian side of the Murray River, about 900 metres south-east of Moira regulator
- A small NPWS campground next to Little Edward River offtake regulator
- Edward River bridge campground, which is located about 500 metres south of Little Edward River offtake regulator.

There are no sensitive receivers located within one kilometre of Pinchgut and Nestrons regulators and Pigsty culvert.

6.8.2 Impacts

6.8.2.1 Construction

Air quality impacts during construction of the proposed activity are expected to be minor. Construction air quality impacts would be limited to localised and temporary indirect impacts from elevated exhaust emissions and dust generation. Dust particles may be generated as a result of a range of activities associated with the proposed activity including:

- Vegetation clearing
- Construction traffic on unsealed roads

- Haulage of spoil
- Stockpiling
- Loading and unloading of material
- Rock and concrete crushing
- Earthworks including stripping topsoil, excavations and placement of fill.

Airborne dust or exhaust emissions from vehicles, plant and equipment can cause nuisance, harm or injury to recreational users, nearby residents and contractor staff if not adequately managed. However, dust generation and exhaust emissions during construction are considered to have only temporary, non-continuous and localised impacts on potential receptors. Given the short duration, small area and relatively minor nature of the proposed construction works, any air quality impacts would be temporary, localised and minor.

The NPWS campground next to Little Edward River offtake regulator would be temporarily closed while construction works are occurring at this site. The nearest sensitive receive to any of the construction works would therefore be at least 500 metres from the construction works, which is sufficiently distant to make it unlikely that any sensitive receivers would experience adverse air quality impacts during the construction phase. Any adverse impacts will be managed through the preparation and implementation of a CEMP and environmental safeguards listed in Table 6-11.

6.8.2.2 Operation

The only air quality impacts during operation of the proposed activity would be emissions from vehicles used to access the replacement and refurbished regulators to carry out operational and maintenance tasks. The operational and maintenance requirements of the replacement and refurbished regulators would be infrequent and minor and no greater than those of the existing regulators. Therefore, operational air quality impacts are expected to be minor and no greater than those associated with the existing regulators.

6.8.3 Safeguards

Measures proposed to avoid, minimise or manage potential air quality impacts as a result of the proposed activity are detailed in Table 6-11.

Table 6-11 Safeguards for air quality impacts

Impact	Safeguard	Responsibility	Timing
Dust generation	Work methods will be modified during high wind conditions if excessive dust is generated.	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
during construction	All vehicles on site will be confined to designated routes.	Contractor	Construction
	Reduce vehicle speeds to minimise dust emissions.	Contractor	Construction
	Visual monitoring for dust will be implemented during the works. Where required, a hose or water cart would be used to regularly wet down haulage access tracks, work sites and laydown areas.	Contractor	Construction
Vehicle emissions	Trips and trip distances will be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.	Contractor	Construction
	Minimise engine idling and ensure vehicle engines are switched off when stationary or parked within ancillary facilities or construction zones.	Contractor	Construction

6.8.4 Residual impacts

The proposed activity has the potential to cause only minor air quality impacts, and the likelihood of any impacts to air quality would be reduced with implementation of the safeguards identified in Table 6-11. The nearest sensitive receivers are about 500 metres from the proposed activity and are unlikely to be adversely affected by adverse air quality.

6.9 Noise and vibration

6.9.1 Existing environment

The acoustic environment of the proposed activity is characterised by the ambient environmental noise of Millewa Forest. Ambient noise levels would be generally consistent with typical day/night patterns in a remote and isolated noise environment. Anthropogenic sources of noise are infrequent and mainly restricted to those vehicles and machinery engaged in park operations and vehicles of recreational visitors.

Noise-sensitive receivers within a five-kilometre radius of the proposed activity include:

- The Timbercutter Redgum Cafe Bar, which is about 3.9 kilometres west of Nestron regulator
- Picnic Point caravan park, which is about 4.2 kilometres west of Nestrons regulator
- Murraybank caravan park, which is about 5 kilometres west of Nestrons regulator
- Barmah Lakes camping and picnic ground, which is located in Barmah National Park, on the Victorian side of the Murray River, about 800 metres south-east of Moira regulator
- Kingfisher Cruises, which is located in Barmah National Park, on the Victorian side of the Murray River, about 900 metres south-east of Moira regulator
- Dharnya cultural centre, which includes a visitors' centre, bunkhouse, kitchen and mess hall and caretaker's residence, located about 1.9 kilometres south-east of Moira regulator
- Homesteads on agricultural properties on Moira Lakes Road, the nearest of which is about 1.4 kilometres south-east of Moira regulator
- Moira Station on the Cobb Highway, a function centre that includes accommodation, about 5 kilometres north-east of Moira regulator
- A small NPWS campground next to Little Edward River offtake regulator
- Edward River bridge campground, which is located about 500 metres south of Little Edward River offtake regulator
- Murray River campgrounds, which is located about 3.3 kilometres east of Little Edward River offtake regulator
- Dwelling and tourist accommodation in Mathoura, the nearest of which is about 4.6 kilometres east of Little Edward River offtake
- Homesteads on agricultural properties along the Cobb Highway, the nearest of which is about 4.3 kilometres east of Pigsty culvert.

6.9.2 Impacts

6.9.2.1 Construction

Sources of noise and vibration during construction of the proposed activity would include:

- Plant and equipment generating intermittent noise and vibration e.g. excavators, compressors, trucks etc
- Key construction activities including demolition works and earthworks
- Traffic noise associated with the movement of construction vehicles to and from the work sites.

Noise and vibration impacts from these activities would be localised, temporary, non-continuous, only experienced for short periods, and in-line with the *Draft Construction Noise Guidelines 2020*

(Environment Protection Authority, 2020). No sensitive receivers are expected to be adversely impacted by construction noise due to the distance of the works from sensitive receivers. The combination of the flat topography of the area and large tracts of bushland separating the works from the nearest sensitive receivers would also minimise the potential for noise impacts to the nearest sensitive receivers.

Given the short duration, small area and relatively minor nature of the proposed construction works, any noise and vibration impacts would be temporary, localised and minor. Any adverse impacts will be managed through the preparation and implementation of a CEMP and the environmental safeguards listed in Table 6-12.

6.9.2.2 Operation

Noise and vibration generated during operation of the proposed activity would primarily be traffic noise from vehicles used to access the replacement and refurbished regulators to carry out infrequent operational and maintenance tasks. There may be occasional ad-hoc noise and vibration from carrying out operational and maintenance tasks, mostly associated with the use of hand tools. The operational and maintenance requirements of the replacement and refurbished regulators would be no greater than those of the existing regulators and, therefore, operational noise and vibration impacts are expected to be low and no greater than those associated with the existing regulators.

6.9.3 Safeguards

Measures proposed to avoid, minimise or manage potential noise and vibration impacts as a result of the proposed activity are detailed in Table 6-12.

Table 6-12 Safeguards for noise and vibration impacts

Impact	Safeguard	Responsibility	Timing
Construction noise and vibration	Inform the local community of the potential impact of increased heavy vehicle traffic during the construction phase, including potential noise impacts.	Department of Planning and Environment–Water	Construction

Impact	Safeguard	Responsibility	Timing
	Unless otherwise approved by the Department of Planning and Environment–Water through an out of hours application process, construction hours will be limited to: • Monday to Friday: 7 am to 6 pm • Saturday: 8 am to 5 pm • No construction work on Sundays or public holidays.	Contractor	Construction
	All site personnel will be made aware of noise issues and mitigation measures through induction processes.	Contractor	Construction
	All machinery will be well maintained and in good working order. All vehicles and equipment will be fitted with silencing devices, where applicable.	Contractor	Construction

6.9.4 Residual impacts

The proposed activity has the potential to cause only minor noise and vibration impacts, and the likelihood of any impacts would be reduced with implementation of the safeguards identified in Table 6-12. The nearest sensitive receivers to the proposed activity are at least 500 metres away and are unlikely to be impacted by noise and vibration.

6.10 Traffic and access

6.10.1 Existing environment

The main access to Murray Valley National Park and Regional Park is from the Cobb Highway. The highway starts at Echuca and proceeds north through Moama, Mathoura and Deniliquin and continues on to connect with the Barrier Highway near Wilcannia. The Cobb Highway passes along the western boundary of Murray Valley National Park and Regional Park. The Cobb Highway passes along the western boundary of Murray Valley National Park and Regional Park. Access between the highway and the parks is provided via Jones Street in Mathoura.

The most recent traffic volume data available on Transport for NSW's Traffic Volume Viewer for the Cobb Highway in the vicinity of Mathoura is from 2012. Traffic was counted about 770 metres east of the intersection with Nine Mile Road. Average daily traffic of 1,888 vehicles in both directions was recorded, of which 83 per cent of vehicles were light vehicles and 17 per cent as heavy vehicles.

The main entrance into Murray Valley National Park and Regional Park from the Cobb Highway is at Jones Street in Mathoura, which connects to Picnic Point Road. Picnic Point Road is a sealed road. It intersects with Millewa Road, an unsealed road that proceeds through the park in an easterly direction to connect with agricultural land at Bullatale on the northern boundary of the park.

There are several other unsealed roads into the park from the Cobb Highway which can provide more direct access to sites in the northern and southern areas of the park.

The road network within Murray Valley National Park and Regional Park is infrequently travelled, particularly outside the peak summer holiday period. Key roads within the park that are relevant to the proposed activity include:

- Millewa Road (described above)
- Millewa River Road, which starts at Millewa Road and heads south to the Murray River and proceeds along the northern side of the river for several kilometres before diverting north and connecting to agricultural land on the northern boundary of the park. Millewa River Road provides access to Pinchgut and Nestrons regulators
- Little Edward Road, which starts at Millewa Road just west of the Edward River bridge and proceeds in a northerly direction along the western side of the Edward River initially before turning westward and connecting with Melville Road. Little Edward Road provides access to Little Edward River offtake regulator
- Edward River Road, which starts at Millewa Road just east of the Edward River bridge and proceeds in a northerly direction initially along the eastern side of the Edward River and then continuing in a northerly direction and connecting with Tuppal Road and Dudley Road
- Tuppal Road, which starts at the intersection of Edward River Road and Dudley Road and proceeds in a northerly direction along the eastern side of the Edward River before turning east and connecting with agricultural land in Bullatale. Tuppal Road provides access to Pigsty culvert
- Poverty Point Road, which connects the Cobb Highway to the southern part of the park. Poverty Point Road connects to Porters Creek Road, which proceeds in a south-easterly direction to the Murray River, where it connects with Narrows Road
- Narrows Road, which starts at Porters Creek Road and proceeds along the western side of the Murray River for several kilometres before ending at Moira Creek. Narrows Road provides access to the eastern side of Moira regulator

- An unnamed access track along the northern side of Moira cutting that extends eastward from Dora Road. This access track provides access to the western side of Moira regulator.

6.10.2 Impacts

6.10.2.1 Construction

Construction would generate heavy vehicle movements associated with the transportation of construction machinery and equipment to and from the site, the delivery of materials to the site, and the removal of demolition and construction waste and surplus materials from the site. This would include 12.5-metre semi-trailer trucks, concrete agitator and pumping trucks, Franna cranes and various smaller trucks. Construction plant that would need to be floated to the work sites includes a 20 to 25-tonne excavator for use at each work site, and a crawler crane, for use at Moira regulator (refer to Section 3.3).

The construction access routes to the work sites have been selected in consultation with NPWS. All of the work sites would be accessed from the Cobb Highway and then via the following routes:

- Pinchgut and Nestrons regulators would be accessed from Jones Street and then Picnic Point Road, Millewa Road and Millewa River Road
- Moira regulator would be accessed from Coolamon Road and then Dora Road and the unnamed access track that follows the northern side of Moira channel to reach the western side of Moira regulator. If access is required to the eastern side of the regulator, it would be via Poverty Point Road and then Porters Creek Road and Narrows Road
- Little Edward River offtake regulator would be accessed from Jones Street and then Picnic Point Road, Millewa Road and Little Edward Road
- Pigsty Culvert would be accessed from Jones Street and then Picnic Point Road, Millewa Road, Edward River Road and Tuppal Road.

These construction access routes have been inspected by the Department of Planning and Environment–Water and selected due to their suitability for the expected types, sizes and number of construction vehicles. Factors considered in the route selections included the adequacy of sight lines for turning onto and off the Cobb Highway, road surface conditions, road widths and total distance.

Construction vehicles would cause a negligible increase in heavy vehicle traffic on the Cobb Highway. No upgrade or maintenance of Transport for NSW or council-owned roads would be required.

Maintenance work is proposed for the unsealed access tracks within Murray Valley National Park and Regional Park that are proposed to be used as construction access routes. The proposed access track maintenance work is the subject of separate environmental assessments.

The replacement Nestrons regulator would be built at the site of an existing timber bridge that carries Millewa River Road over Nestrons Creek. The top of the culverts that comprise the replacement regulator would be trafficable, enabling vehicles travelling along Millewa River Road to drive over the regulator to cross Nestron Creek. The existing bridge would be removed. Millewa River Road would need to be temporarily closed during removal of the existing bridge and construction of the replacement regulator. A detour would be established via Fishermans Bend Road and Millewa Road. The works are proposed to occur outside the peak summer holiday period, which would minimise the number of users of Millewa River Road inconvenienced by its temporary closure and the need to use the detour. The staging and timing of the proposed activity would be developed in coordination with NPWS field staff to minimise disruptions to park operations. The detour would not prevent access to any private property.

Construction vehicles would park within the construction footprint at each site, or along the access tracks that pass each site. It is estimated that construction vehicle movements at each work site would peak at about 10 heavy vehicle and 20 light vehicle return trips to and from each work site per day. The maximum daily heavy vehicle movements at each work site is considered likely to occur during the demolition works and earthworks associated with haulage of spoil and clean fill material. The contractor will produce a construction traffic management plan to describe how management of vehicle movements will occur during construction. The plan will be developed in consultation with NPWS and where required, Murray River Council.

All access tracks proposed to be used during construction have the capacity to accommodate these vehicle movements, with the additional vehicles passing through the surrounding road network considered likely to have a negligible impact on the performance of the road network.

The proposed activity would also require delivery of oversized pieces of equipment and materials, such as prefabricated environmental regulator gates and precast box culverts. It is estimated that oversized deliveries would involve a maximum of about five heavy vehicle movements to each of the four regulator work sites associated with mobilisation and demobilisation of an excavator at each site and a crawler crane at Moira regulator, and delivery of prefabricated elements of the replacement regulators and fishways. The timing and route of these deliveries would be undertaken in consultation with NPWS and in line with the construction traffic management plan to be developed by the contractor.

The proposed activity would not impede access to Moira cutting or assets operated by MPID and would not impact maritime activities or boating access.

6.10.2.2 Operation

There would be no potential traffic and access impacts associated with operation of the proposed activity. Access to the replacement and refurbished regulators for operation and maintenance would be the same as the existing regulators.

6.10.3 Safeguards

Measures proposed to avoid, minimise or manage potential traffic and access impacts as a result of the proposed activity are detailed in Table 6-13.

Table 6-13 Safeguards for traffic and access impacts

Impact	Safeguard	Responsibility	Timing
Construction traffic	A construction traffic management plan will be prepared as part of the CEMP. The plan will include: • A driver code of conduct • Confirmation of haulage routes and access locations • Measures to maintain access and capacity to existing roads where possible • Traffic control measures including signage at appropriate locations to notify road users of increased traffic volumes and construction vehicles • Management of oversized vehicles • A response plan for any construction-related traffic incidents.	Contractor	Construction
	Consultation with NPWS and Murray River Council will be undertaken to minimise the impacts to the surrounding road network during construction including temporary access tracks or road closures. Any agreed traffic management measures will be incorporated into the construction traffic management plan.	Contractor	Construction

6.10.4 Residual impacts

During the construction phase, there would be localised and short-term increases in traffic on the surrounding road network from construction vehicles.

Temporary closure of Millewa River Road would be required during removal of the existing bridge over Nestrons Creek and construction of the replacement Nestrons regulator. A detour would be provided via existing access tracks.

The traffic and access impacts during construction of the proposed activity are considered negligible due to the remote location of the work sites, small number of construction vehicles required, small number of vehicles required to follow the detour during the Nestrons regulator works, and the safeguards detailed in Table 6-13.

The operation of the proposed activity would not result in any change to the traffic and access impacts to those associated with operation of the existing regulators.

6.11 Visual

6.11.1 Existing environment

The existing visual amenity at the construction footprints is typical of a natural floodplain and bushland environment. The existing structures where works are proposed have varying visibility to users of the park:

- The existing Nestrons regulator is within sight of Millewa River Road, however its small size and the presence of large trees either side of it means many users of the road would not notice the structure
- Pinchgut regulator is not visible from Millewa River Road. It can only be seen from the track that leads to the structure from Millewa River Road
- Moira regulator is not within sight of any passing traffic or sensitive receivers
- Little Edward River offtake regulator is visible to users of the NPWS campground that adjoins this structure. It is not within sight of any passing traffic
- Pigsty culvert is not within sight of any passing traffic.

6.11.2 Impacts

6.11.2.1 Construction

There would be negligible public visibility of the construction work sites during the construction phase because Millewa River Road would be temporarily closed to through traffic at Nestrons

regulator and the NPWS campground adjacent to Little Edward River offtake regulator would be temporarily closed. The other construction work sites are not visible from the nearest through road.

Construction traffic travelling through Murray Valley National Park would be seen by recreational users of the park. This would be minor and short-term impact that would have a negligible impact on their use of the park.

6.11.2.2 Operation

The proposed activity would result in some minor visual impacts to users of the park:

- The top of the replacement Nestrons regulator would be trafficable and would carry Millewa River Road over Nestron Creek, which would limit views of the new infrastructure for users of the road to the top of the structure. The absence of mature vegetation within the construction footprint would make this area distinguishable from the surrounding vegetation until the site rehabilitation plantings become established. In time the appearance of the area would become similar to the surrounding forest
- The replacement Pinchgut regulator would be located near to the existing regulator and would not be visible from Millewa River Road. The only people who would see the regulator are those who travel to the end of the access track that leads to the regulator, which is likely to mostly be personnel to operate and maintain the regulator. The absence of mature vegetation within the construction footprint would make the area immediately surrounding the replacement regulator distinguishable from the surrounding vegetation until the site rehabilitation plantings become established. In time the appearance of the area would become similar to the surrounding forest
- The refurbished or replaced Moira regulator would only be visible to people who travel to the ends of the access tracks that lead to the regulator, which is likely to mostly be personnel to operate and maintain the regulator. The absence of mature vegetation within the construction footprint would make the area immediately surrounding the replacement regulator distinguishable from the surrounding vegetation until the site rehabilitation plantings become established. In time the appearance of the area would become similar to the surrounding forest
- The refurbished Little Edward River offtake regulator would be visible to users of the adjoining NPWS campground. The refurbished regulator would be more visually intrusive than the existing regulator because of the additional infrastructure associated with the fishway and the longer walkway on the eastern side of the structure. The refurbished regulator would also be easier to see due to the vegetation removed around the structure to enable the construction works and the time required for the site rehabilitation plantings to become established. Despite these changes, the forest would continue to dominate views from the campground and the overall impact to the visual landscape would be minimal

- The section of Pigsty Creek where the culvert was removed would only be visible to people who travel to the ends of the access tracks that lead to this location. Few people are expected to visit this location as there would be nothing of note there. The recut section of creek bank where the culvert was located would be shaped to align with the upstream and downstream creek banks and as vegetation establishes on the newly cut bank it should blend in seamlessly. The absence of mature vegetation within the construction footprint would make the area immediately surrounding the new section of creek bank distinguishable from the surrounding vegetation until the site rehabilitation plantings become established. In time the appearance of the area would become similar to the surrounding forest.

Due to the small footprint of the works and the dominance of existing trees at each site, the overall visual impact of the proposed activity would be negligible. If any users of the park were walking near the replacement and refurbished regulators they would observe structures similar in appearance to those found elsewhere in the park.

6.11.3 Safeguards

Measures proposed to avoid, minimise or manage potential visual impacts as a result of the proposed activity are detailed in Table 6-14.

Table 6-14 Safeguards for visual amenity impacts

Impact	Safeguard	Responsibility	Timing
Visibility of construction works	During construction, all equipment, materials and temporary facilities, such as site offices and portable toilets, will be located within the designated construction footprints for the works.	Contractor	Construction
	The construction work sites will be clearly demarcated and maintained in an orderly manner.	Contractor	Construction
	All construction equipment will be removed from the park as soon as it is not required, including any material and refuse related to the works.	Contractor	Construction
Revegetation	A site rehabilitation plan will be prepared as part of the CEMP. The site rehabilitation plan will detail how the work sites will be	Department of Planning and	Construction

Impact	Safeguard	Responsibility	Timing
	stabilised and revegetated once the new infrastructure is built. A draft site rehabilitation plan will be provided to NPWS and WaterNSW for comment and any comments provided will be addressed in the final version of the plan. Rehabilitation of the construction footprints including revegetation will be carried out as soon as practicable.	Environment– Water, Contractor	

6.11.4 Residual impacts

Given the remote location, small scale of the proposed activity and safeguards detailed in Table 6-14, the proposed activity is considered to have a negligible impact on visual amenity or landscape character at Millewa Forest during both construction and operation.

6.12 Hazard

6.12.1 Existing environment

6.12.1.1 Bushfire risk

The proposed activity is located on land which has been classed as a designated bush fire prone area. The vegetation category for the construction footprints is Vegetation Category 1 which is considered to be the highest risk for bush fire. This vegetation category has the highest combustibility and likelihood of forming fully developed fires including heavy ember production.

As discussed in Section 4.2.2, the proposed activity is located in the Mid Murray Zone Bush Fire Management Committee area. The bush fire risk management plan prepared by the committee in 2009 identifies the bush fire season for the area as running from October -November to March-April. Fire weather conditions for the area are described as being usually associated with winds from the west around to the north accompanied by high daytime temperatures and low relative humidity. Dry lightning storms occur frequently during the bush fire season and often start forest and grass fires. The area has on average 250 bush/grass fires per year, of which six to 10 on average can be considered to be major fires. The main sources of ignition in the area are lightning strikes, unattended camp fires, power lines, machinery and traffic, escaped agricultural burns and the use of cutting and welding equipment. Potential major risk seasons follow significant periods of high

growth from high winter rainfall which allow the build-up of fine fuels and create the potential for a major fire season across the whole of the Mid-Murray Zone when this material cures (Mid Murray Zone Bush Fire Management Committee, 2009).

NPWS adopts a strategic approach to managing fires in parks and reserves including research, planning, hazard reduction, rapid response firefighting crews and community alerts. NPWS, in consultation with the community and other organisations, develop fire management strategies outlining plans of action for use in the event of a fire. The plans cover the protection and conservation of wildlife and property and extend across all NSW national parks. The type of strategy developed for each park varies according to the complexity of the park's fire management issues.

The NPWS fire management strategy relevant to the proposed activity is the *Murray Valley National and Regional Parks (Millewa, Moira and Gulpa Islands Precincts) Fire Management Strategy* (NPWS, 2012). The strategy identifies two types of fire trail category: essential (category 1) and important (category 2). Of relevance to the proposed activity is that Millewa River Road, Poverty Point Road, Porters Creek Road, Narrows Road, Little Edwards Road, Edward River Road and Tuppal Road are all essential fire trails. The strategy defines fire thresholds for vegetation communities to conserve biodiversity. Fire thresholds are assigned with consideration of fire history including the time since areas of the park were last burnt and the recent frequency of burning. The strategy recognises four fire management zones at the park, with most of the park including all of the proposed activity sites being land management zones. The objectives of this zone are to conserve biodiversity and protect cultural and historic heritage and to manage fire consistent with the applicable fire thresholds.

6.12.1.2 Flooding

The proposed activity is within the flood planning area identified in the Murray Local Environmental Plan 2011. Section 4.1.5.1 outlines the provisions of the plan in relation to development within the flood planning area.

6.12.1.3 Safety and security

Pinchgut, Nestrons and Moira regulators and Pigsty culvert are old, dilapidated, in poor repair, and fail to meet contemporary safety standards. Some elements of Little Edward River offtake regulator also do not meet contemporary safety standards.

6.12.2 Impacts

6.12.2.1 Construction

Bushfire risk

Construction activities for the proposed activity would pose an increased risk of bush fire due to the potential for sparks from machinery (i.e. jack hammers, rock saws, and angle grinders), vehicles (i.e. vehicle exhaust systems when traversing over dry vegetation) and hot works if not appropriately managed. There is also the potential for increased bushfire risk should waste vegetation from vegetation clearing and pruning be left in-situ and/or stockpiled onsite. Fuel leaks and spills from plant and equipment and temporary storages of small quantities of flammable materials, such as fuel, could also provide a fuel source for bush fires or cause a bush fire if ignited.

Flooding

Construction of the proposed activity would be scheduled when there are low flows in the Murray River and Edward River and there would be no or minimal flow in Nestrons Creek, Pinchgut Creek, Moira Creek, Little Edward River and Pigsty Creek. Temporary cofferdams would be used to create dry in-stream work sites. Therefore, there is low potential for flooding of the work sites. If a flood event were to occur during the construction phase that is sufficiently large to overtop the cofferdams it is expected that the readily available information on flows in the Murray River upstream of the work sites would provide ample time to move plant and equipment to higher ground and clear the work sites so as to minimise the damage that inundation of the site could cause. The construction works would have a negligible impact on local flood patterns.

Safety and security

The contractor would be responsible for the safety of their staff and subcontractors working at the construction sites and any visitors to the sites. The contractor would require all people attending the sites to complete a safety induction that informs them of the safety procedures being implemented during the construction works.

6.12.2.2 Operation

Bushfire risk

The operation of the proposed activity would have no impact to bushfire risk and would not increase the occurrence of bushfires or threat to life in an emergency bushfire event.

Flooding

As discussed in Section 3.6, the replacement and refurbished regulators would be available for the site environmental water managers to use for environmental watering of Millewa Forest.

Environmental watering of the forest would occur in accordance with the same management plans that are currently being implemented and, therefore, the inundation area would be the same.

Safety and security

Safety in design workshops have incorporated safety considerations into the design of the replacement and refurbished regulators for the benefit of members of the public and the WaterNSW and site environmental water manager's personnel who would operate and maintain the structures. The replacement and refurbished regulators have been designed in accordance with contemporary health and safety standards and would be easier and more efficient to operate than the existing regulators.

6.12.3 Safeguards

The proposed construction works are unlikely to occur during summer as this is when the Murray River is typically operated at high flow to deliver water to downstream irrigators. This would decrease the bush fire risks associated with the construction works, because the critical wildfire season generally occurs from October/November to March/April. The risk is further reduced given the proposed activity would take place where existing infrastructure is already present and vegetation would be cleared from the construction footprints to enable the construction works to occur.

The bush fire hazard associated with construction of the proposed activity would be managed through equipment selection, appropriate access arrangements, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed in the *Murray Valley National and Regional Parks (Millewa, Moira and Gulpa Islands Precincts) Fire Management Strategy*. As per NPWS policy, the park may be closed to the public during periods of extreme fire danger, wildfire suppression operations or prescribed burning operations, and this closure would extend to the contractor.

Measures proposed to avoid, minimise or manage potential hazard impacts as a result of the proposed activity are detailed in Table 6-15.

Table 6-15 Safeguards for hazards

Impact	Safeguard	Responsibility	Timing
Bushfire risk during construction	The following controls will be implemented to mitigate potential for fires and increased bush fire risk during construction: • No stockpiling or burning of waste vegetation to occur onsite	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
	• Daily weather checks will be undertaken during the pre-start meeting to note for potential fire danger • Any notices erected, displayed or issued by NPWS regulating the use of fire in the park will be complied with • Hot works and machinery which may result in sparking or ignition must not be used on a Total Fire Ban Day without an exemption from the NSW Rural Fire Service • Fuel and other similar flammable materials, such as gas cylinders and paint, will be stored in appropriate fire-resistant storage containers • Appropriate firefighting equipment (e.g., water pump, extinguisher and hand tools) should be available on site along with trained staff • Stationary plant will be parked in cleared areas • No smoking on site in accordance with section 19 of the NPW Regulation.		
	All works will be undertaken in accordance with the operational guidelines under the *Murray Valley National and Regional Parks (Millewa, Moira and Gulpa Islands Precincts) Fire Management Strategy* which includes provisions pertaining to operation of earthmoving equipment and visitor management.	Contractor	Construction
Emergency response	Emergency contacts and response procedures will form part of the CEMP and site inductions.	Contractor	Construction

6.12.4 Residual impacts

Carrying out the construction works outside the critical wildfire season and implementing the safeguards and mitigation measures in Table 6-15 would result in the proposed activity having minimal bushfire risk during the construction phase. The operation of the proposed activity has negligible bushfire risk.

Carrying out the construction works when there is low flow in the Murray River would minimise the potential flooding of the work sites. The operation of the replacement and refurbished regulators would occur in accordance with the same management plans that are currently being implemented and, therefore, the inundation area would be the same.

The proposed activity would provide replacement and refurbished regulators that are safer and easier to operate than the existing regulators.

6.13 Socio-economic

6.13.1 Existing environment

The proposed activity is located within the Murray River Council local government area. As per the 2021 census, 5,834 people were reported as being in the local government area's labour force. Of these, 55.8 per cent were employed full time, 33.5 per cent were employed part-time and 3.1 per cent were unemployed. The most common occupations included managers (22.2 per cent), professionals (14.4 per cent), technicians and trade workers (13.6 per cent) and labourers (12.6 per cent). The population of the surrounding area is sparse, with few towns in the region. The nearest towns within the region include Mathoura with a population of 1,002 people and Tocumwal with a population of 2,862 people.

The Yorta Nation and Bangerang Nation are the traditional custodians of Millewa Forest. Barmah-Millewa Forest has been the heartland of both nations for over 60,000 years providing a rich abundance of food, medicinal and cultural resources and their ongoing connection to the landscape is evident in creation stories and traditional ecological knowledge. The Yorta land use and occupancy map demonstrates an ongoing connection to the forest, with known occupancy and harvest sites for plant, wood, earth, invertebrates, fish, reptile, bird and mammal resources (Murray-Darling Basin Authority, 2012).

Barmah-Millewa Forest is a popular destination for recreation and tourism, with most visitors attracted to the rivers and their surroundings. Barmah-Millewa Forest receives about 100,000 visitor days per year (Abel and O'Connell, 2006). Rivers and lakes are important for boating and fishing, bait collection, picnicking, and canoeing. Scenic driving, 4WD driving, trail bike riding, cycling,

bushwalking, orienteering and camping are other popular recreational uses of the forest (Abel and O'Connell, 2006). The strong interest for nature studies, including activities such as birdwatching, highlights the abundance of wildlife in the area and the importance of the environment for recreational users of the forest.

6.13.2 Impacts

6.13.2.1 Business, employment and social infrastructure

Construction of the proposed activity would provide temporary benefits to local and regional businesses, particularly in industries that provide goods and services to support construction activities. Businesses in hospitality, accommodation and trades at Moama, Mathoura and Deniliquin and other local towns in the region are the most likely to benefit.

Local businesses could also see a short-term benefit with increased revenue from sourcing of local supplies and construction workforce spending. Although local procurement will be prioritised where possible, it is likely that some of the workforce would need to be sourced from outside the local region, due to the technical requirements of the proposed activity and the limited availability of local workers with the necessary skills and experience. This non-resident workforce would contribute to increased spending locally during construction.

Construction of the proposed activity is not expected to negatively impact or significantly increase demand on social infrastructure, health services or accommodation in the region due to the low numbers of workers required and relatively short duration. No impact to irrigation water deliveries via the Murray And Edward Rivers are expected to occur during the construction phase.

6.13.2.2 Recreational users

The proposed activity is unlikely to significantly affect local tourism or recreational usage within the area. Local amenity impacts from construction noise and dust are unlikely to impact park visitors due to the temporary closure of Millewa River Road at Nestrons regulator, the temporary closure of the NPWS campground adjoining Little Edward River offtake regulator, the location of Pinchgut and Moira regulators and Pigsty culvert from the main access tracks in the park, and the distance of all of the proposed work sites from key destinations within the park and organised recreational activity locations.

Key stakeholders including NPWS, park visitors and commercial operators within the park would be notified in advance of construction commencing and would be updated on the progress of the works during the construction phase so impacts can be avoided where possible.

6.13.3 Safeguards

Ongoing consultation will be carried out with key stakeholders regarding the timing of works and notification to any temporarily disrupted users such as park visitors and commercial operators.

A safeguard is proposed in Table 6-16 to avoid any unforeseen impacts to irrigation flows in the Murray and Edward Rivers during the construction phase.

Table 6-16 Safeguards for socio-economic impacts

Impact	Safeguard	Responsibility	Timing
Irrigation flows in the Murray and Edward Rivers	The construction soil and water management plan will include contingency measures in the event of the construction works being carried out during the irrigation season when irrigation water deliveries are being made via the Murray and Edward Rivers.	Contractor	Construction

6.13.4 Residual impacts

Construction of the proposed activity would likely provide temporary benefits to local and regional businesses, including businesses that provide hospitality, accommodation, trades, and goods and services to support construction. The proposed activity is unlikely to significantly affect local tourism or recreational usage within the area given it is located in a remote area of Millewa Forest that is infrequently accessed by the public.

Operation of the proposed activity would have no adverse socio-economic impacts.

6.14 Natural resources

6.14.1 Existing environment

The existing Pinchgut, Nestrons, Moira and Little Edward River offtake regulators are manually operated and do not consume any energy. As discussed in Sections 2.3 and 6.5.1, fish are unable to pass these and other regulators in Millewa Forest when their gates are closed, which can lead to native fish becoming stranded in the forest when high flows recede and at the end of environmental watering events.

The age and condition of environmental regulators at Millewa Forest can limit the site environmental water managers choice of regulators, resulting in inefficient environmental watering of the forest.

As discussed in Section 2.1, an objective of the proposed activity is to enable smarter use of available environmental water.

6.14.2 Impacts

6.14.2.1 Construction

The proposed construction works would necessarily consume energy including embodied energy in the prefabricated and cast in-situ components of the replacement and refurbished regulators, transportation of materials, equipment and personnel to and from the work sites, and fuel used to power plant, equipment and vehicles engaged in the construction works.

The construction works would also require water for a range of activities including dust suppression, washdown, and in-situ concreting. The contractor would be responsible for deciding where they would source water from and obtaining an approval under section 89 of the WM Act if required (refer to Section 4.2.4 and Table 4-2).

Energy and water used during construction would be minor compared to other infrastructure projects due to the short duration and relatively small scale of the proposed works.

6.14.2.2 Operation

Like the existing regulators, the replacement and refurbished regulators would be manually operated and would not consume any energy.

The operation of the proposed activity would enhance conservation at the park by enabling native fish to pass the replacement and refurbished regulators at times when the existing regulators block fish passage. This would reduce the instances of native fish becoming stranded within Millewa Forest and unable to return to the Murray River or Edward River when high flows recede and at the end of environmental watering events.

The proposed activity would also enhance conservation and water efficiency by providing the site environmental water managers with structures that are easier and more efficient to operate than the existing structures. This is expected to reduce the amount of water required to carry out planned environmental watering of the forest.

6.14.3 Safeguards

No specific natural resources safeguards are proposed due to the relatively minor use of natural resources during the construction phase and the expected water savings the proposed activity would deliver by improving the efficiency of environmental watering of the forest.

6.14.4 Residual impacts

The proposed activity is expected to deliver natural resources benefits through the provision of fish passage past Pinchgut, Nestrons, Moira and Little Edward River offtake regulator, and more efficient environmental watering of Millewa Forest.

6.15 Waste, contamination and hazardous materials

6.15.1 Existing environment

A review of the Environment Protection Authority's contaminated land record of notices under section 58 of the *Contaminated Land Management Act 1997* and the list of NSW contaminated sites notified to the Environment Protection Authority under section 60 of the Act did not reveal any registered contaminated land sites within the proposed activity area.

A review of premises currently regulated by an environment protection licence under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not identify any such premises within the proposed activity area. Pursuant to section 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021 there is no apparent reason to consider that the land proposed to be developed would be contaminated and, as such, no further contamination investigation is required. A search of the National Pollutant Inventory for the 2021/2022 reporting period did not identify any sources for air polluting substances near the proposed activity.

6.15.2 Impacts

6.15.2.1 Construction

Waste and hazardous materials

The construction of the proposed activity would generate spoil from earthworks, demolition waste from the removal of existing infrastructure, and construction waste from the regulator replacement and refurbishment works. General waste would also be generated by construction personnel. Waste streams would include:

- Green waste from cleared vegetation
- Concrete, timber, metal and rock riprap materials from removal of the existing structure
- Excess spoil material from excavation to accommodate the replacement and refurbished regulators and the fill material surrounding Pigsty culvert
- Oil, grease, and other liquid waste from the maintenance of construction plant and equipment

- Dried surplus concrete and minor quantities of other surplus construction materials such as scrap metal, paints, glues and other incidental chemicals used in construction
- Minor quantities of general wastes and sewage from ancillary facilities.

Contamination

As the construction activities are proposed within waterways there is the potential for contamination impacts to sensitive aquatic environments. However, the works are proposed to occur when there are low flows in the Murray River and no or minimal flow in the creeks where the works would occur. Cofferdams would be installed to isolate the works from upstream and downstream environments, which would minimise the risk of contamination or sedimentation impacts to downstream waterways.

Localised contamination from accidental spills or leaks of fuels, oils and chemicals (such as hydraulic oils) from construction plant and vehicles during construction is considered unlikely but possible and the risk would be managed with suitable safeguards. Minimal quantities of fuel would be stored at the construction sites, with all refuelling activities to occur in a designated area at least 20 metres away from waterways.

6.15.2.2 Operation

Operation and maintenance of the replacement and refurbished regulators would generate negligible quantities of waste and is anticipated to pose a low contamination risk.

6.15.3 Safeguards

Waste management for the proposed activity would be based on the waste management hierarchy established by the objectives of the *Waste Avoidance and Resource Recovery Act 2001*. This includes reducing the amount of waste produced as much as possible, maximising waste reuse, and disposing waste as the last option and doing so appropriately. Crushed rock fill material would be required for the construction of the proposed structures. This material would be sourced off site, with some material such as rock riprap from demolition of the existing structures being reused where appropriate. All waste including surplus fill material will be classified in accordance with the *Waste Classification Guidelines* (Environment Protection Authority, 2014a), with appropriate records and disposal dockets retained for audit purposes. The proposed activity would further minimise construction waste through:

- Sustainable selection of construction materials
- Detailed estimation and accurate ordering of quantities of materials required
- Prefabricated and precast materials including environmental regulator gates would be preferentially used to minimise onsite construction waste and optimise material usage.

All suitable excavated material will be reused onsite as backfill and/or for the construction of cofferdams where feasible. Any materials that cannot be reused onsite would be removed and recycled or disposed of at a suitably licensed facility.

Measures proposed to avoid, minimise or manage potential waste, contamination and hazardous materials impacts as a result of the proposed activity are detailed in Table 6-17.

Table 6-17 Safeguards for waste, contamination and hazardous material impacts

Impact	Safeguard	Responsibility	Timing
Spoil generation	Where feasible, suitable excavated spoil material will be reused onsite as backfill and/or for construction of cofferdams.	Contractor	Construction
Beneficial reuse onsite	Cleared vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) would be retained on site for later reuse in accordance with the site rehabilitation plan. Other cleared vegetation would be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park.	Contractor	Construction
	Earth removed that is surplus to the requirements of the site where it was excavated and which can be classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility.	Contractor	Construction
Hazardous materials	All hazardous materials will be stored in accordance with existing or agreed NPWS procedures.	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
Accidental spills	All contractors and staff will be appropriately trained through a site induction and toolbox talks to prevent, minimise and manage accidental spills.	Contractor	Construction
	Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. Machines will be maintained as per manufacturers specifications.	Contractor	Construction
	To avoid release to the environment, all waste hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed off-site in accordance with Environment Protection Authority guidelines.	Contractor	Construction
	Spill response procedures will follow existing or agreed NPWS procedures.	Contractor	Construction
	Mobile spill kits fully stocked with adequate spill prevention and absorbent materials (including absorbent pads, granular absorbent and disposal bags) will be maintained onsite and on construction vehicles carting hazardous materials.	Contractor	Construction
	Refuelling of all vehicles and mobile equipment will occur at least 20 metres away from any drainage lines or waterways and with suitable bunding/controls.	Contractor	Construction
Soil contamination	If suspected soil contamination is encountered, the suspect materials should be segregated and placed in a designated bunded stockpile covered in plastic sheeting to prevent rainfall infiltration and/or soil migration during windy conditions.	Contractor	Construction

Impact	Safeguard	Responsibility	Timing
Generation of construction waste	All waste material generated will be handled and disposed of carefully to minimise the risk of pollution.	Contractor	Construction
	All construction and demolition materials able to be recycled shall be separated and recycled at approved facilities or reused onsite.	Contractor	Construction
	All demolition material and waste materials will be classified in accordance with the *Waste Classification Guidelines* (Environment Protection Authority, 2014a), removed from the site in a timely manner, and disposed of at a suitability-licensed waste disposal facility.	Contractor	Construction
	Records of waste classification and disposal dockets will be maintained.	Contractor	Construction
Material usage	Preferential use of fabricated and precast materials will be integrated into the detailed design to minimise onsite construction waste and optimise material usage.	Department of Planning and Environment—Water	Detailed design

6.15.4 Residual impacts

During the construction phase, only small quantities of construction waste (i.e. concrete, timber and metal) primarily from demolition works and green waste from vegetation clearing would be generated.

There is the potential for accidental spills or leaks from vehicles, plant and equipment to cause localised soil and water contamination impacts during construction. If not adequately managed, this is a risk for the proposed activity given significant ecological value and sensitivity of receiving waters. However, given the works would occur in dry waterways and quantities of hydrocarbon are anticipated to be minimal, the risk is considered to be low.

Therefore, potential waste and contamination impacts associated with the construction of the proposed activity are considered likely to have a low impact due to the small scale of the proposed works and safeguards detailed above. The potential waste and contamination impacts associated

with the operation of the proposed activity are considered likely to be negligible due to the small quantities of waste generated, minor contamination risks and safeguards detailed above.

6.16 Cumulative impacts

6.16.1 Existing environment

The proposed activity forms part of the Millewa Forest Supply Project, which, together with the Yanga National Park Supply Project, forms the Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure Project. The other work proposed as part of the Millewa Forest Supply Project is the replacement of Bullatale supply channel inlet regulator, which is located about eight kilometres to the east of the construction footprint for the Pinchgut regulator replacement works.

The Millewa Forest Supply Project would be completed in parallel with the Yanga National Park Supply Project, located at Yanga National Park, near Balranald. The two proposed measures have been developed under a single business case, which passed Phase 2 of the SDLAM assessment process outlined in the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin. Given the large distance between Yanga National Park and Millewa Forest, it has been considered appropriate that separate planning approvals be obtained for the two projects.

Juwi Renewable Energy Pty Ltd is proposing to construct Southdown Solar Farm about 35 kilometres north-west of the proposed activity. The proposed Southdown Solar Farm is a utility-scale renewable energy project of up to 130 megawatts output. Based on preliminary design work, Juwi anticipate deploying about 335,000 photo-voltaic modules. The anticipated construction workforce for the project includes up to 200 full-time equivalent employees who would be located largely in Deniliquin. Access to the site during construction and operation is expected to be from Cal Col Road. At the time of writing, the environmental impact statement for this project was being prepared.

There are no other known major projects near the proposed activity.

6.16.2 Impacts

6.16.2.1 Construction

Given the minor environmental impacts associated with the proposed activity, and the remote locations of the proposed activity and the other work proposed as part of the Millewa Forest Supply Project, any potential cumulative impacts during construction would be negligible. The Department of Planning and Environment—Water, as the proponent of the Millewa Forest Supply Project, is able to manage the delivery of the works to avoid or minimise adverse cumulative impacts. Ongoing

consultation would be carried out with NPWS and other project stakeholders regarding the timing of works and interface with other projects within the area.

6.16.2.2 Operation

The proposed works under the Millewa Forest Supply project, including the proposed activity, have been designed as a package to optimise environmental outcomes for Barmah-Millewa Forest. The works would have an overall positive impact on the safety and efficiency of environmental watering of the forest and would create opportunities for the site environmental water managers to achieve some ecological outcomes more easily than with the existing environmental regulators in the forest.

No cumulative impacts are anticipated between the proposed activity and the Yanga National Park Supply Project or the Southdown Solar Farm project during operation.

6.16.3 Safeguards

Measures proposed to avoid, minimise or manage potential cumulative impacts as a result of the proposed activity are detailed in Table 6-18.

Table 6-18 Safeguards for cumulative impacts

Impact	Safeguard	Responsibility	Timing
Cumulative impacts	Construction of the various components of the Millewa Forest Supply Project would be coordinated by the Department of Planning and Environment–Water to minimise any potential cumulative impacts.	Department of Planning and Environment–Water	Construction

6.16.4 Residual impacts

Given the minor environmental impacts associated with the proposed activity, and the remote locations of the proposed project elements, any potential cumulative impacts during construction would be negligible.

7 Matters of national environmental significance under the EPBC Act

Table 7-1 EPBC factors for consideration

	Applicable?	Residual Impact level	Reasons	Safeguards/mitigation measures
Is the proposal likely to impact on matters of national environmental significance as follows:				
Listed threatened species or ecological communities	Yes	Low	Three threatened fauna species listed under the EPBC Act are considered moderately to highly likely to use the habitats in the construction footprints and surrounding areas: the Koala (*Phascolarctos cinereus*) (listed as endangered), Australasian Bittern (*Botaurus poiciloptilus*) (listed as endangered) and Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable). Assessments of significance for these species have been prepared in accordance with the EPBC Act and are provide in Appendix B of Attachment A. The assessments conclude that the proposed activity has a low potential for significant impacts on the Superb Parrot, Australasian Bittern and the Koala as the impacts associated with the proposed activity are minimal in the context of the available habitat located within Murray Valley National Park and Regional Park and Barmah National Park.	Refer to Section 6.4.3 and Section 6.5.4 for safeguards for potential impacts to listed threatened species or ecological communities.

	Applicable?	Residual Impact level	Reasons	Safeguards/mitigation measures
Listed migratory species	Yes	Low	While migratory bird species do use the habitats within the locality, the construction footprints would not be classed as an 'important habitat' as defined under the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013), in that the construction footprints do not contain: • Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species • Habitat used by a migratory species which is at the limit of the species' range • Habitat within an area where the species is declining. Based on the above considerations, the proposed activity is unlikely to have a significant effect on any of the listed migratory species predicted to occur within the locality.	Refer to Section 6.4.3 for safeguards for potential impacts to listed migratory species.
Wetland of international importance (Ramsar wetland)	Yes	Negligible	The proposed activity is located within the NSW Central Murray Forests Ramsar site in NSW, and near the Barmah Forest Ramsar site in Victoria. The proposed activity would not have significant impacts on the NSW Central Murray Forests Ramsar site because: • The areas of direct impact are small and previously disturbed	Refer to Section 6.4.3 for safeguards for wetlands of international importance.

	Applicable?	Residual Impact level	Reasons	Safeguards/mitigation measures
			• There would be minimal hydrological change because the replacement and refurbished regulators would be operated in a manner consistent with the existing regulators. The *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012) and *Murray-Lower Darling Long Term Water Plan* (Department of Planning, Industry and Environment, 2020a) would continue to form the basis for environmental watering of Millewa Forest • Water quality would be protected by carrying out the works when there are low flows in the Murray River and using cofferdams to create dry work sites • The operation of the proposed activity would reduce the instances of native fish becoming stranded in Millewa Forest when high flows recede and at the end of environmental watering events • The proposed fishways would not enable invasive species to become established or spread to areas that they cannot already access when Millewa Forest is inundated when there are high flows in the Murray River.	

	Applicable?	Residual Impact level	Reasons	Safeguards/mitigation measures
World heritage values of world heritage properties	No	Nil	There are no world heritage areas in proximity to the proposed activity.	N/A
The national heritage values of national heritage places	No	Nil	There are no national heritage places in proximity to the proposed activity.	N/A

8 Summary of impacts

In accordance with sections 5.5 and 5.7 of the EP&A Act, the significance of impacts against each environmental factor listed in section 171(2) of the EP&A Regulation have been considered in Table 8-1 to assess the likely impacts of the proposed activity on the environment.

Table 8-1 Compliance with section 171(2) of the EP&A Regulation

Environmental Factor	Impact	Where addressed
(a) the environmental impact on the community	The proposed activity would benefit the site environmental water managers by providing them with more flexibility in how they can achieve environmental watering outcomes for Millewa Forest. The proposed activity would have negligible socio-economic impacts.	Section 6.13

Environmental Factor	Impact	Where addressed
(b) the transformation of the locality	The proposed activity would not result in the transformation of the locality at and surrounding Pinchgut, Nestrons, Moira and Little Edward River offtake regulators and Pigsty culvert. The replacement Pinchgut and Nestrons regulators would be larger than the existing regulators, and the addition of fishways to Moira and Little Edward River offtake regulator would also increase the size of these structures, however the overall impact of these changes would be minor and would not substantially change the predominantly natural character of these sites. Pigsty Creek would appear more natural following the removal of Pigsty culvert. The potential visual impacts of the proposed activity have been assessed and were found to be negligible.	Section 6.11
(c) the environmental impact on the ecosystems of the locality	A comprehensive biodiversity assessment considering terrestrial and aquatic biodiversity has been completed and found that the proposed activity is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.	Section 6.4 and Section 6.5

Environmental Factor	Impact	Where addressed
(d) reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	This REF comprehensively assesses potential environmental impacts of the proposed activity and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.	Chapter 6
(e) the effects on any locality, place or building that has — (i) aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or (ii) other special value for present or future generations	Potential impacts to Aboriginal heritage and historic heritage as a result of the proposed activity have been assessed and are anticipated to be negligible.	Section 6.6 and Section 6.7
(f) the impact on the habitat of protected animals, within the meaning of the *Biodiversity Conservation Act 2016*	A comprehensive biodiversity assessment considering terrestrial and aquatic biodiversity has been completed and found that the proposed activity is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.	Section 6.4 and Section 6.5
(g) the endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air		
(h) long-term effects on the environment	This REF comprehensively assesses potential environmental impacts of the proposed activity and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.	Chapter 6
(i) degradation of the quality of the environment		

Environmental Factor	Impact	Where addressed
(j) risk to the safety of the environment	The proposed activity involves modernising infrastructure that is old, in poor repair, and doesn't meet contemporary safety standards. Safety in design workshops have incorporated safety considerations into the design of the replacement and refurbished regulators for the benefit of members of the public and WaterNSW and the site environmental water managers who would operate and maintain the structure.	Section 3.2
(k) reduction in the range of beneficial uses of the environment	An objective of the proposed activity is to remove constraints to the movement of water across the floodplain and reopening pathways for native fish. The proposed activity is not expected to significantly affect land use in the region. The proposed activity is replacing or refurbishing existing infrastructure.	Section 2.1
(l) pollution of the environment	There is a low potential for minor impacts to water quality due to erosion and sedimentation during construction. This risk is readily managed by standard construction practices and additional safeguards outlined in Table 6-2.	Section 6.2
(m) environmental problems associated with the disposal of waste	Waste management during construction of the proposed activity is a minor risk and would be readily controlled by construction practices and safeguards outlined in Table 6-17.	Section 6.15

Environmental Factor	Impact	Where addressed
(n) increased demands on natural or other resources that are, or are likely to become, in short supply	Concrete and steel quantities used for construction of the flow control structures are widely available and would deliver long-term beneficial environmental outcomes by operation of the proposed activity. Re-use of materials is discussed in Section 6.15.	Section 6.15
(o) the cumulative environmental effect with other existing or likely future activities	Given the minor environmental impacts associated with the proposed activity, and the remote locations of the proposed project elements, any potential cumulative impacts during construction would be negligible.	Section 6.16
(p) the impact on coastal processes and coastal hazards, including those under projected climate change conditions	N/A	N/A
(q) applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1	The proposed activity is a water supply system under section 2.159 of the Transport and Infrastructure SEPP and therefore development consent from council is not required. The proposed activity is to be assessed under Division 5.1 of the EP&A Act with the Department of Planning and Environment — Water being the determining authority.	Section 4.1.4.1
(r) other relevant environmental factors.	This REF comprehensively assesses potential environmental impacts of the proposed activity, including potential socio-economic impacts, and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.	Chapter 6

9 Environmental management

9.1 Construction environmental management

Safeguards have been proposed in this REF to avoid, minimise or manage potential environmental impacts of the proposed activity. Should the proposed activity proceed, these safeguards will be incorporated into the detailed design and applied during construction and operation of the proposed activity.

The CEMP would include the safeguards identified in Chapter 6 of this REF and any additional measures required by licences, permits or approvals that are required to construct the proposed activity. The CEMP would provide a framework for establishing how the safeguards would be implemented and who would be responsible for their implementation. It would include a procedure for managing and reporting environmental incidents where there is a breach of the requirements contained in the safeguards. The CEMP would be prepared prior to commencement of construction. The CEMP would include the following subplans:

- Erosion and sediment control plan
- Construction soil and water management plan
- Biodiversity management plan
- Site rehabilitation plan
- Construction traffic management plan.

A draft of the CEMP would be provided to NPWS and WaterNSW for comment and any comments provided would be addressed in the final CEMP. The CEMP would be a working document that is subject to ongoing change and updates as necessary during the construction phase.

The key objective of the CEMP would be to deliver and implement the environmental commitments made in the REF throughout the construction period, together with conditions imposed by any licences and approvals. The CEMP would include the following information:

- Details of key project personnel and their contact details
- An audit and reporting program to ensure all of the safeguards are implemented
- Training requirements, including site induction requirements to ensure that all personnel understand the principles of environmental management
- Emergency and incident response procedures

- List of approvals to be obtained before construction commences
- Consultation requirements (government and community) and a complaint handling procedure
- Actions for meeting environmental objectives based on the safeguards identified in this REF and any statutory or regulatory obligations
- Details of the personnel responsible for the implementation of each safeguard.

9.2 Operational environmental management

The joint operations working group would operate the replacement and refurbished regulators in accordance with the same operational management plans that govern their use of the existing regulators in Millewa Forest. As discussed in Section 6.2.1.8, decisions on environmental watering at The Living Murray icon sites including Barmah-Millewa Forest are facilitated through The Living Murray annual watering plan.

The Department of Planning and Environment—Water is preparing an operational risk management strategy and a fish management strategy for the replacement and refurbished regulators including their fishways. The findings from the operational risk management strategy and fish management strategy will be incorporated into the adaptive management framework document that augments existing NPWS site management plans using the improved management flexibility provided by the replacement and refurbished regulators.

The adaptive management framework will provide:

- An operational guide for environmental water managers to assist with water planning and ordering – supplementary to the *Barmah-Millewa Forest Environmental Water Management Plan* (Murray-Darling Basin Authority, 2012)
- A decision support tool for optimising ecological outcomes.

The framework is not intended to be used by the asset operator, but the land managers and environmental water managers to assist with annual water planning and managing within season water deliveries. A focus on the framework will be a tool to assist with a process of continual improvement and balance trade-offs which typically vary from year to year.

The structure of the framework will be developed collaboratively with key environmental watering program partners based on the outcomes of the development of the fish exit strategy and operational risk assessment, and review of existing site watering plans (3Rivers, 2023).

9.3 Summary of safeguards

A summary of all measures proposed to avoid, minimise, or manage potential environmental impacts of the proposed activity, as identified throughout Chapter 6, are detailed in Table 9-1.

Table 9-1 Summary of safeguards

Impacts	Safeguards	Responsibility	Timing
Topography, geology and soils			
Erosion and sediment	An erosion and sediment control plan will be prepared as part of the contractor's CEMP. Site specific erosion and sediment control measures will be designed, implemented and maintained in accordance with relevant sections of *Managing Urban Stormwater: Soil and Construction Volume 1* (Landcom, 2004) (the Blue Book). The erosion and sediment control plan will provide details of the cofferdams to be installed upstream and downstream of instream work sites and the strategies that will be implemented to stabilise soils during the construction phase.	Contractor	Construction
Surface water and drainage			
Impact of construction activities and mobilising sediment	Erosion and sediment control measures will be implemented to stabilise ground surfaces disturbed during the construction phase and will include but not be limited to: • Sediment fences along the clearing boundaries • Stockpiling materials on site for the shortest time feasible • Contouring disturbed areas of waterway beds and banks to reinstate natural contours or otherwise in accordance with the design drawings • Covers on truck loads when transporting loose material • Covers on (or watering of) stockpiles. Where feasible, these control measures will be in place before any vegetation clearing or earthwork starts and will remain in place throughout the	Contractor	Detailed design Construction

Impacts	Safeguards	Responsibility	Timing
	construction phase until the site rehabilitation plan has been fully implemented.		
Instream works	The construction soil and water management plan will include contingency measures in the event of high flows in the Murray River during the construction works.	Contractor	Construction
	Control measures to manage potential pollution or sedimentation impacts from instream works will include but not be limited to: • Floating silt fences • Cofferdams to create dry sites for instream works • Undertake work when flows are low/dry for a suitable duration to complete work • Develop contingencies for unexpected moderate to high flows in the Murray River during instream works. Control measures will be in place prior to commencement of any instream works.	Contractor	Detailed design Construction
Spills and leaks	• An emergency spill response procedure will be prepared in accordance with the Department of Planning and Environment–Water's incident management protocols to minimise the impact of accidental spillages of fuels, chemicals and fluids during construction • Hazardous materials such as oils, chemicals and refuelling activities will occur in bunded areas and as far from waterways as feasible.	Contractor	Detailed design Construction
Concrete works	• Bunded receptacles for concrete waste including concrete slurries and washout water will be provided at the work sites to capture, contain and appropriately dispose of any concrete waste at a suitably licensed waste facility. These will be located as far from waterways as feasible	Contractor	Detailed design Construction

Impacts	Safeguards	Responsibility	Timing
	• Concrete elements of the replacement and refurbished regulators will be prefabricated, where practicable.		
Dewatering of in-stream work areas	A construction soil and water management plan will be prepared as part of the CEMP and will outline procedures and water quality standards (ANZG, 2018) to be achieved prior to dewatering within the cofferdam areas (dry work areas), if required.	Contractor	Detailed design Construction
Water release from water quality controls during construction	The construction soil and water management plan will outline procedures (as per the Blue Book) and water quality standards (ANZG, 2018) to be achieved prior to discharging water to waterways.	Contractor	Detailed design Construction
Water quality monitoring	Visual monitoring of local water quality (e.g. turbidity, hydrocarbon spills/slicks) will be carried out daily during construction to identify any potential spills or deficient erosion and sediment controls. Should a change in water quality appear evident samples will be collected and analysed.	Contactor	Construction
Groundwater			
Groundwater ingress into the work site during construction	Any groundwater that enters excavations within the work sites will be tested and, if suitable, pumped into nearby waterways or otherwise pumped into a treatment pond and treated before being discharged into nearby waterways. If treatment ponds are proposed they must be located within the construction footprints and their location, size and proposed uses must be documented in the construction soil and water management plan. The construction soil and water management plan will include water quality criteria for any water to be discharged into nearby waterways.	Contractor	Construction
Terrestrial biodiversity			

Impacts	Safeguards	Responsibility	Timing
Impact to surrounding vegetation	The approved construction footprints will be accurately and clearly marked out by a surveyor using flagging tape and signage prior to the start of works. The signage will prohibit any access or construction work outside the construction footprints. The biodiversity management plan will specify the type of flagging and signage required to delineate the approved construction footprints.	Contractor	Prior to construction
	The vegetation clearing boundary at each work site will be accurately and clearly marked out using flagging tape prior to the start of works. The clearing boundaries must not extend outside the approved construction footprints. The biodiversity management plan will specify the type of flagging required to delineate the clearing boundaries. If there are opportunities to not clear the entire approved construction footprints, preference should be given to avoiding clearing of areas containing established trees (including hollow-bearing trees) and good quality native vegetation and instead concentrate clearing to areas of the footprints that are subject to previous disturbance. To assist in this process, the biodiversity management plan will include figures of the approved construction footprints showing the locations of hollow-bearing trees, vegetation communities; important flora and fauna habitat areas; and locations where threatened species, populations or ecological communities have been recorded.	Contractor	Prior to construction
	Materials, plant, equipment, work vehicles and stockpiles will be stored, parked or placed as applicable within the clearing boundaries or on existing access tracks at or leading to the works sites that are temporarily closed to traffic and as a result are available for the sole use of the contractor.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	Where feasible, materials, plant, equipment, work vehicles and stockpiles will be stored, parked or placed as applicable away from the driplines of trees that are outside the clearing boundaries or that are within the clearing boundaries but proposed for retention.	Contractor	Construction
	If any damage occurs to vegetation outside the approved construction footprints it is to be reported and managed as an environmental incident in accordance with the environmental incident management procedure contained in the CEMP. The Department of Planning and Environment — Water and NPWS will be notified so that appropriate remediation strategies can be developed and implemented.	Contractor, Department of Planning and Environment — Water	Construction
	Construction personnel will be informed of the environmentally sensitive aspects of the construction footprints, including being shown plans of directly impacted and adjoining areas that identify vegetation communities; important flora and fauna habitat areas; and locations where threatened species, populations or ecological communities have been recorded.	Contractor	Construction
Impact to native plants and animals including threatened species	A pre-clearing inspection will be undertaken 48 hours prior to any native vegetation clearing by a suitably qualified ecologist and the Contractor's Environmental Manager (or delegate). The pre-clearing inspection at each work site will include, as a minimum: • A check of the physical demarcation of the clearing boundary and construction footprint • Identification of trees that are just outside the marked clearing boundary that require protection to avoid unintended damage during the clearing and subsequent construction works	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	• Identification of hollow bearing trees that need to be removed in accordance with the hollow-bearing tree removal procedure (see below) • Identification of other habitat features that may need to be relocated outside the clearing boundary • Identification of any threatened flora and fauna • Implementation of the erosion and sediment control plan for the work site, including erosion control structures. The completion of the pre-clearing inspection will form a hold point requiring sign-off from the Department of Planning and Environment—Water.		
	Trees within the construction footprints that do not require felling will be protected during the construction phase in accordance with Australian Standard 4970-2009 *Protection of Trees on Development Sites*.	Contractor	Construction
	If hollow-bearing trees require removal the following procedure will be followed: • Non-hollow bearing trees and vegetation surround a hollow-bearing tree will be removed first. Trees should be felled into the construction footprint to avoid damaging adjacent vegetation • Leave the hollow-bearing tree standing for at least one night after other clearing to allow any fauna using the hollows to leave • An NPWS ranger or suitably qualified ecologist is to be present during felling of hollow-bearing trees • Before felling a hollow-bearing tree, tap along the trunk using an excavator or loader to scare fauna from the hollows. Repeat several times • After felling a hollow-bearing tree check its hollows and surrounds to ensure no fauna have	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	become trapped or injured. Any fauna found should be safely located to nearby habitat by the attending NPWS ranger or ecologist • If a hollow-bearing tree is removed in stages the non-hollow-bearing branches should be removed before the hollow-bearing branches are removed. In consultation with NPWS, felled hollow-bearing trees should be cut into sections and the sections with hollows prioritised for placement into the surround forest to provide additional potential habitat for ground dwelling fauna such as reptiles and small mammals.		
	The biodiversity management plan will include a procedure for dealing with the presence of native fauna species within the construction footprints during the construction works. The procedure will require construction work at the site of the find to immediately cease and the subject animal allowed to leave the construction footprint without being harassed. If an animal needs to be relocated to outside a construction footprint, the contractor is to notify the Department of Planning and Environment—Water and they will in turn notify NPWS to agree on appropriate mitigation measures (including relocation measures). The contractor will only restart work at the subject site when authorised by the Department of Planning and Environment—Water.	Contractor	Construction
	Construction and worker vehicles and machinery will be checked at the start and end of each workday to ensure fauna are not entrapped.	Contractor	Construction
	Construction during the Superb Parrot breeding period (September to January) will be avoided if possible. If this cannot be achieved, this species will be considered during pre-clearing surveys to ensure that no impacts will occur.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
Impacts to habitat features	Relocation of habitat features (e.g. fallen timber, hollow logs) from within the clearing boundary will occur in accordance with an approved project-specific procedure to be included in the biodiversity management plan.	Contractor	Construction
Impacts from introduction and spread of weeds	Weed management will be undertaken in consultation with NPWS in areas affected by construction prior to any clearing works in accordance with the *Biosecurity Act 2015* to minimise the risk of weeds being spread to the surrounding environment; including during transport of waste off-site to a licensed waste disposal facility.	Contractor	Construction
	All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules will be treated on site or bagged, removed from site, and disposed of at a suitably licensed waste facility. If pesticide use is proposed it must occur in accordance with NPWS's requirements including the *Pesticide Use Notification Plan* (NPWS, 2022).	Contractor	Construction
Impacts from introduction and spread of plant pathogens	All vehicles and machinery engaged in earthworks and vegetation clearance activities will follow the Myrtle Rust hygiene protocol for vehicles and heavy machinery in Table 5 of the *Hygiene Guidelines* (Department of Planning, Industry and Environment, 2020).	Contractor	Construction
Wildlife impacts from vehicle strike	Drivers must stay vigilant for fauna during machinery operation and vehicle movements.	Contractor	Construction
Aquatic biodiversity			
Interactions with fauna during construction	A pre-construction survey will be undertaken in areas that will be enclosed by cofferdams.	Contractor	Prior to construction
	A fish screen will be installed on pumps to prevent entrainment of fish into pumps during dewatering.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	The biodiversity management plan will include a procedure for dealing with the presence of native fauna species within the construction footprints during the construction works. The procedure will require construction work at the site of the find to immediately cease and the subject animal allowed to leave the construction footprint without being harassed. Where assistance is required to relocate an animal, the contractor is to notify the Department of Planning and Environment — Water and they will in turn notify NPWS to agree on appropriate mitigation measures (including relocation measures). The contractor will only restart work at the subject site when authorised by the Department of Planning and Environment — Water.	Contractor	Prior to construction
Removal of snags, riparian and instream vegetation	Large woody debris, snags and native aquatic vegetation will be relocated (where possible outside the breeding season of spring and summer) from instream work sites (including at cofferdams if required) to suitable locations upstream and/or downstream in consultation with a qualified ecologist, NPWS and WaterNSW. Relocation of these aquatic habitat features from dry in-stream work sites will occur after aquatic fauna salvage and dewatering.	the Department of Planning and Environment — Water, contractor	Construction
	Rehabilitation of disturbed areas of riparian and instream vegetation will be undertaken as soon as practicable, progressively and in accordance with a site rehabilitation plan prepared as part of the CEMP and in consultation with NPWS and WaterNSW. Where possible, woody debris, snags and native instream vegetation that was removed to make way for instream work sites will be used in the rehabilitation works.	Contractor	Construction
	Rehabilitation of the construction footprints will involve replacing and stabilising topsoil and re-planting native trees and plants.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
Sediment build-up in the fishways	Inspections and maintenance of the fishways will be carried out on a regular basis to ensure that fish passage is not obstructed.	WaterNSW	Operation
Ongoing monitoring of fishways and nearby waterways	Existing aquatic species monitoring at Millewa Forest as part of The Living Murray initiative will document impacts/benefits on the aquatic ecosystem due to the replacement and refurbished regulators.	NPWS, in liaison with Arthur Rylah Institute for Environmental Research	Operation
Invasive species	An ongoing management response should be adopted to mitigate movement and proliferation of invasive aquatic species in the floodplain environments.	NPWS	Operation
Aboriginal heritage			
Unexpected finds	Unexpected Aboriginal cultural heritage finds will be managed in accordance with NPWS's Unexpected Finds Protocol – Aboriginal Cultural Heritage, which is provided as an appendix to Attachment C and summarised below. **Aboriginal objects** If an Aboriginal object is discovered during construction, all works in this location must stop and no further harm must occur to the area. The find must be left in place and protected from any further harm. Notify the Department of Planning and Environment–Water Project Manager of the find, who in turn will notify NPWS, WaterNSW's heritage officer, Heritage NSW, and the Environment Line (13 15 55) and arrange for a qualified archaeologist and representatives of the registered Aboriginal parties to inspect the find. If they confirm that the find is an Aboriginal object, the item will be recorded on AHIMS, agreement reached on its management, and an application made for an Aboriginal heritage impact permit. **Aboriginal human/ancestral skeletal remains**	Contractor, Department of Planning and Environment—Water	Construction

Impacts	Safeguards	Responsibility	Timing
	If Aboriginal human/ancestral skeletal remains are discovered, all work in the vicinity of the remains must stop. Notify the Department of Planning and Environment–Water Project Manager of the find, who in turn will notify NSW Police if the material is determined to be of human origin and less than 100 years old, or NPWS Aboriginal Partnerships and Heritage Unit, WaterNSW's heritage officer, and Heritage NSW if the remains are believed to be Aboriginal. If in doubt or required by NSW Police, the Department of Planning and Environment–Water will obtain specialist advice from a forensic anthropologist or bioarchaeologist to confirm that the bones are human, their age and whether they are Aboriginal or not. The remains must be left in place and protected from further harm or damage or unauthorised access until further advice states otherwise. • If the remains are confirmed to be Aboriginal, the Department of Planning and Environment–Water will notify the RAPs. Aboriginal ancestral remains will be recorded in a culturally appropriate manner in collaboration with Heritage NSW and the registered Aboriginal parties. Work will not recommence at the location until authorised in writing by Heritage NSW if the remains are considered by the NSW Police and Heritage NSW to be Aboriginal.		
Historic heritage			
Unexpected finds	If historical archaeological relics are discovered during construction, all work will cease in the area. The contractor will notify the Department of Planning and Environment — Water Project Manager, who in turn will notify NPWS and WaterNSW's heritage officer. A historical archaeologist will be engaged to assess the item's significance.	Contractor, Department of Planning and Environment — Water	Construction

Impacts	Safeguards	Responsibility	Timing
Air quality			
Dust generation during construction	Work methods will be modified during high wind conditions if excessive dust is generated.	Contractor	Construction
	All vehicles on site will be confined to designated routes.	Contractor	Construction
	Reduce vehicle speeds to minimise dust emissions.	Contractor	Construction
	Visual monitoring for dust will be implemented during the works. Where required, a hose or water cart would be used to regularly wet down haulage access tracks, work sites and laydown areas.	Contractor	Construction
Vehicle emissions	Trips and trip distances will be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.	Contractor	Construction
	Minimise engine idling and ensure vehicle engines are switched off when stationary or parked within ancillary facilities or construction zones.	Contractor	Construction
Noise and vibration			
Construction noise and vibration	Inform the local community of the potential impact of increased heavy vehicle traffic during the construction phase, including potential noise impacts.	Department of Planning and Environment — Water	Construction
	Unless otherwise approved by the Department of Planning and Environment–Water through an out of hours application process, construction hours will be limited to: • Monday to Friday: 7 am to 6 pm • Saturday: 8 am to 5 pm No construction work on Sundays or public holidays.	Contractor	Construction
	All site personnel will be made aware of noise issues and mitigation measures through induction processes.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	All machinery will be well maintained and in good working order. All vehicles and equipment will be fitted with silencing devices, where applicable.	Contractor	Construction
Traffic and access			
Construction traffic	A construction traffic management plan will be prepared as part of the CEMP. The plan will include: • A driver code of conduct • Confirmation of haulage routes and access locations • Measures to maintain access and capacity to existing roads where possible • Traffic control measures including signage at appropriate locations to notify road users of increased traffic volumes and construction vehicles • Management of oversized vehicles • A response plan for any construction-related traffic incidents.	Contractor	Construction
	Consultation with NPWS and Murray River Council will be undertaken to minimise the impacts to the surrounding road network during construction including temporary access tracks or road closures. Any agreed traffic management measures will be incorporated into the construction traffic management plan.	Contractor	Construction
Visual			
Visibility of construction works	During construction, all equipment, materials and temporary facilities, such as site offices and portable toilets, will be located within the designated construction footprints for the works.	Contractor	Construction
	The construction work sites will be clearly demarcated and maintained in an orderly manner.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	All construction equipment will be removed from the park as soon as it is not required, including any material and refuse related to the works.	Contractor	Construction
Revegetation	A site rehabilitation plan will be prepared as part of the CEMP. The site rehabilitation plan will detail how the work sites will be stabilised and revegetated once the new infrastructure is built. A draft site rehabilitation plan will be provided to NPWS and WaterNSW for comment and any comments provided will be addressed in the final version of the plan. Rehabilitation of the construction footprints including revegetation will be carried out as soon as practicable.	Department of Planning and Environment—Water, contractor	Construction
Hazards			
Bushfire risk during construction	The following controls will be implemented to mitigate potential for fires and increased bush fire risk during construction: • No stockpiling or burning of waste vegetation to occur onsite • Daily weather checks will be undertaken during the pre-start meeting to note for potential fire danger • Any notices erected, displayed or issued by NPWS regulating the use of fire in the park will be complied with • Hot works and machinery which may result in sparking or ignition must not be used on a Total Fire Ban Day without an exemption from the NSW Rural Fire Service • Fuel and other similar flammable materials, such as gas cylinders and paint, will be stored in appropriate fire-resistant storage containers	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	• Appropriate firefighting equipment (e.g., water pump, extinguisher and hand tools) should be available on site along with trained staff • Stationary plant will be parked in cleared areas • No smoking on site in accordance with section 19 of the NPW Regulation.		
	All works will be undertaken in accordance with the operational guidelines under the *Murray Valley National and Regional Parks (Millewa, Moira and Gulpa Islands Precincts) Fire Management Strategy* which includes provisions pertaining to operation of earthmoving equipment and visitor management.	Contractor	Construction
Emergency response	Emergency contacts and response procedures will form part of the CEMP and site inductions.	Contractor	Construction
Socio-economic			
Irrigation flows in the Murray and Edward Rivers	The construction soil and water management plan will include contingency measures in the event of the construction works being carried out during the irrigation season when irrigation water deliveries are being made via the Murray and Edward Rivers.	Contractor	Construction
Waste, contamination and hazardous materials			
Spoil generation	Where feasible, suitable excavated spoil material will be reused onsite as backfill and/or for construction of cofferdams.	Contractor	Construction
Beneficial reuse onsite	Cleared vegetation suitable for use in the rehabilitation works (e.g. fallen logs that could provide habitat) will be retained on site for later reuse in accordance with the site rehabilitation plan. Other cleared vegetation will be mulched and either disposed off-site at a suitably licensed waste facility or, if requested by and agreed with NPWS, made available for NPWS to reuse within Murray Valley National Park and Regional Park.	Contractor	Construction
	Earth removed that is surplus to the requirements of the site where it was excavated and which can be	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
	classified as virgin excavated natural material or excavated natural material could be used for other works proposed in Millewa Forest as part of the Millewa Forest Supply Project, or otherwise disposed off-site at an appropriately licensed waste facility.		
Hazardous materials	All hazardous materials will be stored in accordance with existing or agreed NPWS procedures.	Contractor	Construction
Accidental spills	All contractors and staff will be appropriately trained through a site induction and toolbox talks to prevent, minimise and manage accidental spills.	Contractor	Construction
	Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. Machines will be maintained as per manufacturers specifications.	Contractor	Construction
	To avoid release to the environment, all waste hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed off-site in accordance with Environment Protection Authority guidelines.	Contractor	Construction
	Spill response procedures will follow existing or agreed NPWS procedures.	Contractor	Construction
	Mobile spill kits fully stocked with adequate spill prevention and absorbent materials (including absorbent pads, granular absorbent and disposal bags) will be maintained onsite and on construction vehicles carting hazardous materials.	Contractor	Construction
	Refuelling of all vehicles and mobile equipment will occur at least 20 metres away from any drainage lines or waterways and with suitable bunding/controls.	Contractor	Construction
Soil contamination	If suspected soil contamination is encountered, the suspect materials should be segregated and placed in a designated bunded stockpile covered in plastic sheeting to prevent rainfall infiltration and/or soil migration during windy conditions.	Contractor	Construction

Impacts	Safeguards	Responsibility	Timing
Generation of construction waste	All waste material generated will be handled and disposed of carefully to minimise the risk of pollution.	Contractor	Construction
	All construction and demolition materials able to be recycled shall be separated and recycled at approved facilities or reused onsite.	Contractor	Construction
	All demolition material and waste materials will be classified in accordance with the *Waste Classification Guidelines* (Environment Protection Authority, 2014a), removed from the site in a timely manner, and disposed of at a suitability-licensed waste disposal facility.	Contractor	Construction
	Records of waste classification and disposal dockets will be maintained.	Contractor	Construction
Material usage	Preferential use of fabricated and precast materials will be integrated into the detailed design to minimise onsite construction waste and optimise material usage.	Department of Planning and Environment—Water	Detailed design

10 Conclusion

10.1 Justification

From the 1930s, the Millewa Forest water channel network has been manipulated by the installation of many banks and regulators and, in some cases, construction of artificial channels. These management interventions influenced the movement of water on the floodplain largely to optimise floodplain forestry. Further infrastructure was constructed during the 1990s to assist with river operations in the Murray and Edward River systems. Many of these structures, including the four regulators and culvert that are the subject of the proposed activity, are now old, in poor repair, fail to meet contemporary safety standards and were not designed to optimise fish movement.

The proposed replacement or refurbishment of four regulators would provide modern regulators that meet contemporary health and safety standards and include fishways that enables bi-directional fish movement past the structures. The fishways would enable fish to return to the Murray River from Toupna Creek and from Little Edward River to the Edward River when high flows are receding.

The proposed removal of Pigsty culvert would remove an obstruction to flows and fish passage on Pigsty Creek.

The efficiency of operation of the replacement or refurbished regulators compared to existing regulators used for environmental watering of Millewa Forest would contribute to the 45 gigalitre per annum water saving targeted by the Acceleration Program.

Potential environmental impacts of the proposed activity have been identified and assessed in Chapter 6 and found to be minor or insignificant. Required native vegetation removal would be limited and disturbed areas of the construction footprint not occupied by new infrastructure would be revegetated in accordance with a site rehabilitation plan prepared as part of the CEMP. The proposed activity is unlikely to significantly impact threatened species, populations, ecological communities or migratory species.

Safeguards specific to the proposed activity have been developed to avoid, minimise or manage these potential impacts. The minor potential environmental impacts of the proposed activity are outweighed by the broader, long-term benefits of the proposed activity and the proposed activity is considered to be in the public interest.

10.2 Ecological sustainable development

Ecologically sustainable development is development that improves the total quality of life, both now and in the future. Section 193 of the EP&A Regulation identifies four principles of ecologically sustainable development that are presented in Table 10 1. The table also identifies how the proposed activity aligns with each of the principles.

Section 2A(2) of the NPW Act requires that the objects of the NPW Act are to be achieved by applying the principles of ecologically sustainable development. The consistency of the proposed activity with the objects of the NPW Act is presented in Table 4-1. The alignment of the proposed activity with both section 193 of the EP&A Regulation and the objects of the NPW Act means that the requirement of section 2A(2) of the NPW Act is also satisfied.

Table 10-1 Consideration of the EP&A Regulation principles of ecologically sustainable development

EP&A Regulation principles of ecologically sustainable development	Proposed activity response
The precautionary principle This principle states: 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.'	A key objective of the proposed activity is to remove constraints to the movement of water across the floodplain and reopen pathways for native fish which would improve environmental (in particular fish passage) outcomes for Millewa Forest, as described in Section 2.1.
Intergenerational equity This principle states: 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.'	This REF comprehensively assesses the potential environmental impacts of the proposed activity, including potential socio-economic impacts, and has found them to be primarily positive. Potential adverse impacts are minor or insignificant.
Conservation of biological diversity and ecological integrity This principle states: 'the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival.'	A comprehensive biodiversity assessment considering aquatic and terrestrial biodiversity has been completed (refer to Section 6.4 and Section 6.5 and Attachment A and Attachment B) and found that the proposed activity is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.
Improved valuation, pricing, and incentive mechanism This principle is defined as:	As discussed in Section 2.5, an options evaluation framework was developed to assess the

EP&A Regulation principles of ecologically sustainable development	Proposed activity response
'Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as: i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, ii. the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, iii. environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'.	advantages and disadvantages of a range of potential options and alternatives considered. The preferred option was selected due to the ability to avoid the operation and maintenance risks and costs and environmental impacts associated with some of the alternatives considered.

10.3 Conclusion

The proposed activity is subject to assessment under Division 5.1 of the EP&A Act. As per Sections 6 and 8 of this REF, all matters affecting or likely to affect the environment by reason of the proposed activity have been examined and taken into account to the fullest extent possible.

The site selection, options assessment and concept design development of the proposed activity aimed to minimise environmental impacts, and the proposed activity as described in this REF best meets the project objectives. However, the proposed activity would still have some minor environmental impacts as identified in this REF including clearing of up to 0.95 hectares of native vegetation and temporary traffic , noise and air quality impacts during the construction phase. Safeguards outlined in this REF would or have or will avoid, minimise or manage known or likely impacts, ensuring residual risks as identified in Section 6will remain low.

The proposed activity would improve the efficiency of environmental watering of Millewa Forest and reduce the instances of native fish becoming stranded within Millewa Forest and unable to return to the Murray River or Edward River when high flows are receding and at the end of environmental watering events.

The proposed activity is unlikely to cause a significant impact on the environment. Therefore, an environmental impact statement and approval from the NSW Minister for Planning under Division 5.2 of the EP&A Act is not required. As the Department of Planning and Environment–Water has not opted under section 7.8(3)(b) of the BC Act to prepare a biodiversity development assessment report and the proposed activity will not have a significant impact on threatened entities under that Act, or the FM Act, a species impact statement is also not required.

The proposed activity is unlikely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the Commonwealth EPBC Act and a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water has confirmed that the proposed activity is not a controlled action.

11 References

3Rivers (2023), *Millewa Forest: Draft Operational Risk Management Strategy*. Prepared by 3Rivers for the Department of Planning and Environment–Water. Version 2.0, 19 July 2023

Abel, N and O'Connell, D (2006), *Barmah Forest: A review of its values, management objectives and knowledge base*. Goulburn Broken Catchment Management Authority, Shepparton, Victoria, May 2006, https://www.gbcma.vic.gov.au/downloads/Wetlands/Barmah_Final_20060522.pdf

ALA (2022), *The Atlas of Living Australia*. Atlas of Living Australia, http://www.ala.org.au

Atkinson, W. and Berryman, A. (1983), *Aboriginal Association with the Murray Valley Study area*. Victorian Land Conservation Council, Victoria

Austral Archaeology (2003), *Heritage Assessment of 304 River Structures Southern Region, NSW and 36 River Structures Northern Region, NSW for Section 170 Heritage and Conservation Register, 2003*

Austral Archaeology (2023), *Millewa Forest Supply Project Aboriginal Cultural Heritage Assessment*. Prepared for 3Rivers, on behalf of the Department of Planning and Environment–Water, Austral Archaeology, Swan Hill, Victoria, May 2023

Bonhomme, T. (1990), *Aboriginal Burials and Sand Mining on the Riverine Plains, NSW*. National Parks and Wildlife Service, 1990

Borrell, A. and Liefting, A. (2017), *Intervention Flow Monitoring, Millewa Forest 2016-17*. Report prepared for National Parks and Wildlife Service, Moama, https://www.mdba.gov.au/sites/default/files/pubs/Millewa-flow-monitoring-2016-17.PDF

Bucan, R.A. (1974), *Report on an Archaeological Survey in the Murray Valley, New South Wales, 1973-4*. Report to the National Parks and Wildlife Service, 1974

Chesterfield, E.A. (1986), Changes in the vegetation of the river red gum forest at Barmah, Victoria, *Australian Forestry* **49** pp. 4-15.

Colloff, M.J., Ward, K.A. and Roberts, J. (2014), Ecology and conservation of grassy wetlands dominated by spiny mud grass *Pseudoraphis spinescens* in the southern Murray-Darling Basin, Australia. *Aquatic Conservation*: Marine Freshwater Ecosystems, **24** pp 238-255

Craib, J.L. (1991), *Archaeological Survey in the Moira-Millewa State Forests*. Report to the National Parks and Wildlife Service, 1991

Curr, E. (1883), *Recollections of Squatting in Victoria, then called the Port Phillip District (from 1841 to 1851)*. Reproduction, Rich River Printers, Echuca, 1883

DCCEEW (2022), *Protected Matters Search Tool*. Commonwealth Department of Climate Change, Environment, Energy and Water, Canberra, http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf

Department of Environment, Land, Water and Planning (2015), *Business case for operating rule change to the use of the Barmah-Millewa Forest Environmental Water Allocation, A Sustainable Diversion Limit Adjustment Measure*. Prepared by Alluvium Consulting Australia, RM Consulting Group and DG Consulting for the Victorian Department of Environment, Land, Water and Planning, https://www.water.vic.gov.au/__data/assets/pdf_file/0018/325080/23-Barmah-Millewa-Forest-Environmental-Water-Allocation-BMFEWA-Current-notification-Amendment-1-Applied.pdf

Department of Planning and Environment (2021), *Guidelines for Preparing a Review of Environmental Factors: How to Assess the Environmental Impacts of Activities within NSW National Parks*. Environment, Energy and Science Group of the Department of Planning and Environment, Parramatta, February 2022, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Development-guidelines/guidelines-for-preparing-a-review-of-environmental-factors-220069.pdf

Department of Planning and Environment (2022a), *Guidelines for Division 5.1 assessments*. NSW Department of Planning and Environment, Sydney, June 2022, https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/Policy-and-legislation/SSI-Guidelines/Guidelines-for-Division-51-assessments.pdf

Department of Planning and Environment (2022b), *BioNet Atlas ‑ the Atlas of NSW Wildlife Threatened Species Profile Database*. NSW Department of Planning and Environment, Sydney, https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

Department of Planning, Industry and Environment (2020), *Hygiene Guidelines*. Environment, Energy and Science Group of the former Department of Planning, Industry and Environment, Parramatta, April 2020, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Wildlife-management/saving-our-species-hygiene-guidelines-200164.pdf

Department of Primary Industries (2013), *NSW Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)*. NSW Department of Primary Industries,- Fisheries, Wollongbar, NSW, June 2013, https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/634694/Policy-and-guidelines-for-fish-habitat.pdf

Department of the Environment (2013), *Matters of National Environmental Significance, Significant Impact Guidelines 1.1*. Commonwealth Department of the Environment, Canberra, 2013, https://www.dcceew.gov.au/sites/default/files/documents/nes-guidelines_1.pdf

Ecological Associates and SKM (2011), *Environmental Water Delivery: Yarrawonga to Tocumwal and Barmah-Millewa*. Prepared for Commonwealth Environmental Water, Department of Sustainability, Environment, Water, Population and Communities, Canberra, https://www.dcceew.gov.au/sites/default/files/documents/ewater-delivery-yarrawonga.pdf

Environment Protection Authority (2020), *Draft Construction Noise Guidelines 2020*. NSW Environment Protection Authority, Parramatta, November 2020, https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/noise/20p2281-draft-construction-noise-guideline.pdf

Fairfull and Witheridge (2003), *Why do fish Need to Cross the Road? Fish Passage Requirements for Watercourse Crossings*. NSW Department of Primary Industries - Fisheries, January 2003, Cronulla, https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/202693/Why-do-fish-need-to-cross-the-road_booklet.pdf

Gippel, C.J. (2003), *Review of Achievements and Outcomes of Environmental Flow Initiatives Undertaken on the Extended River Murray System to August 2002*. Report by Fluvial Systems Pty Ltd, Stockton, to the Murray-Darling Basin Commission, Canberra, ACT, March 2003, https://www.mdba.gov.au/sites/default/files/archived/mdbc-tlm-reports/2106_Review_of_Achievements_Outcomes_of_eflows_2002.pdf

Gower, T., Rutherfurd, I., Sims, A., Vietz, G., and Arrowsmith, C. (2020), *Barmah Choke Sediment Transport Investigation*. Report by Streamology for the Murray Darling Basin Authority, Canberra, 29 November 2020, https://www.mdba.gov.au/sites/default/files/pubs/barmah-millewa-forest-sediment-transport-investigation.pdf

Greenwood, S. (2003), *Barmah Island and Richardson's Lagoon Aboriginal Cultural Heritage Investigations*. A Joint Heritage Investigation Project of Northeast, Regional Cultural Heritage Program and Aboriginal Affairs, Victoria, 2003

Hale, J. and Butcher, R. (2011), *Ecological Character Description for the Barmah Forest Ramsar Site*. Report to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, Canberra

Harrington, B. and Hale, J., (2011), E*cological Character Description for the NSW Central Murray Forests Ramsar site*. Report to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, Canberra, https://www.dcceew.gov.au/sites/default/files/documents/ecd-nsw-central-murray-forests.pdf

Murray-Darling Basin Authority (2012), *Barmah-Millewa Forest Environmental Water Management Plan*. Murray-Darling Basin Authority, Canberra, February 2012, https://www.mdba.gov.au/sites/default/files/pubs/BMSL_FA_screen.pdf

NPWS (2012), *The Murray Valley National and Regional Parks (Millewa, Moira and Gulpa Islands Precincts) Fire Management Strategy*, Office of Environment and Heritage, 2012

NSW Heritage Office, 2001, *NSW Heritage Manual, Assessing Heritage Significance*. NSW Heritage Office, Sydney, July 2001, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Heritage/assessing-heritage-significance-2001.pdf

Invasive Plants and Animals Committee (2016), *Australian Weeds Strategy 2017 to 2027*. Australian Government Department of Agriculture and Water Resources, Canberra, https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/pests-diseases-weeds/consultation/aws-final.pdf

Jones, M. J. and Stuart, I. G. (2008), *Regulated floodplains a trap for unwary fish*. Fisheries Management and Ecology. vol 15, pp 71-79

Jones, M., Stuart, I.G., Sharpe, C., Childs, P., Allen, W., Cronin, B. and Fanson, B. (2022) *Optimising the Millewa Forest regulators to enhance native fish movement.* Unpublished client report for the NSW NPWS. Arthur Rylah Institute for Environmental Research, Victorian Department of Environment, Land, Water and Planning, Heidelberg, Victoria, 2022

King, A. J., Tonkin, Z., & Mahoney, J. (2007), *Assessing the effectiveness of environmental flows on fish recruitment in Barmah-Millewa Forest*. Report to the Murray-Darling Basin Commission. Arthur Rylah Institute for Environmental Research, Victorian Department of Sustainability and Environment

Lauchlan Arrowsmith, C. Vietz, G., Gower, T. Woods, K. (2021). *Options for Managing Sediment in the Barmah-Millewa Reach of the River Murray – Preliminary Investigations*. Report prepared for the Murray-Darling Basin Authority, Canberra, 29 November 2021, https://www.mdba.gov.au/sites/default/files/pubs/barmah-millewa-sediment-management-options-assessment-report.pdf

Leitch, C. (1989), *Towards a strategy for managing the flooding of Barmah Forest*. Victorian Department of Conservation, Forests and Lands: Benalla

Leslie, D.J. and Lugg, A. (1994), *Proposed plan for the rehabilitation of the Moira Lakes wetlands*. NSW Murray Wetlands Working Group Report. Department of Water Resources, Murray Region.

Leslie, D.J. (1995), *Moira Lake: A Case Study of the Deterioration of a River Murray Natural Resource*. M. For. Sci. Thesis, University of Melbourne, Parkville

Littleton, J. (1999), East and west: Burial practices along the Murray River, *Archaeology in Oceania*. **34**(1), pp. 1–14

Lyon, R. H., Lumsden, L. F. & Ward, K.A. (2002), Vertebrate fauna of Barmah Forest, a large forest of river red gum Eucalyptus camaldulensis on the floodplain of the Murray River. *The Victorian Naturalist*, Volume 119: pp. 230-248

Macumber, P.G and Thorne, R. (1975), The Coh–na cranium site - A re-appraisal. *Archaeology in Oceania* **10**(1), pp. 67–72

McKinnon, L. J. (1997), *Monitoring of Fish Aspects of the Flooding of Barmah Forest*. Marine and Freshwater Resources Institute, Queenscliff

Mid Murray Zone Bush Fire Management Committee (2009), *Bush Fire Risk Management Plan*. Mid Murray Zone Bush Fire Management Committee, November 2009, https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0014/2381/Mid-Murray-BFRMP.pdf

Murray-Darling Basin Authority (2010), *Assessing Environmental Water Requirements*. Chapter 10: Barmah-Millewa Forest. Murray-Darling Basin Authority, Canberra

Murray-Darling Basin Authority (2012). *Barmah-Millewa Forest Environmental Water Management Plan*, Murray-Darling Basin Authority, February 2012, https://www.mdba.gov.au/sites/default/files/pubs/BMSL_FA_screen.pdf

Murray-Darling Basin Authority (2015), *River Murray from Yarrawonga Weir to Wakool Junction Reach Report: Constraints Management Strategy*. Licensed from the Murray–Darling Basin Authority under a Creative Commons Attribution 3.0 Australia Licence, Murray Darling Basin Authority, July 2015, https://www.mdba.gov.au/sites/default/files/pubs/Yarrawonga-to-Wakool-reach-report.pdf

Murray-Darling Basin Authority (2022), *Central Murray*. https://www.mdba.gov.au/water-management/catchments/central-murray

Murray-Darling Basin Authority (2023), *Who manages the Murray -Darling Basin*. https://www.https://www.mdba.gov.au/water-management/allocations-states-mdba/managing-murray-river

Murray-Darling Basin Commission (2006), The Barmah-Millewa Forest Icon Site Environmental Management Plan 2006-2007. Murray-Darling Basin Commission, Canberra, https://www.mdba.gov.au/sites/default/files/archived/mdbc-tlm-reports/2083_Env_Man_Plan_Barmah_Millewa_2006-07.pdf

NPWS (2022), *Pesticide Use Notification Plan*. Environment and Heritage Group of the Department of Planning and Environment, Parramatta, April 2022, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/pesticide-use-notification-plan-220222.pdf

Raymond, S., Rourke, M., & Tonkin, Z. (2011) *Barmah-Millewa Fish Condition Monitoring: 2010/11 Annual Report*. New South Wales Department of Primary Industries and Arthur Rylah Institute for

Environmental Research. Victorian Department of Sustainability and Environment, Heidelberg, Victoria. Unpublished report submitted to the Murray-Darling Basin Authority

Raymond, S., Duncan, M., Tonkin, Z., and Robinson, W. (2021), *Barmah-Millewa Fish Condition Monitoring (2007-2021)*. Arthur Rylah Institute for Environmental Research Unpublished client report for the Murray-Darling Basin Authority. Victorian Department of Environment, Land, Water and Planning, Heidelberg, Victoria

Roberts, J. and Marston, F. (2011), *Water Regime of Wetland and Floodplain Plants. A Source Book for the Murray -Darling Basin*. National Water Commission: Canberra

Sharpe, C. (2018), Restoring Large bodied fish populations at Millewa Forest. Project status and summary report for NSW National Parks and Wildlife Service by CPS Enviro Pty Limited, 2018

Sharpe, C. and Wilson, E., (2012), *Fish surveys at 39 Sites Throughout Millewa Forest, NSW, with Focus on the Distribution of Southern Pygmy Perch* (Nannoperca australis). May/June 2012. Summary of Findings Report for the NSW Office of Environment and Heritage by CPS Environmental Research

Stuart, I., Sharpe, C. and Childs. P. (2020), *Recovery of large-bodied fish in Millewa Forest*. Unpublished client report for the NSW National Parks and Wildlife Service. Arthur Rylah Institute, Heidelberg, Victoria, 2020

Tindale, N. B. (1974). *Aboriginal Tribes of Australia - Their Terrain, Environmental Controls, Distribution, Limits, and Proper Names*, Canberra: Australian National University Press

Trueman, W.T. (2007), *Some Recollections of Native Fish in the Murray-Darling System with Special Reference to the Trout Cod* Maccullochella macquariensis, *Summary & Source Material from the Draft Publication* Bluenose: The Lost World of the Trout Cod. Prepared as an interim report for Native Fish Australia (Victoria) Incorporated, Doncaster, Victoria, June 2007, https://www.nativefish.asn.au/userfiles/files/Recollections_compressed.pdf

Vivian, L. and Godfree, R. (2012), The response of a degraded Murray River floodplain wetland to extreme drought and flood, in Grove, J.R. and Rutherford, I.D. (eds.) *Proceedings of the 6th Australian Stream Management Conference, Managing for Extremes*, 6 to 8 February, 2012, Canberra, Australia, published by the River Basin Management Society, pp1 - 7.

12Terms and abbreviations

AHD	Australian height datum
AHIMS	Aboriginal Heritage Information Management System
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	Biodiversity Conservation Regulation 2017
Biodiversity and Conservation SEPP	State Environmental Planning Policy (Biodiversity and Conservation) 2021
CEMP	Construction environmental management plan
DPI	Department of Primary Industries
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2021
FM Act	*Fisheries Management Act 1994*
IBRA	Interim Biogeographic Regionalisation for Australia
Joint operations working group	The operator of Pinchgut, Nestrons and Moira regulator and Little Edward River offtake regulator. The group comprises the Murray-Darling Basin Authority, NPWS and WaterNSW
LEP	Local environmental plan
Murray Valley SoMI	Statement of Management Intent: Murray Valley National Park and Murray Valley Regional Park (NPWS, 2014)
NPW Act	*National Parks and Wildlife Act 1974*
NPW Regulation	National Parks and Wildlife Regulation 2019
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NT Act	*Native Title Act 1993*

OEH	Office of Environment and Heritage
PCT	Plant community type
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
Proposed activity, the	The Millewa Forest Supply Project
RAP	Register Aboriginal party
REF	Review of environmental factors
SDL	Sustainable diversion limit
SDLAM	NSW Sustainable Diversion Limit Adjustment Mechanism Program
SEPP	State environmental planning policy
Site environmental water managers	Stakeholders with an interest in and/or responsibility to carry out environmental watering of Millewa Forest are: • NPWS, as the icon site manager for The Living Murray • The Biodiversity and Conservation Division of the Environment and Heritage Group of the Department of Planning and Environment, which manages the Barmah-Millewa water account • The Commonwealth Environmental Water Office and the Murray-Darling Basin Authority, which hold the water entitlement for The Living Murray. While all these stakeholders are involved in the management of environmental watering of Millewa Forest, for practical reasons NPWS has assumed day-to-day responsibility for carrying out environmental watering of the forest. For simplicity, environmental watering of the forest is discussed in this REF as the responsibility of 'the site environmental water manager'.
Transport and Infrastructure SEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
WM Act	*Water Management Act 2000* (NSW)

Attachment A Biodiversity assessment report

Attachment B Aquatic ecology and water quality assessment report

Attachment C Aboriginal cultural heritage assessment report

Attachment D Historic heritage assessment