Wilcannia Weir Replacement

Environmental Impact Statement

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Water Infrastructure NSW
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Wilcannia Weir Replacement Environmental Impact Statement

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Declaration

Project details	
Project name	Wilcannia Weir Replacement
Application number	SSI-10050
Address of the land on which the infrastructure is to be carried out	The project would be carried out on land near the Wilcannia township along the Darling River (Baaka), within the Central Darling local government area
Proponent details	
Proponent name	Water Infrastructure NSW
Proponent address	4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150
Details of person by whom this environmental impact statement was prepared	
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Professional qualifications	MPhil (science) Environmental and Geographical Science
Declaration by person by whom this environmental impact statement was prepared	
Name	Mike Luger
Organisation	Jacobs
Declaration	**The undersigned declares that this environmental impact statement:** ▪ Has been prepared in accordance with sections 190 and 192 of the Environmental Planning and Assessment Regulation 2021 ▪ Contains all available information relevant to the environmental assessment of the development, activity or infrastructure to which the environmental impact statement relates ▪ Does not contain information that is false or misleading ▪ Addresses the Planning Secretary's environmental assessment requirements (SEARs) for the project ▪ Identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments ▪ Has been prepared having regard to the Department's *State Significant Infrastructure Guidelines – Preparing an Environmental Impact Statement* ▪ Contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development ▪ Contains a consolidated description of the project in a single chapter of the environmental impact statement ▪ Contains an accurate summary of the findings of any community engagement ▪ Contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.
Signature	
Date	30 June 2022

Glossary of terms and abbreviations

Term	Definition
ABS	Australian Bureau of Statistics
AAR	Archaeological assessment report
Accessible storage	The portion of water stored behind a dam or weir that can be accessed for water supply purposes.
ADWG	*Australian Drinking Water Guidelines* (National Health and Medical Research Council and Natural Resource Management Ministerial Council, 2011).
AEP	Annual exceedance probability The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a flood event has an AEP of five per cent (one in 20 chance), then there is a five per cent chance of that flood event (or larger event) occurring in any one year.
Afflux	Afflux is used in this environmental impact statement to refer to the predicted change in flood levels between the proposed new weir and the existing weir.
AHD / mAHD	Australian height datum (in metres)
AHIMS	Aboriginal Heritage Information Management System
ALR Act	*Aboriginal Land Rights Act 1983* (NSW)
APIC Policy	*Aboriginal Participation in Construction Policy* (NSW Government, 2018)
ARI	Average recurrence interval The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as big as, or larger than the 20-year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
Barwon-Darling WSP	Water Sharing Plan for the Barwon-Darling Unregulated River Water Source 2012
Basin Plan	Murray-Darling Basin Plan
BCD	Biodiversity and Conservation Division of the Department of Planning, Industry and Environment
BDAR	Biodiversity development assessment report
BC Act	*Biodiversity Conservation Act 2016* (NSW)
Capital Project Plan	The funding plan for large projects, including Wilcannia Weir. It has the total cost to build the weir so the government can release that value of the grant to allow construction to start.
Construction contractor	The entity appointed by Water Infrastructure NSW to undertake the construction of the proposal.
CPTED	Crime prevention through environmental design
Darling Alluvial WSP	Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020
DEC	Department of Environment and Conservation NSW (former)
Detailed design	Detailed design broadly refers to the process that the construction contractor undertakes (should the proposal proceed) to refine the concept design to a design suitable for construction (subject to Water Infrastructure NSW acceptance).

Term	Definition
DP	Deposited plan
DPE	Department of Planning and Environment NSW
DPIE	Department of Planning, Industry and Environment NSW (former)
DFSL	Drought full supply level (66.71 metres AHD)
Dynamic storage	Operation of a weir so that the volume of water it is capable of storing varies over time. Dynamic storage is typically used to manage the discharge rate from a weir in response to the inflow rate and current storage volume.
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPBC Regulations	Environment Protection and Biodiversity Conservation Regulations 2000 (Commonwealth)
EPL	Environment protection licence
Fishways	Structures built into weirs or dams to allow fish to move upstream when there are flows.
FM Act	*Fisheries Management Act 1994* (NSW)
Full supply level	The water level when the weir pool is full to the top of the weir crest.
Headwater level	The height of the water column immediately upstream of a control structure that is not affected by any significant draw-down or related disturbance. For the new weir this is the depth of the new town pool at the new weir.
Headwater rating	The relationship between the headwater level and the rate at which water discharges from a weir.
Headwater rating curve	A chart of headwater ratings that plots headwater levels (y axis) against the rate of discharge from a weir (x axis).
IAP2	International Association for Public Participation
ICNG	*Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009)
ICOMOS	International Council of Monuments and Sites
ILUA	Indigenous land use agreement
Left and right riverbank	Reference to the left and right riverbank is with respect to the view in the downstream direction, in accordance with industry practice.
LEP	Local environmental plan
MDBA	Murray-Darling Basin Authority
ML/day	Megalitres per day
MNES	Matters of national environmental significance
New town pool	The new section of weir pool that would be created along an about 4.92 river kilometre stretch of the Darling River (Baaka) between the new weir and the existing weir.
NFSL	Normal full supply level (65.71 metres AHD)
NSW	New South Wales

Term	Definition
OCHRE Plan	*OCHRE – NSW Government Plan for Aboriginal Affairs: Education, Employment and Accountability* (NSW Government, 2013). OCHRE stands for Opportunity, Choice, Healing, Responsibility, Empowerment.
Operation rules	Rules which the operator has to follow for opening and closing the weir gates.
Overshot gate	Passes water over the top of a gate. It has a steel panel which is raised and lowered to control water flow.
OSOM	Oversized overmass
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PAD	Potential archaeological deposit
PRG	Project reference group
RAP	Registered Aboriginal party
River kilometre	Distance measured along the centreline of a river.
RMS	Roads and Maritime Services (former)
Tailwater level	The height of the water column immediately downstream of a control structure that is beyond the zone of any high energy flow and/or turbulent water. For the new weir this is the depth of the Darling River (Baaka) downstream of the new weir.
The proponent	Water Infrastructure NSW
The proposal	The Wilcannia Weir Replacement project
SEARs	Secretary's environmental assessment requirements
SES	NSW State Emergency Service
SIA Guidelines	*Social Impact Assessment Guideline for State Significant Projects* (DPIE, 2021d)
Tailwater level	The height of the water column downstream of a weir. For the new weir this is the depth of the flow in the Darling River (Baaka) downstream of the new weir.
TIA	Traffic impact assessment
Translucency rules	Weir operating rules that allow for some, but not all, of the inflows to the weir pool to pass the weir.
Transparency rules	Weir operating rules that allow for all of the inflows to the weir pool to pass the weir.
Undershot gate	Sliding gate for controlling the flow of water, where water is released under the gate.
Vertical slot fishway	Common fishway on larger rivers in eastern Australia. It includes a series of connected weirs and pools allowing fish to swim past barriers in the river, like the weir wall.
Weir crest	The highest surface of a weir over which water flows.
Weir drown-out	Weir drown-out occurs when the water level of the river immediately downstream of the weir rises above the level of the weir crest, resulting in the weir becoming submerged. At weir drown-out the weir ceases to be the primary hydraulic control on upstream river water levels.
Weir pool	The water that collects behind a weir structure.
Weir pool extent	The maximum length of a waterway along which water would pool behind a weir before it starts overtopping.
WM Act	*Water Management Act 2000* (NSW)

Term	Definition
WM Regulation	Water Management (General) Regulation 2018
WRP	Water resource plan
WRPA	Water resource plan area

Executive summary

Overview

Water Infrastructure NSW proposes to replace the existing Wilcannia Weir on the Darling River (Baaka) with a new weir located about five river kilometres downstream of the existing weir (the proposal). This would provide a more reliable long-term town water supply for Wilcannia to meet community needs. The existing weir would also be partially removed and decommissioned as part of the proposal. The proposal is located in the Central Darling local government area.

The proposal is declared State significant infrastructure under section 2.13 and Schedule 3 of the State Environmental Planning Policy (Planning Systems) 2021. The proposal is subject to assessment in accordance with Part 5 Division 5.2 of the *Environmental Planning and Assessment Act 1979* and the environmental assessment requirements of the Secretary of the NSW Department of Planning and Environment (the SEARs) (SSI-10050), dated 28 August 2020.

Need for the proposal

The existing Wilcannia Weir is near the end of its design life and is unable to hold a weir pool at its full supply level. The declining condition of the weir poses a risk to the town's water security. Currently when the water storage in the weir pool is low and particularly during periods of drought, Wilcannia draws on three emergency water supply bores.

Several studies and a detailed business case have been carried out to investigate options to replace the existing weir and improve the water security for Wilcannia. Technical investigations and community consultation have identified the preferred location of the new weir to be about 4.92 river kilometres downstream of the existing weir.

Once the new weir has been commissioned, the existing weir would need to be partially removed and decommissioned so that the structure would no longer be classified as a barrier on the waterway.

A small area of public open space is needed near the new weir to facilitate visitors.

Proposal objectives

The proposal aims to sustain Wilcannia through a reoccurrence of the worst historical drought on record (the Federation drought) inclusive of the consideration of the future impact of climate change. The proposal also seeks to benefit the local community by enhancing water quality, socio-economic opportunities and cultural connections to the Darling River (Baaka).

The objectives of the proposal are to:

- Improve water security for Wilcannia
- Enhance cultural connection to the river
- Improve water management of the weir pool
- Indirectly increase tourism opportunities and investment
- Provide better recreational amenity to walk and picnic
- Remove current barriers to native fish migration.

Description of the proposal

The new weir would be located about two kilometres south of the Wilcannia township. The key features of the new weir include:

- Storage capacity of about 7,832 megalitres of water when the weir gates and fishway gates are closed
- A fixed crest portion of the weir about five metres high and 21.5 metres wide
- A fishway about 120 metres long and 10.5 metres wide to provide fish passage past the weir
- Remotely operated weir gates (with a manual function) to manage the storage, release and quality of water within the weir pool
- An upgraded unsealed access track about three kilometres long, between the Barrier Highway and the left (southern) side of the new weir
- A new unsealed access track about 270 metres long, between Union Bend Road and the right (northern) side of the new weir
- A permanent maintenance access track about 120 metres long, from the top of the right riverbank extending along the length of the fishway
- An electricity easement from the existing overhead powerlines on Union Bend Road to a new pole-mounted substation on the right side of the new weir.

Other elements of the proposal include:

- Partial removal and decommissioning of the existing weir, which is located in the Wilcannia township
- A small recreation area, known as a community river place, at Union Bend
- Conversion of an existing flow gauging station located between the new and existing weirs into a weir pool height gauging station.

The new weir would have dual modes of operation comprising a normal operation mode when it would operate at the same full supply level as the existing weir, and a drought security operation mode when it would operate at a 'drought' full supply level one meter above the existing full supply level.

When the new weir is at the existing full supply level it would result in a weir pool of about 66.71 river kilometres comprising the existing 61.79 river kilometres of weir pool upstream of the existing weir plus a new section of weir pool of about 4.92 river kilometres between the new and existing weirs, which is referred to as the 'new town pool'.

When the new weir is at the drought full supply level it would result in the 66.71 river kilometres of weir pool that occurs at the existing full supply level being one metre deeper and an additional 18.81 river kilometres of weir pool upstream of the existing weir pool being inundated to a depth of up to one metre, to create a total weir pool length of about 85.52 river kilometres.

Construction of the proposal

Construction of the new weir is expected to start in early 2023. Construction and commissioning of the new weir is expected to take about 12 to 18 months, weather permitting. Construction of the proposal would occur in two distinct steps: construction of the fishway followed by construction of the fixed crest weir and the gate bay structure. The construction workforce is expected to average about 10 full time equivalent construction personnel, with a peak workforce of about 20 full time equivalent personnel.

Partial removal and decommissioning of the existing weir would take about 10 weeks and is proposed to occur after the new weir starts operating. Victory Park Caravan Park would be leased during these works to provide access to the existing weir and for use as a temporary construction compound and laydown area.

Benefits of the proposal

The key benefit of the proposal is to improve the liveability of Wilcannia by securing the town's water supply and providing readily available water for consumption. The proposal, together with the separate project proposed by Central Darling Shire Council for a new Wilcannia water treatment plant, would make the supply of drinking water less of a concern for the local community.

The proposal would also have some ecological benefits and create new recreational, tourism and employment opportunities:

- *Fishway* — The proposal includes a fishway that would allow fish passage past the new weir when flows in the river are greater than 30 megalitres per day. Fish passage past the new weir is predicted to be possible for an average of 255 days per year, which is substantially greater than the average of 54 days per year that fish passage is predicted to be possible past the existing weir. Importantly, the fishway would significantly increase the number of days that fish passage is available during the spawning season (October to April). Increased fish passage would provide native fish species with an improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which would in turn boost biodiversity, long-term population resilience and contribute to food webs.
- *New town pool* — The proposal would extend the weir pool to include the reach of the river between the new and existing weirs, which would result in there nearly always being some water visible in the river where it runs through the township. The new town pool would enhance civic amenity and pride and engender a 'feel good factor' in the local community. Also, the new town pool would be visible from the Barrier Highway at Wilcannia Bridge and could encourage more tourists to stop in Wilcannia and visit Baker Park. Any increase in foot traffic in Wilcannia as a result of more tourists stopping in the town would create greater trading opportunities for retail businesses.
- *Community river place* — The community river place would provide a space where cultural teachings could be conducted, a place for relaxation and recreational activities and also offers opportunities to celebrate cultural connections to the Darling River (Baaka). The community river place, together with the new weir, has the potential to be a local tourist attraction, particularly if the local community pursues opportunities such as incorporating these sites into an Aboriginal cultural heritage walk, for example.
- *Training and employment* — The proposal is likely to generate direct and indirect benefits for local and regional businesses, in industries that provide goods and services to support construction activities. Water Infrastructure NSW has established the Wilcannia Weir Local Business Register and would share the details of businesses on the register with the principal contractors who tender for the construction of the new weir so that they can select and partner with registered businesses as part of their commercial offer. Water Infrastructure NSW, in partnership with the Regional Enterprise Development Institute and Murdi Paaki Regional Assembly, has supported a TAFE program to upskill local residents to be job ready for employment opportunities when construction planning commences.

Community and stakeholder engagement

Water Infrastructure NSW has adopted a proactive approach to consultation with the local community and other project stakeholders in the development of a design of the new weir. One of the goals of Water Infrastructure NSW's engagement strategy for the proposal has been to give the Wilcannia community an active voice in the development of the preliminary concept design for the proposal. Water Infrastructure NSW has aimed to deliver culturally appropriate engagement and collaboration that is fair, accessible, inclusive and involved each family clan grouping.

Engagement with the community and key stakeholders has influenced the selection of the preferred location for the new weir as well as the design of the proposal and the mitigation and management measures that will be implemented during detailed design, construction and operation. The inclusion of a community river place in the proposal and its siting at Union Bend were also a direct result of community and stakeholder engagement.

Should the project be approved, Water Infrastructure NSW would continue to engage with the community and stakeholders in the lead up to, and during construction.

Environmental impact assessment

This environmental impact assessment is based on a preliminary concept design of the proposal that Water Infrastructure NSW has developed over a number of years in close consultation with the local Wilcannia community and other key stakeholders. Impacts have been avoided or minimised through the preliminary concept design development process by way of the following design elements:

- New weir location — The new weir is located about two kilometres from Wilcannia, which reduces the potential for the local community to be adversely impacted by noise, vibration, dust and visual impacts during its construction and operation
- Fish passage — The new weir includes a fishway that would enable fish to move upstream and downstream past the new weir when there are flows in the river greater than 30 megalitres per day
- Dual modes of operation — The new weir would only operate at the drought full supply level when low flows in the river are anticipated or occurring. This provides water security for Wilcannia for the longest drought on record without permanently storing the volume of water required to provide this level of water security. This minimises the hydrology, groundwater, flooding and aquatic ecology impacts of operating the new weir at a higher full supply level than the existing weir
- Translucency discharges — Some inflows to the weir pool would be discharged when the new weir is in drought security operation mode, which would increase the frequency of flows downstream of Wilcannia during droughts compared to the existing weir
- Vegetation clearing — Temporary construction compounds and laydown areas would be located away from areas of good quality or dense native vegetation, which would minimise clearing required for the project. Vegetation impacts have also been reduced by using existing tracks to provide access to construction sites, where feasible. The proposed staging of the construction works would further reduce the footprint of the construction works compared to carrying out all of the works concurrently
- Aboriginal cultural heritage — The construction footprint for the proposal is designed to avoid impacts to some Aboriginal cultural heritage items located near the new weir site, particularly hearths
- Partial removal of the existing weir — The existing weir has cultural significance to the local Wilcannia community and its partial removal respects the wishes of the community while ensuring that it does not impede flows or block fish passage.

The construction and operation of the new weir would have a range of impacts, particularly to hydrology, terrestrial and aquatic biodiversity and Aboriginal cultural heritage. The key impacts of the new weir would include:

Construction

- Hydrology — During construction of the fishway, river flows would be constricted by the narrowing of the river channel to accommodate a cofferdam around the fishway work site, which could result in some water temporarily ponding behind the cofferdam before flowing past the work site. Then, during construction of the weir wall and upstream and downstream embankments, flows would be directed into the newly built fishway to pass the work site. The elevation of the upstream end of the bed of the fishway relative to the elevation of the riverbed would result in ponding of water to a depth of 2.87 metres before it would spill down the fishway and continue downstream
- Surface water quality — There would be potential for sediment and nutrient laden runoff from areas disturbed by construction to impact water quality in the Darling River (Baaka) through increased turbidity if this risk is not appropriately managed. Areas which would present a high risk of soil erosion include locations where both surface gradients and slope lengths combined would increase the erosive potential of runoff

- Biodiversity — The proposal would directly impact 10.14 hectares of native vegetation, including 1.49 hectares of native vegetation present in the river channel between the new and existing weirs. The impacted vegetation includes ecosystem credit species habitat for the purposes of the Biodiversity Offset Scheme for 25 birds, seven mammals and one reptile. The proposal would also require the removal of instream vegetation at the new weir site including within the footprint of the fishway
- Aboriginal cultural heritage — Four Aboriginal cultural heritage items would be directly impacted including removal of a dead fallen canoe tree, ground disturbance at two open archaeological sites and trimming of a living canoe tree above the height of this tree's scar. Excavation may also impact currently unidentified subsurface Aboriginal objects, which could include artefacts, hearths, midden and potentially human burials
- Non-Aboriginal heritage — The existing weir is of local heritage significance and its partial removal would directly impact this item
- Social — There could potentially be some competition for temporary accommodation between the construction workforce and the travelling public during the peak tourism season. Also, the removal of some large River Red Gum trees at the new weir site would be a concern for some of the local community
- Land use and property — There would be no public access to the new weir site during construction.

Operation

- Hydrology (upstream inundation) — The new weir would permanently inundate about 4.92 river kilometres of the Darling River (Baaka) between the new and existing weirs. Additionally, when the new weir is in drought security operation mode it would temporarily inundate about 18.81 river-kilometres of the Darling River (Baaka) at the upstream end of the existing weir pool to a depth of up to one metre. The existing weir pool and the new town pool would also be inundated by an extra one metre of water
- Hydrology (downstream flows) — Modelling of the proposed operating regime of the new weir predicts an increase in short duration (less than five days) cease-to-discharge events due to the new weir not discharging when it is in the filling phase. Due to the short duration of these events their effect on flows downstream of the new weir is likely to dissipate, which would limit their effect on downstream cease-to-flow characteristics. The implementation of translucency operating rules at the new weir would break some long duration cease-to-flow events into two (or more) shorter duration cease-to-flow events. This would reduce the mean duration of cease-to-flow spells compared to the existing weir. The number of low flow events would increase but the duration of these events would decrease, due to the filling phase being triggered and the weir being in drought security operation mode for brief periods. However, the net result would be minor, with the total number of days of low flow spells predicted to be similar to that for the existing weir
- Groundwater — Equilibrium groundwater levels are expected to rise to within five metres of the ground surface either side of the river at the new town pool between the new and existing weirs. The rise in the groundwater level along this section of the river would be similar to that along the river at the existing weir pool. Long-term groundwater salinisation in low-lying areas up to 100 metres from the new town pool would be similar to that which already occurs upstream of the existing weir in low-lying areas
- Aquatic biodiversity — The permanently change in the hydraulic characteristics of the river at the new town pool from a flowing environment to a still water environment has the potential to impact the abundance and diversity of species reliant on flowing conditions as it can disrupt life-cycles of species and degrade habitat conditions. The predicted increase in short duration cease-to-flow events has the potential to result in local scale impacts immediately downstream of the new weir. The downstream extent of any impact to aquatic ecology is likely to be short for the predicted increase in short duration cease-to-flow events given that discharge from the new weir would recommence relatively quickly (within days). Downstream flows would continue as pools drawdown and these pools would refill once discharge from the weir recommences. The short duration of the increase in number of cease-to-flow events at the weir discharge point means that downstream pools are unlikely to draw down to levels that would result in downstream flows ceasing before refilling occurs
- Aboriginal cultural heritage — The new town pool would permanently inundate five Aboriginal cultural heritage items including fish traps located immediately downstream of the existing weir

- Non-Aboriginal cultural heritage — Fluctuations in the level of the new town pool have the potential to exacerbate existing corrosion to the piers and cross braces of Wilcannia Bridge, a local heritage item. The new town pool would also complicate any attempts at stabilisation or remediation of Wilcannia Bridge due to the permanent presence of water under the bridge
- Social — The new town pool would create a different swimming environment to the current (sometimes shallow) flowing water and sandbar environment that the community is accustomed to at Baker Park and elsewhere along the river between the new and existing weirs. This may present some safety risks for young children or people who are not strong swimmers
- Visual amenity — The new weir and fishway would be permanent structures within the river channel downstream of Union Bend in what is currently a mostly natural setting. Power poles and overhead powerlines and a new access track would cross the landscape between Union Bend Road and the new weir. The new town pool would transform this reach of the river from a flowing water and sandbar environment to a weir pool with deep standing water. The top of the retained portion of the weir crest of the existing weir would occasionally be visible when the water level in the weir pool is low, but otherwise the existing weir would be submerged.

Next steps

Water Infrastructure NSW is seeking approval from the Minister for Planning for the construction and operation of the project. Steps in the process include:

- Exhibition of the environmental impact statement for a minimum of 28 days in accordance with statutory requirements and invitation for the community and stakeholders to make submissions
- Consideration of submissions. Submissions received by the Secretary of the Department of Planning and Environment would be provided to Water Infrastructure NSW and any relevant public authorities. Water Infrastructure NSW may then be required to prepare and submit:
  - A submissions report, responding to issues raised in the submissions
  - A preferred infrastructure report, outlining any proposed changes to the project to minimise its environmental impacts or to deal with any other issues raised
- Determination of the environmental impact statement. The Minister for Planning would then make a decision on the project and, if approved, set conditions of approval.

Consultation with the community and stakeholders would continue throughout the detailed design and construction phases as required.

During the exhibition period, the environmental impact statement will be available for viewing at the Department of Planning and Environment major project planning portal: www.planningportal.nsw.gov.au/major-projects/projects/on-exhibition

Physical copies of the environmental impact statement will be available for viewing during the exhibition period at:

- Wilcannia Local Aboriginal Land Council
  72 Woore Street
  Wilcannia
- Regional Enterprise Development Institute
  35 Reid Street
  Wilcannia
- Central Darling Shire Council
  21 Reid Street
  Wilcannia

Written submissions can be made to the Secretary of the Department of Planning and Environment. All submissions received will be placed on the Department of Planning and Environment website. Submissions can be made by creating an account at www.planningportal.nsw.gov.au/major-projects/projects/on-exhibition. This allows you to save a submission in progress and stay up to date with the progress of an application.

1. Introduction

1.1 Proposal overview

Water Infrastructure NSW ('the proponent') is seeking approval to construct and operate a new weir on the Darling River (Baaka), and to partially remove and decommission the existing weir, next to the township of Wilcannia in western New South Wales (NSW) ('the proposal'). The proposal is located in the Central Darling local government area and would provide a more reliable long-term town water supply for Wilcannia to meet community needs. The proposal is funded by a $30 million commitment from both the NSW and Commonwealth governments.

The proposal location is shown in **Figure 1-1**. The key features of the proposal are shown in **Figure 1-2**. A detailed proposal description is provided in **Section 2**.

The new weir would provide 5,435 megalitres of water accessible for the town's water supply and extend water availability to Wilcannia during dry years. This would allow the town's unrestricted dry year extraction to increase by about 100 megalitres.

1.1.1 Proposal history

Wilcannia Weir was constructed in 1942 as the primary source of water supply for the town. Major refurbishment to the weir was carried out in 1987 and included scour restoration and additional rockfill. The existing weir continues to degrade, being near the end of its design life and is unable to hold a weir pool at its full supply level. The declining condition of the weir poses a risk to water security for Wilcannia. Currently when the water storage in the weir is low and particularly during periods of drought, Darling Shire Council introduces restrictions on water use and operates three emergency water supply bores to supplement the town's water supply.

Several studies and a detailed business case have been carried out to investigate options to replace the existing weir and improve the water security for Wilcannia. Technical investigations and community consultation have identified the preferred location of the new weir to be about 4.92 river kilometres downstream of the existing weir. The replacement weir location has been agreed upon with the community following an extensive period of consultation.

1.1.2 Proposal objectives

The proposal would secure existing and future water supply for the township of Wilcannia and also create opportunities for new recreational uses of the Darling River (Baaka) where it passes through the township. The proposal aims to sustain Wilcannia through a reoccurrence of the worst historical drought on record (the Federation drought) inclusive of the consideration of the future impact of climate change. The proposal also seeks to benefit the local community by enhancing water quality, socio-economic opportunities and cultural connections to the Darling River (Baaka).

The specific objectives of the proposal are to:

- Improve water security for Wilcannia
- Enhance cultural connection to the river
- Improve water management of the weir pool
- Indirectly increase tourism opportunities and investment
- Provide better recreational amenity to walk and picnic
- Remove current barriers to native fish migration.

The new weir would improve water security by providing 7,832 megalitres of water storage, of which 5,654 megalitres would be accessible to the town's water supply. In comparison, the existing weir can store a maximum of 4,207 megalitres, of which 2,173 megalitres is accessible to the town's water supply. The new weir would also include a fishway to enable fish passage past the weir, which would enable fish migration upstream and downstream at Wilcannia.

1.2 Approval requirements

The proposal is declared to be State significant infrastructure and is subject to the provisions of Part 5 Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The proposal also requires assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the referral to the Commonwealth Department of Agriculture, Water and the Environment has determined the proposal to be a controlled action. As a result of the referral decision, the proposal will be assessed under the Bilateral Agreement between the NSW and Commonwealth governments.

Further information on the approval requirements is provided in **Section 4.**

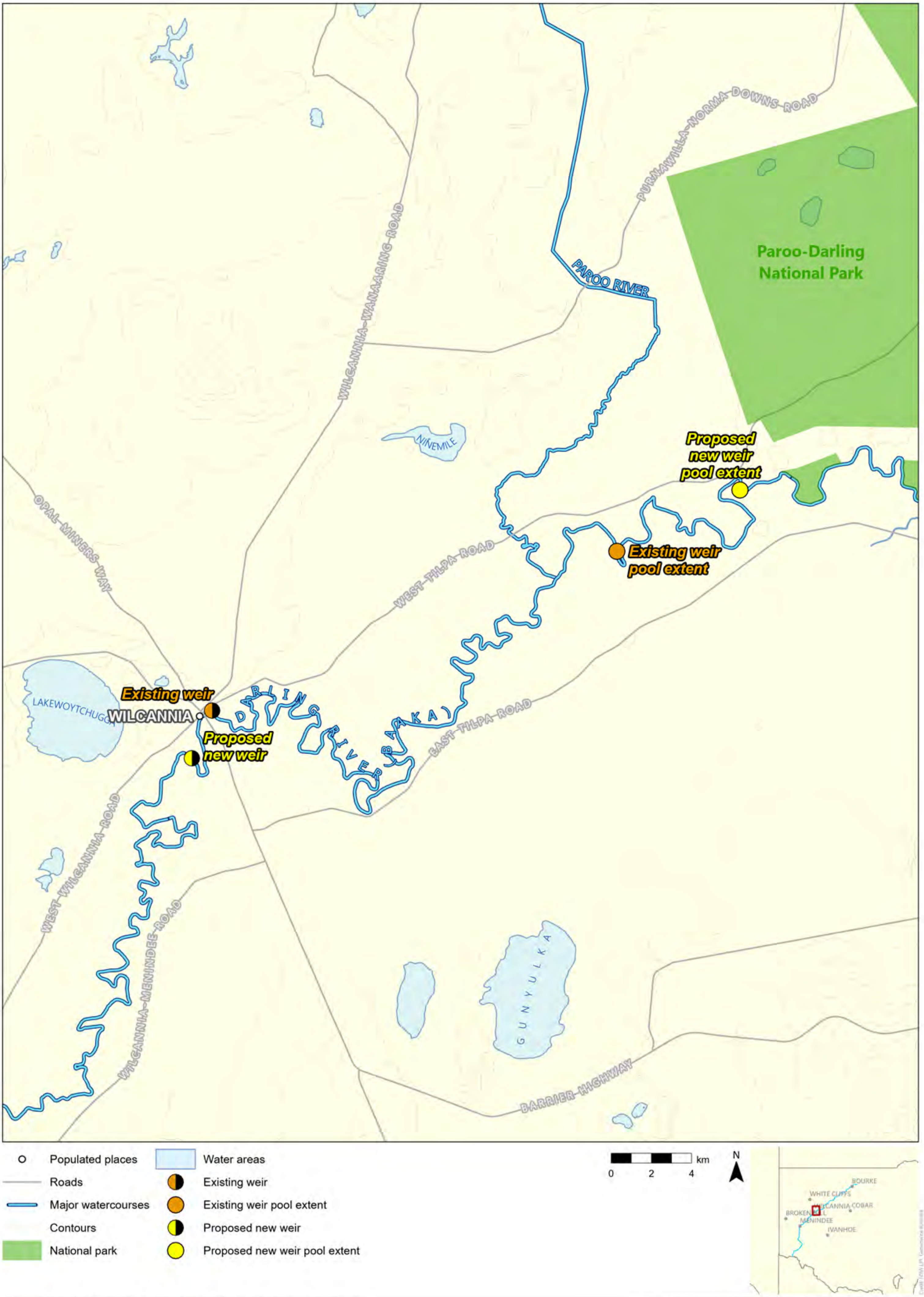

Figure 1-1: Proposal location and regional context

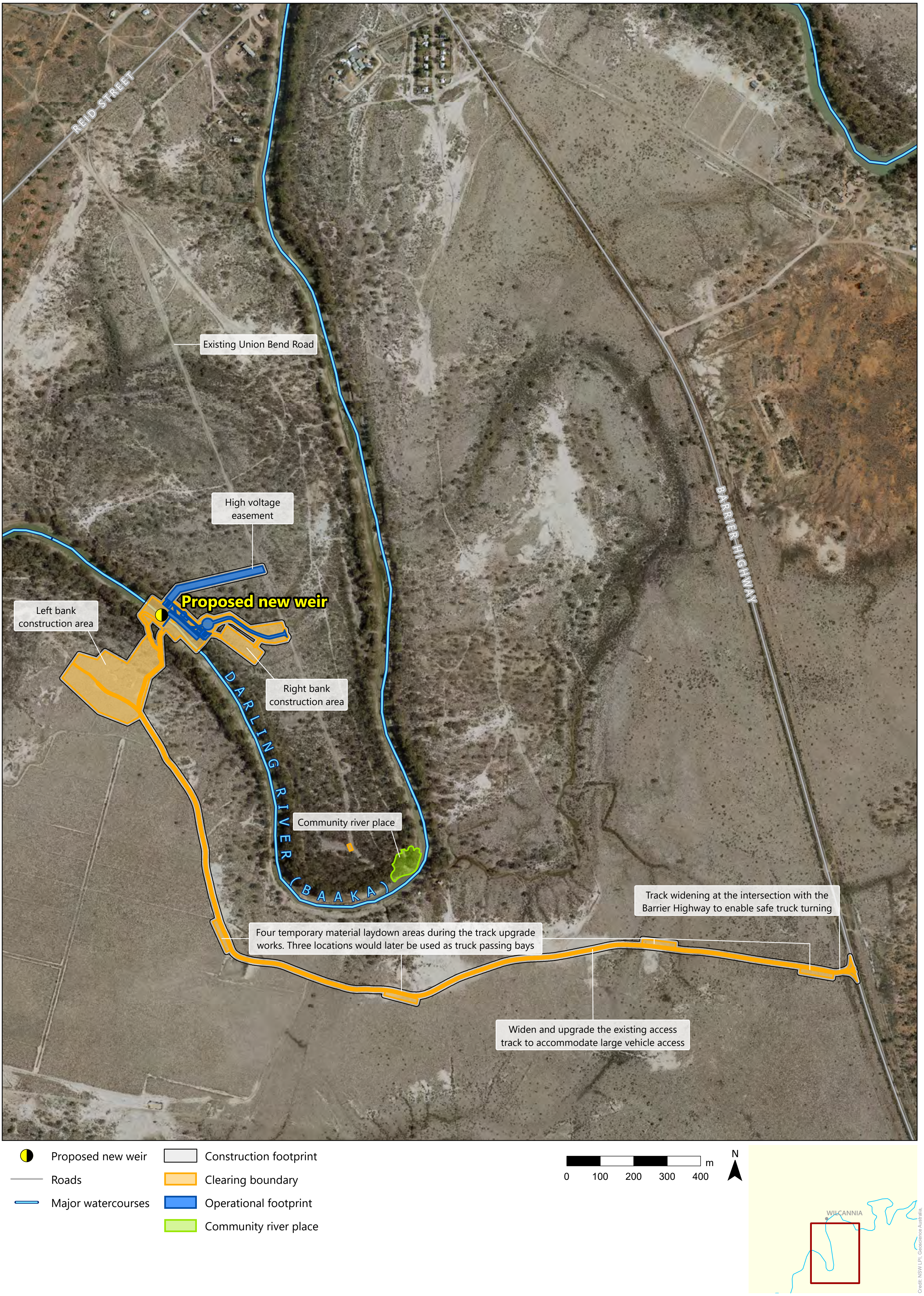

Figure 1-2: Key design features of the proposal – new weir site (overview)

1.3 Site and surrounds

Wilcannia was established in 1866 and during the 1880s became one of the major river ports on the Murray-Darling River (Baaka). Today, Wilcannia is a small town with a population of 549 (Australian Bureau of Statistics (ABS), 2016) with Aboriginal and/or Torres Strait Islander people making up 74.4 per cent of the population, mostly from the Barkandji[1] Nation (Barkandji meaning “people of the river”). There is archaeological evidence of occupation dating back 26,000 years.

The Darling River (Baaka) at Wilcannia forms part of the Barwon-Darling catchment in the Murray-Darling Basin. The Barwon-Darling catchment takes in the Barwon River, from upstream of Mungindi at the confluence of the Macintyre and Weir Rivers, to where the Barwon meets the Culgoa River, a distance of 577 kilometres). From this point the river channel becomes the Darling River (Baaka) and continues downstream to the Menindee Lakes and onwards to the River Murray, a distance of 1,545 kilometres. Multiple tributaries enter the Barwon-Darling River (Baaka) as it travels through the valley including the Gwydir, Namoi, Macquarie, Bogan, Warrego and Paroo Rivers. There are 14 weirs on the Darling (Baaka) and Barwon Rivers upstream of Wilcannia Weir. These include six weirs for town water supply at Mungindi, Collarenebri, Walgett, Brewarrina, Bourke, Louth and Tilpa.

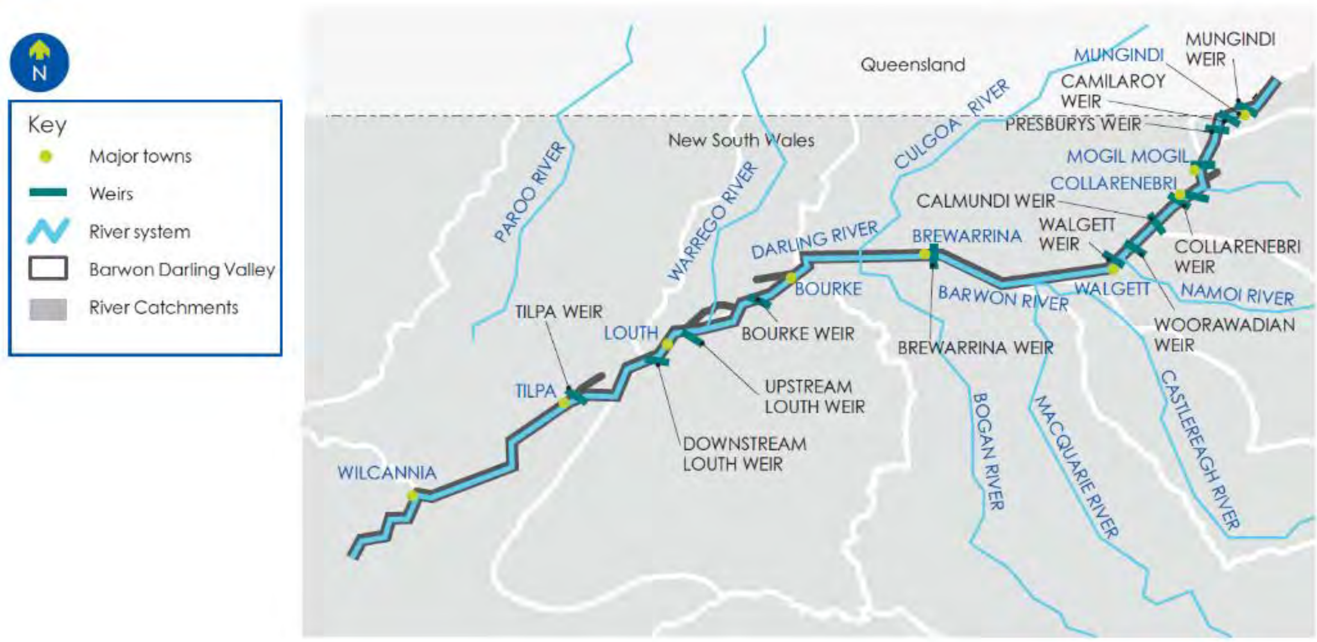

Figure 1-3 Weirs on the Barwon-Darling River (Baaka) upstream of Wilcannia

Source: WaterNSW (2019)

The Barwon-Darling River (Baaka) system is mostly dependent on rainfall-generated flow from unregulated tributaries that carry water from northern NSW and southern Queensland. Several tributaries such as the Macquarie, Namoi, Gwydir and Border Rivers and the Condamine-Balonne river system are regulated to varying degrees by major dams and weirs and private diversions and are only well-connected to the Barwon-Darling River (Baaka) during large flows. Once flows reach the Barwon-Darling they are contained in a series of constructed low-level weirs until their capacity is exceeded and they overflow. The presence of weirs alters flow patterns and geomorphic processes such as sediment movement (Thoms and Walker, 1993).

Average rainfall across the Barwon-Darling catchment is low, ranging from about 500 millimetres per year at Mungindi to 250 millimetres per year at Wilcannia (Murray-Darling Basin Authority (MDBA), 2016). Annual river flow may range from just one per cent to over 1,000 per cent of the annual average, and periods of no flow can

> [1] Note several spellings are commonly used, including Baakandji, Barkindji, Baakinji, Paakantyi. This report uses the spelling ‘Barkandji’, as this spelling was used in native title documents. Use of this spelling in this document should not be taken as implying elevated legitimacy or correctness of this spelling over others.

persist from months to years (Saintilan & Overton, 2010). Rainfall in the catchment is extremely variable, resulting in highly variable river flows. Typically, rain events are summer dominated with the largest events tending to be associated with ex-tropical cyclones that have moved inland (Thoms et al, 2004).

Water extraction from the Barwon-Darling River (Baaka) tends to be large volumes that are diverted from the river opportunistically for subsequent use in irrigated agriculture, or small volumes that are diverted often to provide stock and domestic water including for towns. Large diversions are extracted from the river or harvested as floodplain runoff, often being transferred to large private off-river storages. Most water entitlements under the water sharing plan for the catchment allow diversions when flows reach levels specified in water licences, reducing the amount of flow remaining in the river (MDBA, 2016).

The existing Wilcannia gauging station is the last flow measurement point before water enters Menindee Lakes, where it is re-regulated, and the Lower Darling catchment begins. There are very few extractions between Wilcannia and Menindee Lakes. The average total annual discharge (flow) from the Barwon-Darling River (Baaka) system measured at Wilcannia is 2,048,000 megalitres. This amount fluctuates significantly over time due to the variability in flow between wet and dry years (WaterNSW, 2019).

The Barwon-Darling corridor connects all the rivers, lakes and wetlands in the northern Murray-Darling Basin and provides a connection to the southern Murray-Darling Basin through the Lower Darling catchment. The river system provides important ecological habitats during dry periods or small flows, and travel corridors through the semi-arid inland. There are many billabongs and lagoons along the Barwon-Darling corridor, as well as lakes and wetlands on the floodplains, which provide major bird breeding sites during wet periods (WaterNSW, 2019).

The major land use in the Barwon-Darling catchment is agriculture, and other significant industries include tourism and retail. Heritage buildings and local art are the main local attractions. The town of White Cliffs and the Paroo-Darling National Park are also tourist destinations, within a two-hour drive from Wilcannia. Wilcannia Weir and its surrounds along the Darling River (Baaka) are popular for recreation, fishing and bushwalking.

Central Darling Shire Council currently operates the Wilcannia Weir as well as the emergency water supply bores (located on Union Bend Road), the water supply intake structure located about 80 metre upstream of the existing weir wall within the weir pool, and the town's water filtration and treatment plants. The exiting weir comprises a fixed crest that has no ability to pass flows, with water only flowing downstream when the weir overtops.

The new weir site is on a reach of the river downstream of Union Bend where the river channel is about 12 metres deep and the surrounding area is characteristic of the broader river landscape with relatively flat topography and undisturbed riverine vegetation. Land next to the left (southern) riverbank near the new weir site is owned by the Wilcannia Local Aboriginal Land Council. Land next to the right (northern) riverbank near the new weir site is Crown land.

The access to the left riverbank at the new weir site would be through land owned by Wilcannia Local Aboriginal Land Council in accordance with a lease agreement with Water Infrastructure NSW. The proposal site is located on native title (exclusive on land owned by the Wilcannia Local Aboriginal Land Council and non-exclusive on land owned by the Crown) held by the Barkandji Native Title Group Aboriginal Corporation. The native title rights extend over the upstream stretch of the new weir pool, and the existing weir site.

1.4 Proponent

Water Infrastructure NSW is the proponent for the proposal. Water Infrastructure NSW is responsible for leading the development and delivery of key NSW Government water infrastructure projects and programs. It aims to deliver projects that will contribute to the safety, security and sustainability of the State's water resources. Water Infrastructure NSW collaborates with industry partners and stakeholders, to deliver innovative infrastructure and water management solutions, with a focus on outcomes that support the health, well-being and prosperity of its customers and communities as well as the natural environment. Water Infrastructure NSW is responsible for designing and constructing the proposal on behalf of the NSW and Commonwealth governments.

It is proposed that WaterNSW would own and operate the new weir. WaterNSW is an NSW Government State owned corporation established under the *Water NSW Act 2014*. It operates the State's rivers and water supply systems in accordance with the rules set by regulators. It supplies two-thirds of water used in NSW and its customers include regional towns and local water utilities.

The proposal was originally proposed by WaterNSW as the proponent, and WaterNSW conducted the earlier studies and stakeholder consultation associated with the preparation of the proposal's detailed business case and environmental impact statement. In September 2021, the proposal was transferred to Water Infrastructure NSW as the proponent. A substantial part of the proposal's preliminary concept design development, detailed business case, stakeholder consultation and environmental impact statement preparation and finalisation has been undertaken by Water Infrastructure NSW. An overview of the previous studies, the options and alternatives to the proposal and selection of the preferred weir location is detailed in **Section 2.2**.

Water Infrastructure NSW will consult with WaterNSW throughout the detailed design phase of the proposal, during which a final design for the new weir would be developed prior to construction starting.

1.5 Report structure

This environmental impact statement has been prepared to support the application for approval of the proposal under Part 5 Division 5.2 of the EP&A Act. It addresses the Planning Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment (DPE) on 25 June 2020 and 28 August 2020 (refer to **Appendix A**) and the form and content requirements of sections 190 and 192 of the Environmental Planning and Assessment Regulation 2021 (refer to **Appendix A.3**) and the *State Significant infrastructure Guidelines – Preparing an Environmental Impact Statement* (Department of Planning, Industry and Environment (DPIE), 2021a).

The environmental impact statement structure is as follows:

- **Section 1** provides a general proposal overview, approval requirements and a description of the site and surrounds
- **Section 2** establishes the proposal need and strategic context
- **Section 3** provides a description of the proposal
- **Section 4** outlines the planning and assessment process
- **Section 5** provides a summary of the engagement and consultation conducted for the proposal
- **Section 6** outlines the assessment approach and methodology adopted for this environmental impact statement
- **Section 7** summarises the hydrology assessment provided in **Technical Report 1**
- **Section 8** summarises the geomorphology assessment provided in **Technical Report 1**
- **Section 9** summarises the groundwater assessment provided in **Technical Report 1**
- **Section 10** summarises the surface water assessment provided in **Technical Report 1**
- **Section 11** summarises the flooding assessment provided in **Technical Report 1**
- **Section 12** summarises the terrestrial biodiversity assessment provided in **Technical Report 2**
- **Section 13** summarises the aquatic ecology assessment provided in **Technical Report 3**
- **Section 14** summarises the Aboriginal heritage assessment provided in **Technical Report 4**
- **Section 15** summarises the non-Aboriginal heritage assessment provided in **Technical Report 5**
- **Section 16** provides an assessment of the social, land use and property impacts
- **Section 17** provides an assessment of the visual impacts and summarises the landscape design described in **Technical Report 6**

- **Section 18** provides an assessment of the geology, soils and contamination impacts
- **Section 19** summarises the traffic and transport assessment provided in **Technical Report 7**
- **Section 20** summarises the noise and vibration impact assessment provided in **Technical Report 8**
- **Section 21** provides an assessment of other key issues, comprising: air quality, waste, bush fire, climate change and greenhouse gas emissions and sustainability
- **Section 22** provides a cumulative impact assessment of the proposal
- **Section 23** presents an environmental risk analysis for the proposal
- **Section 24** presents the proposal justification.

2. Strategic context

This section provides a strategic justification of the proposal. Alternatives to the proposal that have been considered are summarised, a justification for the selection of the preferred option is provided and the strategic policy context is presented.

2.1 Proposal need

2.1.1 Overview

In a semi-arid climate zone community such as Wilcannia, water performs a vital role in sustaining the community, through drinking water supply, the irrigation of green spaces, the cooling of living and working spaces and supporting local industry and commerce. The Darling River (Baaka) is critical to the liveability, social amenity, and general wellbeing of the Wilcannia community, in terms of providing a safe water supply and a focal point for community amenity and recreation. It is also a much-valued cultural asset.

The existing Wilcannia Weir pool is the primary source of water for the township. The Darling River (Baaka) experiences prolonged low flow and dry periods. Inflow to Wilcannia Weir ceased between December 2013 and March 2014, October 2014 and March 2015 and again between August 2019 and March 2020. These events are projected to continue into the future, leading to significant reductions in river flows and threatening critical town water supply. There is a fundamental need to protect long-term town water security for the community by providing suitable water infrastructure to increase the volume of the weir pool and maintain water quality in the absence of sufficient regular flows. This is even more critical when factoring in climate change.

Currently, raw water is pumped from the weir pool to a water treatment plant owned and operated by Central Darling Shire Council that treats the raw water for delivery of potable (drinking) water to the town. In addition, the pump services a separate non-potable (raw) water supply to the town for irrigation purposes. During periods of low or no flow in the Darling River (Baaka) when the existing weir pool is below the maximum operating depth of the intake pump or of poor raw water quality, water is sourced from 'emergency' groundwater bores located at Union Bend, downstream of the existing weir. However, bore water cannot be used as the sole source of supply as the bore yields are not sufficient to supply the potable and non-potable water demands for the town.

The resumption of river flow after a low or dry period often results in excessive salinity levels in the weir pool, which needs to dissipate before supply from the weir pool can resume. The recent frequency of water restrictions and the reliance on emergency bore water supply highlights a clear service need that is currently unfulfilled. More frequent restrictions on water use have an adverse impact on community amenity, lifestyle and commerce (Jacobs, 2016).

2.1.2 Engineering

Wilcannia Weir is 80-years old and is in poor condition. In spite of a substantial refurbishment carried out in 1987, there is erosion of the river channel and degradation of the weir structure on the right abutment (refer to **Photo 2-1**). The main issues with the existing weir identified by Public Works Advisory (2019) include:

- It is unable to maintain an upstream weir pool at the design full supply level (65.71 metres Australian Height Datum (AHD)) due to a crest gap on the right abutment where a dilapidated section of timber (plank) sheet piling has resulted in a breach of the weir crest of at least 0.6 metres in height
- Minor seepage can be observed on the downstream face of the weir, which could be expected to increase under a full weir pool. The age of the weir suggests that the steel sheet pile cut-off wall may be corroded in areas
- There is a loss of large rockfill downstream of the crest, particularly towards the right side of the weir

- There is erosion on the right bank abutment and immediately upstream and downstream of the abutment. The erosion of this bank particularly occurs during flood events when there are large flows of high velocity water over the weir
- There is moderate deterioration of the weir crest capping concrete quality, although these cracks are not recent
- There is a large scour hole at the downstream weir toe
- There is no formal access to the weir site.

The poor condition of the weir makes the town more susceptible to low and no flow periods in the Darling River (Baaka) because of the risk of not being able to maintain the weir pool at the design full supply level. Without any remedial work, the weir is likely to continue to degrade in height, and hence the weir pool would continue to reduce in volume. This would lead to more frequent water restrictions, increased reliance on the emergency bores or implementation of emergency pumping from upstream river pools to maintain supply. This scenario presents an unacceptable risk to the security and reliability of water for the local Wilcannia community.

Photo 2-1 Erosion of the river channel and degradation of the right abutment of the existing weir structure

2.1.3 Water security analysis

A secure town water supply is one where the secure yield of the system exceeds the unrestricted dry year extraction requirements for the water supply. Secure yield is defined as the highest annual demand that can be supplied whilst meeting the 5/10/10 rule (NSW Office of Water, 2013). This rule requires that:

- Restrictions should be in place for no more than five per cent of the total time

- Restrictions should be in place in no more than 10 years out of every 100 (10 per cent of years)
- Restrictions should not require a reduction of more than 10 per cent of the unrestricted dry year water demand.

The unrestricted dry year extraction predictions for Wilcannia for the period from 2016 to 2046, as identified in the *Wilcannia Weir Upgrade Addendum to Business Case* (Public Works Advisory, 2019) are provided in **Table 2-1.**

Table 2-1 Unrestricted dry year extraction predictions for the Wilcannia water supply system, 2016 to 2046 (megalitres per year)

Dry year extraction	2016	2021	2026	2031	2036	2041	2046
Potable supply	172	178	183	186	190	194	198
Non-potable supply	273	277	280	281	282	284	285
Total dry year demand	**445**	**455**	**463**	**467**	**472**	**478**	**483**

Source: Public Works Advisory (2019)

A secure yield analysis was undertaken as part of the development of Central Darling Shire Council's Integrated Water Cycle Management Strategy. The water security provided by the existing weir was analysed by assessing its capacity to meet the town's water needs if there was nil inflow to the weir pool for 12 months. The analysis found that the existing weir does not provide adequate water security to Wilcannia when applying the 5/10/10 rule. The analysis did not consider the emergency borefield supply as the reliability of supply from the bores is unknown (Public Works Advisory, 2019), or implementation of emergency pumping from upstream river pools.

2.1.4 Water quality

Raw water is pumped from the weir pool to a non-potable 25 megalitre raw water reservoir owned and operated by Central Darling Shire Council. Raw water supplied from the reservoir represents 65 per cent of the total water consumed from the weir pool. It is reticulated untreated and generally unmetered for a range of non-potable (outdoor) uses including irrigation of open spaces and gardens. The remaining 35 per cent of the water drawn from the weir pool is diverted to the town's water treatment plant for treatment for potable (indoor) water uses.

During times of no inflow at the weir, drinking water is sourced from groundwater bores at Union Bend. The extracted bore water is aerated and stored in a 22-kilolitre balance tank before being transferred to the water treatment plant. This infrastructure is all owned and operated by Central Darling Shire Council.

Water quality issues at Wilcannia are identified in the Concept Design Report for Three New Water Treatment Plants at Ivanhoe, White Cliffs and Wilcannia in the Central Darling Shire, NSW (Public Works Advisory, 2017). The key issues associated with the raw water sourced from the river are:

- Saline groundwater intrusion can occur when there is low flow in the Darling River (Baaka)
- Iron and manganese levels exceed the Australian Drinking Water Guidelines
- The turbidity of the raw water exceeds the Australian Drinking Water Guidelines
- Algal growth has been noted at the clarifier of the existing water treatment plant
- The raw water is visibly coloured, which is attributed to iron, organics and algae
- Taste and odour problems are experienced sometimes
- The bore water extracted at Union Bend also has elevated iron and manganese levels.

The existing water treatment plant at Wilcannia is nearing the end of its design life and Central Darling Shire Council proposes to replace it. Construction of a new water treatment plant for the town is scheduled to start in 2022 (refer to **Section 22.3**). The construction of a new water treatment plant at Wilcannia is unrelated to the proposal, however it would further support the supply of quality potable water to the community once completed. Water Infrastructure NSW is engaging with Central Darling Shire Council to coordinate the timing of council's delivery of the proposed new water treatment plant to occur prior to commissioning of the new weir.

The inclusion of weir gates in the design of the new weir would create opportunities to manage water quality in the weir pool by altering the discharge rate and thereby the rate at which water flows through the weir pool. These opportunities to manage water quality in the weir pool are currently unavailable as the existing weir is a fixed crest weir.

2.1.5 Funding

In November 2018, the Commonwealth and NSW Governments acknowledged the need to address the security and quality of Wilcannia's water supply by committing $30 million to upgrade the Wilcannia Weir.

The Commonwealth funding of $15 million is drawn from the Sustainable Rural Water Use and Infrastructure Program, a national program managed by the Department of Agriculture, Water and the Environment to invest in rural water use, management and efficiency.

The State funding of $15 million falls under the Safe and Secure Water Program, a regional infrastructure co-funding program established in 2017 to address regional water safety and security in NSW. The funding commitment came after many years of community lobbying.

Water Infrastructure NSW has received additional funding for the project from the NSW Government.

2.2 Options and alternatives considered

2.2.1 Options and potential locations

A number of investigations and studies have been carried out over the past 20 years to identify a preferred solution for water supply at Wilcannia. The local community played a key role in the identification and consideration of options and alternatives and the selection of the proposal as preferred (refer to **Section 5.3**).

In 2000, an investigation of 10 sites between six and 10 kilometres downstream of the existing weir was undertaken, with the results documented in *Wilcannia Water Supply Augmentation – Weir Based Options Study* (SMEC, 2000). Four of the 10 sites were considered further, as documented in *Wilcannia Weir Upgrade – Reconnaissance of Four New Weir Sites* (NSW Public Works, 2013).

Site B is situated about 4.2 kilometres downstream from the existing weir and was initially elected as the preferred location. In a subsequent ranking of site suitability, site A2, located a further one kilometre downstream from Site B, was identified as the alternative preferred site. In 2014, the NSW Government began investigating options for upgrading the Wilcannia Weir based on these investigations and community consultation.

In 2015-2016, a scoping study and business case for the replacement of Wilcannia Weir was prepared (Jacobs, 2016). The scoping study and business case identified three possible options for the future of the Wilcannia Weir. These were:

1) Do nothing
2) Replacement of the weir at the existing site
3) Replacement of the weir at a new downstream site.

In both replacement options, the town water supply intake structure would remain at its existing location.

A multi-criteria assessment process was used at a workshop held on 17 August 2015 attended by participants from the Commonwealth Government (one representative), NSW Government (10 representatives), Central

Darling Shire Council (two representatives) and the Wilcannia community (six representatives including Wilcannia Local Aboriginal Land Council and Wilcannia Tourism Association) to assess the three weir options in a fair, open and transparent way to arrive at the preferred option.

The analysis used a set of agreed evaluation criteria with agreed weightings which were chosen to assess each option. Each option considered was given a score against the following assessment criteria:

- Environmental
  - Improves riverine ecosystem health
  - Enhances the terrestrial riparian zone health
  - Increases native fish populations
- Social
  - Restores cultural connection to the river
  - Creates local employment opportunities
  - Improves civic amenity and pride
  - Improves visual and recreational amenity
  - Improves water security
- Financial
  - Capital and operational cost
  - Reduces risk of economic loss due to severe water restrictions
  - Stimulates private investment
  - Enhances impact of government investment and services.

All groups at the multi-criteria assessment workshop selected Option 3, the downstream option for a new weir as the preferred option based on the above 12 criteria.

Following discussion with the community about the most appropriate downstream site and consideration of the local geomorphology and heritage features, the question of the most appropriate downstream site was re-visited. Four downstream locations were considered (refer to **Figure 2-1**):

- Site B, located about 4.2 kilometres downstream from the existing weir
- Site 1, located about six kilometres downstream from the existing weir
- Site A2, located about 5.25 kilometres downstream from the existing weir
- Site D, located about 1.9 kilometres downstream of the existing weir.

Figure 2-1 Locations considered for the proposed new weir

Aboriginal heritage constraints were considered in the process of identifying a suitable location for the replacement weir. All known Aboriginal heritage sites (at that time) were considered along with the potential for further unrecorded sites and places of heritage significance. Consultation with the community identified a concern regarding the possible presence of burial sites in the area, particularly where elevated sandy dunes or lunettes are present.

During the consultation with the community, concerns were raised about Site B, due to:

- Its close proximity to a number of canoe tree heritage sites
- The need for the construction of a lengthy access road through a relatively undisturbed landscape.

Site A2 had several advantages compared to Site B including being closer to town, having better access and, based on what was known at the time, a lower risk of disturbance to Aboriginal heritage sites.

Following the workshop and in consideration of the feedback, the 2016 business case adopted site A2 as the preferred downstream site, noting that the final location may be adjusted during the design phase of the proposal following community consultation.

2.2.2 Retention of the existing weir

A further consideration arose through consultation regarding the status of the existing weir if a new downstream weir was to be developed. Some stakeholders indicated that in the event that the replacement weir was located at a downstream site, it would be preferable to retain the existing weir. The benefits of this were assumed to be:

- The existing weir is a play area for children, with the rocks often re-arranged to create fish traps during lower flow periods
- The existing weir would quarantine the town water supply from urban runoff during local rain events.

However, these perceived benefits would not be realised if the existing weir was retained because the weir would have the same fully supply level during normal operation as the existing weir, which would result in the water level in the weir pool when full being at the same level as the crest of the existing weir. This would mean that the rocks downstream of the existing weir would be under up to about three metres of water most of the time. Therefore, there would be no opportunity for play and cultural activities at the existing weir.

In relation to urban runoff, the new weir pool would extend through the township and during rain events there would be potential for urban stormwater runoff to enter the weir pool. Urban stormwater can include nutrients and pollutants from roadways, industry, animals and overflows from wastewater collection and on-site treatment systems. There is also a potential risk of sewage overflows occurring under dry weather conditions due to power or mechanical failures at sewage pumping stations or telemetry system failures. The existing Wilcannia sewerage system comprises of seven sewage pumping stations, with two of these being central to the system: effluent from the north-eastern side of the town is collected at pumping station no. 1 (PS1) and effluent from the south-western side is collected at pumping station no. 2 (PS2) (Public Works Advisory, 2020). To address the risk of sewage overflows entering the stormwater system and the new town pool Water Infrastructure NSW proposes to augment the existing sewerage system by installing diesel-powered back-up pumps at both PS1 and PS2 to provide redundancy in the event of pump station failure to avoid untreated effluent waste overflowing into the stormwater system. These stormwater mitigation works do not form part of the Wilcannia Weir Replacement project and would be subject to a separate environmental impact assessment. Further details of the proposed stormwater mitigation works are provided in **Section 22.3**.

It is important to note that retaining the existing weir would not entirely quarantine the town water supply from urban runoff, because when the new weir gates are closed and the weir pool is at the ‘drought’ full supply level, the existing weir would be under water and water in the weir pool downstream of the town could be drawn into the town water supply intake pumps.

Retaining the existing weir would also adversely impact some of the benefit of the new weir:

- Retaining the existing weir would isolate the section of new weir pool between the new and existing weirs from the existing raw water intake pipe below the height of the existing weir. This would reduce the water security benefits provided by the new weir. During normal operation of the new weir, about 415 megalitres of water stored in the weir pool in the about five kilometres of river between the new and existing weirs would not be accessible if the existing weir was retained
- If the existing weir was retained it would require extensive refurbishment and ongoing maintenance, which would add to the capital and life cycle costs of the proposal
- Retaining the existing weir would present a barrier to fish passage, which would greatly reduce the ecological benefits of the proposed fishway at the new weir.

2.2.3 Confirmation of a preferred option – 2019

Public Works Advisory completed a business case addendum in 2019 including associated technical investigations and community consultation. This was prepared to further investigate technical matters to inform the feasibility and estimated cost of refurbishing the existing weir, and to consult with both the Aboriginal and broader community with an aim to understand their expectations and confirm the final preferred location. Water modelling and design development to inform the final preferred option were also undertaken.

Alternative weir locations

At the start of consultation with the community for the business case addendum, two alternative locations for a replacement weir were proposed by the local community that had not been suggested in previous consultation:

- Just downstream of the Woytchugga Creek junction with the Darling River (Baaka), about 10.7 kilometres downstream of the existing weir
- At a location known as Christmas Rocks, which is a site of Aboriginal significance, about 31 kilometres downstream of the existing weir.

These alternative weir locations were proposed by the community to provide a weir pool that could backup water into Woytchugga Creek and produce inflows to and inundation of Woytchugga Lake, with the aim of creating opportunity for enhanced cultural practices and other benefits. However, Woytchugga Lake is shallow and is characterised by porous soils, which makes it unsuitable as a water storage. Use of the lake as a water storage would result in very high water losses due to evaporation from a shallow weir pool that extends across a wide area and also infiltration into the ground. The unsuitability of this location would result in poor water security, with a weir pool in the lake estimated to only provide about three months of storage in a nil inflow scenario.

Another disadvantage of the alternative weir locations is that they would require a substantially higher weir than the preferred option to cause filling of Lake Woytchugga. The lake only fills during a flood event of at least eight metres above the bed of the river, and a weir of this height would therefore be required. This is substantially higher than the about 4.5 metres height of the new weir. The larger size required for weirs at these alternative locations would result in higher cost and greater environmental impacts and operational challenges than the preferred option.

Given their disadvantages compared to the preferred option, these alternative weir locations were not further investigated in agreement with the community.

Community feedback

Consultation with the community identified some concerns and issues about Wilcannia's water supply generally and the proposal for a replacement weir downstream of the existing weir. These were:

- Aboriginal cultural heritage
  - Significance of Lake Woytchugga and the frequency of its natural filling

  - Aboriginal elders' desire for the natural rock bar at Christmas Rocks be re-established
- Water security
  - The need to secure the supply of drinking water for Wilcannia
  - Concern over the ongoing reliance on bores that could result in a drop in groundwater levels
- Water quality
  - Concern over the current poor quality of the town's drinking water and its contribution to economic, social and health disadvantages
  - Some considered the quality of raw water in the weir pool to be poor and not of an acceptable standard. Saline water has impacted gardens with some fruit trees dying
  - Concern over algal blooms
  - Sewage system failures in town could end up in the river and the new weir pool
  - Stormwater feeds into the new weir pool
  - Concern regarding the potential dumping of oil and waste into town waterways
- Recreation
  - The recreational needs of children were emphasised, particularly for the section of the river from the existing weir to the southern end of town which has been a historical recreational area for children
- Employment
  - Strong community desire to ensure the weir replacement would have a positive community impact, particularly for promoting local employment opportunities
- Proposal timing and process
  - Many community members believed the weir construction would likely occur during 2019 or 2020. After the consultations, the majority of community were in favour of a new weir location at the previously preferred A2 site
- False impressions
  - With a permanent weir pool under the bridge, tourists and travellers are likely to think there is plenty of water in the Darling River (Baaka) when in fact there may be no flow. This does not help with ongoing community and regional drive for improved river conditions and water flows.

Upgrading of the existing weir

The business case addendum included a structural investigation and condition assessment of the existing Wilcannia Weir to assess the feasibility of upgrading the existing weir as an alternative to developing a new weir at another location. It found that it would be possible to upgrade the existing weir to restore the water storage capacity of the weir pool to the design full supply level. It also found that it would be possible to increase the storage capacity of the existing weir. However, because the existing weir is nearing the end of its effective design life, it would be necessary to extend its design life by installing a new line of steel sheet piling. Any upgrade of the existing weir would also need to include a fishway. As a result, the cost of upgrading the existing weir would be similar to that of constructing a new weir and fishway. Without a cost advantage, the option of upgrading the existing weir would have few benefits relative to developing a new weir and fishway.

Outcome

Agreement was reached with the community that the new weir would be located at site A2 (refer to **Figure 1-1**). A Wilcannia Weir Community Reference Group was formed to ensure ongoing, meaningful and representative consultation continued as it developed a preliminary concept design for a new weir at this location and preparation of this environmental impact statement.

2.2.4 Weir type options

The business case addendum considered the advantages and disadvantages of two types of weir:

- *Fixed crest weirs* - Fixed crest weirs are typically used to achieve a fixed weir pool storage capacity when there is no requirement for regulation of flows.
- *Gated (modulated) weirs* -Weir gates are mechanically movable devices that are used to regulate flow releases from a weir pool and/or to control weir pool levels. Traditionally, undershot gates – that is, the flow passes under the gate, were typically used. However, in more recent times, overshot gates – where the flow pass over the top of a lowered gate, are increasingly common. This is due to the simplicity of operation of overshot gates and their significantly improved passage of downstream moving fish and other aquatic organisms, and the clearance of debris, compared to undershot gates.

The relative advantages and disadvantages of fixed crest and gated weirs are listed in **Table 2-2**.

Table 2-2 Advantages and disadvantages of fixed crest and gated weirs

Characteristic	Fixed crest weirs	Gated weirs
Weir pool storage capacity	▪ Weir pool level unable to be adjusted independent of river inflow to the weir pool	▪ Allows water level control
Operation	▪ Lower operational requirements	▪ Higher operational requirements ▪ Most gates are too large to be operated manually and therefore require connection to a power source
Maintenance	▪ Less complex infrastructure / lower maintenance requirements	▪ More complex infrastructure / higher maintenance requirements
Capital cost	▪ Lower cost	▪ More expensive
Flood passage	▪ Good flood passage	▪ Very good flood passage (greatest with a fully gated structure)
Environmental flows	▪ Unable to control the release of water downstream	▪ Potential for managed release of environmental flows
Water quality control	▪ Unable to control the release of water downstream	▪ Potential for water quality control

Fully gated weir structures are typically provided when flood passage and the discharge of large flows are a main design requirement. A fully gated weir structure can minimise the extent of waterway area obstruction compared to that of either a fixed crest or partially gated weir. Accordingly, a fully gated weir is more flexible in ensuring that potential upstream impacts are minimised by limiting any increase in upstream flood levels. However, the new weir is expected to have a negligible impact on upstream flooding (refer to **Section 11**) therefore there is no justification for a fully gated structure specifically to allow the passage of flood flows at Wilcannia.

Community consultation carried out at the time identified support for a gated outlet for the purposes of weir pool water quality management including managing salinity and thermal stratification. A partially gated weir would provide this functionality.

Public Works Advisory (2019) concluded that a partially gated fixed crest weir is the preferred weir type as it would enable water quality management during no or low flow periods when the water level is drawn down below the weir crest level and in response to poor water quality inflows. Draw-off of stored water would be required from both the surface and bed levels of the weir pool and this could be achieved with one or more overshot gates drawing water from the surface and a scour outlet system drawing water from the bed.

2.2.5 Weir height

Public Works Advisory (2019) carried out a secure yield analysis to assess the required height of a weir at site A2 to provide water security to Wilcannia. The analysis showed a weir with a crest one metre higher than the existing weir would provide water security for Wilcannia while also accounting for future climate variability by storing a volume of water that exceeds the unrestricted dry year extraction requirements by about 100 megalitres per annum. A weir crest at this level with gated outlets would also provide the benefit of being able to make small controlled releases equivalent to inflows when the weir pool level is below the weir crest, plus additional managed releases of up to 100 megalitres per annum, if required.

2.2.6 Refinement of the preferred option

Preparation of a preliminary concept design of the new weir commenced in 2020 and since then several opportunities to minimise the environmental impact of the new weir have been investigated. These investigations have resulted in several refinements of the preferred option, including:

- Relocation of the proposed weir about 250 metres upstream of site A2 to a straighter section of the river that is easier to access from existing tracks. The proposed new weir location is shown in **Figure 2-1** and is about five kilometres downstream of the existing weir
- An alternative operating regime for the new weir whereby it would be operated at the existing full supply level (65.71 metres AHD) most of the time and only raised to a drought full supply level (66.71 metres AHD) if upstream flows dropped below a predetermined threshold (refer to **Section 3.5.4**)
- Development of operating rules including a translucency rule to optimise flow downstream of the new weir during dry periods (refer to **Section 3.5.3**).

2.2.7 Summary of the benefits of the preferred option

The preferred option would meet the proposal objectives identified in **Section 1.1.2** as follows:

- *Improve water security for Wilcannia* — The preferred option would store sufficient water to sustain Wilcannia through a reoccurrence of the worst historical drought on record (the Federation drought) inclusive of the consideration of the future impact of climate change.
- *Enhance cultural connection to the river* — The preferred option includes a community river place at Union Bend near the new weir that would provide opportunities to recognise both the long history of the Barkandji people in the local area as well as the recent history of the existing weir and its role in the development of Wilcannia. Water Infrastructure NSW in conjunction with the local community is considering a range of ways that Aboriginal and non-Aboriginal heritage can be interpreted at the community river place.
- *Improve water management of the weir pool* — The inclusion of weir and fishway gates allows for greater control of the discharge rate from the weir pool and, therefore, the rate at which water flows through the weir pool. The gates could be used to manage water quality in the weir pool.
- *Increase tourism opportunities and investment* — The new weir would create a weir pool that extends through the town. The improved accessibility to the weir pool from the town centre is likely to encourage tourists to stop in Wilcannia and to increase the amount of time they spend in Wilcannia. Any increase in the number and length of stay of tourists would increase opportunities for tourism businesses. More broadly, it should be supportive of investment in the town.
- *Provide better recreational amenity to walk, swim, picnic and fish* — The extension of the new weir pool through the town would improve the visual amenity of the river, making it a more attractive location for a wide range of recreational activities.

- *Improve native fish migration* — The preferred option would include a fishway to enable fish to migrate upstream and downstream of the new weir when the fishway gate is open. The proposal would also partially remove the existing weir, which currently obstructs fish passage.

2.3 Consistency with national, state and regional strategic planning

The strategic context of the proposal is influenced by, and would meet the outcomes of, strategic plans and policy documents at the State and regional levels, particularly those related to regional water security and the engagement of Aboriginal communities. The proposal is consistent with the following relevant strategies and programs:

National

- Sustainable Rural Water Use and Infrastructure Program

NSW

- Building Momentum State Infrastructure Strategy 2018-2038 (Infrastructure NSW, 2018)
- NSW State Priorities (NSW Government, 2019)
- NSW Water Strategy (DPIE, 2021b)
- Western Weirs Program
- Safe and Secure Water Program
- *Floodplain Development Manual: The Management of Flood Liable Land* (Department of Infrastructure, Planning and Natural Resources, 2005)
- NSW Aquifer Interference Policy (DPI Office of Water, 2012)
- Guideline for Controlled Activities on Waterfront Land – Riparian Corridors (Department of Industry, 2018)
- *NSW Weirs Policy* (NSW Government, 1997)
- Policy and Guidelines for Fish Habitat Conservation and Management (Department of Primary Industries, 2013)
- Planning for Bush Fire Protection (NSW Rural Fire Service, 2019)
- OCHRE – NSW Government Plan for Aboriginal Affairs: Education, Employment and Accountability (NSW Government, 2013) (OCHRE Plan)
- Aboriginal Communities Water and Sewerage Program.

Regional and local

- Making it Happen in the Regions: Regional Development Framework (Department of Industry, 2017)
- Far West Regional Plan 2036 (DPE, 2017)
- Barwon-Darling Long Term Water Plan Part A (DPIE, 2020a)
- *NSW Regional Water Statement* (Department of Industry, 2019).

Further information on these strategies and their relationship to the proposal is provided in **Appendix G**.

3. Proposal description

This section provides a full description of the proposal including activities associated with construction and operation of each component of the proposal, based on current available design information.

The proposal described in this section is based on a preliminary concept design. Flexibility has been provided in the description of the proposal to allow for refinement during detailed design and in response to submissions received following public exhibition of this environmental impact statement and/or if opportunities arise to further minimise environmental impacts. Design refinements may also be identified in the preferred infrastructure report (if required) and the project approval. The final design may therefore vary from the preliminary concept design described in this section.

3.1 Proposal overview

The proposal comprises the construction and operation of a new weir and fishway and the partial removal and decommissioning of the existing weir on the Darling River (Baaka) in the township of Wilcannia in western NSW.

The proposal would provide a more reliable long-term town water supply for Wilcannia. The new weir would be located on a reach of the Darling River (Baaka) downstream of Union Bend (refer to **Photo 3-1**). The new weir would be about 4.92 river kilometres downstream of the existing weir, and about two kilometres south of the Wilcannia township. The crest of the five metre high weir would be about 4.7 metres below the top of the left bank (southern side) of the river and about 6.5 metres below the top of the right bank (northern side) of the river at this location.

The key design features of the new weir are shown in **Figure 1-2** and include:

- A weir with storage capacity of about 7,832 megalitres of water when the weir gates and fishway gates are closed
- A fixed crest portion of the weir about five metres high and 21.5 metres wide, next to the left bank (southern side) of the river
- A fishway about 120 metres long and 10.5 metres wide, next to the right bank (northern side) of the river to provide fish passage past the weir
- Two weir gates built into a gate bay structure, about 22 meters long (extending downstream of the weir crest) and eight meters wide, located between the fixed crest weir and the fishway
- New and upgraded access tracks for construction and maintenance activities
- A new electricity easement to provide high voltage power to a new substation near the weir. Underground consumer mains would provide low-voltage power from a new main switchboard near the substation to operate the weir and fishway gates.

The new weir would meet the future demand for town water, which is forecast to increase from 322 megalitres of unrestricted dry year extraction in 2020, to 362 megalitres per annum in 2050 (Public Works Advisory, 2021).

The existing weir pool extends about 61.79 river kilometres along the Darling River (Baaka) upstream from the existing weir when at the existing full supply level of 65.71 metres AHD. Construction of the new weir would create a new section of weir pool of about 4.92 river kilometres between the new and existing weirs, which is referred to as the ‘new town pool’. The new town pool would extend the total weir pool to about 66.71 river kilometres when the new weir is at the existing full supply level.

The new weir would have dual modes of operation comprising a normal operation mode when it would operate at the existing full supply level (65.71 metres AHD) and a drought security operation mode when it would operate at a full supply level of 66.71 metres AHD i.e. one meter above the existing full supply level. These full supply levels are referred to from this point on as the normal full supply level and drought full supply level respectively. The temporary increase in the full supply level of one metre during drought security operation mode would result in a weir pool that extends about 18.81 river kilometres further upstream than the existing weir pool, to create a total weir pool length of about 85.52 river kilometres (refer to **Figure 3-1**).

The proposal also includes:

- Developing a small recreation area, known as a community river place, at Union Bend. An informal parking area would be developed at the community river place, and visitors to the new weir would be able to walk between the community river place and the new weir via an existing trail along the top of the right riverbank
- Minor modifications to an existing flow gauging station located between the new and existing weirs
- Partial removal and decommissioning of the existing weir. This would involve removing the central portion of the existing weir, and removing the sheet piles and concrete capping so that the remaining structure is no longer classified as a weir asset on the waterway and would no longer be a barrier to fish passage.

Construction of the new weir would start once all necessary planning and statutory approvals are received, and a detailed design prepared. Depending on when these occur, it is anticipated that construction would start in early 2023 and take about 12 to 18 months to complete, weather and river flow conditions permitting. Partial removal and decommissioning of the existing weir is expected to take about 10 weeks and would occur after construction of the new weir is completed so that the existing weir remains available for town water supply purposes.

Photo 3-1 The Darling River (Baaka) facing downstream from the right riverbank; the crest of the new weir would align with the clearing on the left riverbank visible on the right of the photo

A summary of the key aspects of the proposal is provided in **Table 3-1** and the proposal is described in detail in the following sections.

Figure 3-1 The proposed weir pool in normal and drought security operation modes

New and existing weir pool
New permanent weir pool (the 'new town pool')
New temporary weir pool (drought security operation mode only)

Roads
Major watercourses

km
0 0.5 1
N

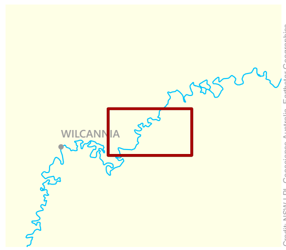

Figure 3-1 The proposed weir pool in normal and drought security operation modes

Figure 3-1 The proposed weir pool in normal and drought security operation modes

Table 3-1 Proposal summary

Proposal element	Summary of the proposal		Figure reference
Site description			
Local government area	Central Darling Shire		—
Proposal location	Darling River (Baaka), Wilcannia		**Figure 1-1**
Formal identifier	Lot 3445 Deposited Plan (DP) 765734	Access and construction (new weir)	**Figure 16-1**
	Lot 4143 DP766648	Access (new weir)	
	Lot 7314 DP1181235	Access and construction (new weir)	
	Lot 7315 DP1181235	Community river place	
	Lot 7301 DP1181254	Access (existing weir)	
	Lot 4 DP757028	Access (existing weir)	
	Darling River (Baaka)	Location of new weir and existing weir	
Zoning	Central Darling Local Environmental Plan 2012: ▪ W1 – Natural Waterways (river channel, new weir and existing weir) ▪ RU1 – Primary Production (access tracks and compound sites) ▪ RE2 – Private Recreation (access through Victory Park Caravan Park to the existing weir).		**Figure 16-2**
Operational footprint	▪ New weir – 1 hectare ▪ Community river place – 0.7 hectares ▪ Maximum weir pool inundation area – 340.3 hectares.		**Figure 1-2**
Access	▪ Upgrade an existing access track between the Barrier Highway and the left bank of the river at the new weir location ▪ Construct a new permanent access track between Union Bend Road and the right bank of the river at the new weir location ▪ Construct a temporary access track between the existing weir (left bank) and Victory Park Caravan Park. The caravan park would be accessed via an existing unsealed access track that connects to the Barrier Highway.		**Figure 3-2** **Figure 3-3** **Figure 3-11**

Proposal element	Summary of the proposal	Figure reference
Specifications of the new weir		
Weir embankment wall	The fixed crest portion of the new weir would be located next to the left bank (southern side) of the river and would comprise: ▪ An indicative 14.9-metre-long main crest section at the drought full supply level (66.71 metres AHD) ▪ An indicative 6.6-metre-long raised crest at an indicative level of 67.01 metres AHD (drought full supply level+0.3 metres), which is 0.3 metres above the main crest level.	**Figure 3-6**
Weir gates	Weir gates would be built into a gate bay structure between the fixed crest weir and the fishway. These would be used to deliver downstream flow, manage water quality in the weir pool and as a supplementary discharge to the fishway gates. The preliminary concept design includes two weir gates. A third weir gate may be added during detailed design in conjunction with the optimisation of the fishway design. The weir gates would be stainless steel overshot gates with dimensions of about 3.5 metres wide and 2.5 metres high each. The weir gates would be hydraulically powered and able to be both remotely and locally operated.	**Figure 3-7**
Scour protection	The weir embankment wall would be protected from scouring by upstream and downstream rockfill: ▪ 0.9-metre-thick upstream rockfill protection would be provided at a gradient of 1 vertical :2 horizontal ▪ 1.2-metre-thick downstream rockfill protection would be provided at a gradient of 1 vertical :5 horizontal. A 0.3-metre thick gravel bedding layer over geofabric would be provided under all rockfill protection. The size of rock for upstream and downstream rockfill protection would be about 0.5-metres and 0.9-metres in diameter respectively.	**Figure 3-6**
Fishway	A fishway about 120 metres long and 10.5 metres wide would be located next to the right bank (northern side) of the river. An innovative hybrid pool and ridge type fishway is proposed that would comprise precast concrete ‘castellated’ type baffles to delineate internal fishway pools each of about four metres in length. The fishway included in the preliminary concept design comprises 28 baffles and 27 pools. The fishway would be recessed upstream into the weir pool and separated by a sheet pile and concrete dividing wall along the river side length.	**Figure 3-8**
Fishway gates	Two gates would be built into a gate bay structure at the upstream end of the fishway. These would be used to isolate the fishway from the weir pool during extended drought periods. The gates would be stainless steel lay-flat gates with dimensions of about two metres wide and 2.05 metres high each. The gates would be hydraulically powered and able to be both remotely and locally operated.	—

Proposal element	Summary of the proposal	Figure reference
Construction access	Construction access is proposed to both sides of the river at the new weir site: ▪ A three-kilometre-long existing access track between the Barrier Highway and the southern bank of the river (the 'southern access'), which would be upgraded to serve the construction of the fixed crest portion of the new weir and the weir gate bay. The access track would be widened from about four metres wide currently to about 7.5 metres wide with three passing bays added to improve construction traffic flow. The access track would be widened where it joins the Barrier Highway to facilitate safe truck turning and entry and exit ▪ A 280-metre-long new access track (the 'northern access') would be constructed between Union Bend Road and the northern bank of the site to serve the construction of the fishway and to provide operation and maintenance access. The access road would be eight metres wide to enable two-way traffic. Construction vehicle access tracks would be cut into the riverbank on both sides to provide a maximum 1 vertical:8 horizontal grade for large heavy vehicles to access the weir and fishway structure.	**Figure 3-2** **Figure 3-3**
Maintenance access	The northern access would be maintained as the permanent maintenance access to the new weir. A permanent vehicle access track with a minimum width of three metres would be constructed along the full length of the fishway for maintenance. The maintenance track would be at the crest level of the fishway and about 4.5 metres below the top of the northern embankment, with a 1 vertical:8 horizontal graded connection to the northern access for light vehicle, vacuum truck and excavator access.	**Figure 1-2**
Flow gauging station	The existing gauging station at Rock Bar, located between the new and existing weirs, would be inundated by the new town pool following the commencement of operation of the new weir. Once this occurs its primary purpose would be to monitor water levels in the weir pool. A dissolved oxygen sensor would be fitted to also measure dissolved oxygen levels in the weir pool. It would continue to measure water temperature and electrical conductivity.	—
Utilities	Estimated power requirement would be a 415-volt, three-phase 30-ampere supply, for control and operation of the weir and fishway gates. A 360-metre-long three-phase overhead extension would be constructed from the existing overhead high voltage (HV) infrastructure on Union Bend Road to the new weir site, with a substation at the end power pole. A main switchboard would be installed within a prefabricated concrete switch room at the top of the right riverbank near the weir gates and crest. The main switchboard would be connected to the substation via an underground connection. A power supply easement up to 20-metres wide (10 metres either side of the overhead wires) would be cleared to safely accommodate the power poles and overhead wires. A 150-metre-long consumer main of low voltage (LV) would be constructed from the switch room to the weir gates and fishway gate control rooms along the maintenance access parallel to the fishway to supply power to allow remote control of the weir and fishway gates.	**Figure 1-2**

Proposal element	**Summary of the proposal**	**Figure reference**
Gate control	The weir and fishway gates would be hydraulically powered by a hydraulic power unit. The weir and fishway gates would be operated by separate hydraulic power units. The hydraulic power units would be located in a prefabricated concrete control room at the top of the right riverbank with stainless steel hydraulic pipes connecting each unit to the gates being powered. The gates would be remotely operable through a Supervisory Control and Data Acquisition (SCADA) system. Telemetry equipment such as a radio antenna mast, modem/router, and remote terminal unit would be installed in the switch room to enable the functioning of the SCADA system.	—
Community river place	The community river place is proposed at an existing recreation reserve at the end of Union Bend Road, on the right bank (northern side) of the river at Union Bend, upstream of the new weir. The community river place would consist of: ▪ An informal parking area with up to 12 parking spaces at the end of Union Bend Road ▪ Informal seating and traditional picnic arrangements scattered through the site, shaded by existing trees. Site won material and rocks salvaged during the partial removal and decommissioning of the existing weir would be used for the car parking area and informal seating. The community river place is subject to further consultation with the local Aboriginal community, Barkandji Native Title Group Aboriginal Corporation, Central Darling Shire Council and Heritage NSW.	**Figure 3-9**
Construction – general		
Construction footprint	About 20.9 hectares.	**Figure 3-2** **Figure 3-3** **Figure 3-11**
Cut/fill	The riverbanks on either side of the river at the new weir site would be cut to accommodate the fishway (right riverbank) and weir crest and embankments (left riverbank). Both riverbanks would be restored once the works are completed and smoothly transitioned to the adjacent existing riverbanks.	**Figure 3-2** **Figure 3-3**
Temporary construction features	The following temporary construction features are proposed: ▪ Construction compounds and materials laydown areas on both sides of the river near the new weir ▪ Access tracks down to the bed of the river from both sides of the river at the new weir ▪ An access track down to the riverbed from the southern side of the river at the existing weir site (within the Victory Park Caravan Park) ▪ Cofferdams to create dry work areas within the river channel ▪ A small container storage area alongside Union Bend Road near the community river place for the temporary storage of new outdoor furniture, signage and other items.	**Figure 3-2** **Figure 3-3** **Figure 3-11**

Proposal element	Summary of the proposal	Figure reference
River flow diversion	Water in the river would flow around the outside of the temporary in-stream work sites at the new and existing weir sites. Flows would travel downstream via the portion of the river channel not occupied by the work sites. Flows would be directed by the obstruction created by the cofferdams.	**Figure 3-2** **Figure 3-3** **Figure 3-11**
Dewatering	Dewatering would be required following cofferdam installation to create dry work sites at the new and existing weir sites. Dewatering would be ongoing throughout construction to maintain dry instream work sites. Water that collects within the sites would be pumped into sediment basins on the riverbanks and treated (if necessary) before being discharged back into the river.	**Figure 3-2** **Figure 3-3** **Figure 3-11**
Property	Construction of the proposal would only directly impact the properties identified in the site description above.	—
Construction workforce	An average of about 10 full time equivalent construction personnel, with a peak workforce of about 20 full time equivalent personnel.	—
Construction hours	Standard construction hours would be Monday to Friday 7.00 am to 6.00 pm, 8.00 am to 1.00 pm Saturdays and no work on Sundays or public holidays. During the hotter months (November to February), work hours on forecast hot days would be adjusted to 5.00 am to 3.00 pm Monday to Saturday, to reduce workers exposure to hot weather conditions.	—
Construction schedule	▪ Construction of the new weir is expected to start in early 2023 ▪ Construction and commissioning of the new weir is expected to take about 12 to 18 months, weather permitting ▪ Construction of the new weir would occur in two distinct steps: construction of the fishway followed by construction of the fixed crest weir and the gate bay structure ▪ Partial removal and decommissioning of the existing weir would take about 10 weeks and would occur after construction of the new weir is completed.	**Figure 3-2** **Figure 3-3**

Proposal element	Summary of the proposal	Figure reference
Operations		
Commissioning work	Commissioning of the new weir would occur after construction. Commissioning work would take up to 12 months and would include testing of the weir's gates.	—
Partial removal and decommission-ing of the existing weir	Partial removal of the existing weir is proposed to ensure the continuity of the weir pool between the new town pool and the existing raw water intake pipe located about 80 metres upstream of the existing weir, and to prevent the existing weir from obstructing fish passage. Partial removal of the existing weir would involve excavating a 16-metre wide section of the central portion of the weir down to a level of 63.65 metres AHD, which is about two metres below the level of the existing weir crest. Decommissioning of the remaining weir is also proposed so as the structure is no longer classified as a barrier on the waterway. Decommissioning of the existing weir would involve removal of the sheet piles and the concrete capping over the sheet piles. Water Infrastructure NSW would engage with the local community to identify opportunities to reuse some of the larger rocks removed during the above works. Rocks identified for reuse that cannot be transported directly to where they would be reused would be temporarily stored at the Central Darling Shire Council's local depot.	**Figure 3-11**
Inundation area	The new weir would inundate the about 4.92 river kilometres of the Darling River (Baaka) between the new weir and the existing weir (the new town pool). When the gates of the new weir are closed, the weir pool would store an additional one metre of water above the level of the existing weir pool when at the drought full supply level. Additionally, in this drought security operation mode, a further 18.81 kilometres of the Darling River (Baaka) upstream of the existing weir pool would be inundated by up to one metre of water.	**Figure 3-1**
Operational workforce	It is proposed that WaterNSW would own and operate the new weir. WaterNSW proposes that its existing workforce stationed at Menindee would manage the new weir.	—
Typical operating scenario	The new weir would have dual modes of operation separated by transition phases: ▪ Normal operation mode — During normal operation mode the weir would mostly be operated at the same full supply level as the existing weir (65.71 metres AHD) except at times of increased inflows ▪ Drought security operation mode — During drought security operation mode the weir would mostly operate at a full supply level of 66.71 metres AHD i.e. one metre above the normal full supply level ▪ Filling phase — This is a transitional phase between normal operation mode and drought security operation mode. During the filling phase the full supply level would be raised from the normal full supply level (65.71 metres AHD) to the drought full supply level (66.71 metres AHD) ▪ Reset phase — This is a transitional phase between drought security operation mode and normal operation mode. During the reset phase	**Figure 3-1**

Proposal element	Summary of the proposal	Figure reference
	the full supply level would be lowered from the drought full supply level (66.71 metres AHD) to the normal full supply level (65.71 metres AHD). In the case of a prolonged drought the weir pool would be filled back up to the normal full supply level ▪ Transitions between the normal and drought security operation modes would be triggered by monitoring upstream flows to assess risks to Wilcannia's water security. For the purposes of the storage behaviour modelling carried out for this environmental impact statement the adopted trigger levels are flows past Bourke Town Weir falling below 250 megalitres per day (start of the filling phase) and flows past Bourke Town Weir rising above 300 megalitres per day (start of the reset phase). Flows past Bourke Town Weir are represented by the location of the Myandetta gauge (gauging station no. 425038 (Darling River at Myandetta)), which is located about 31 river kilometres downstream of the Bourke Town Weir.	
Operational water supply	Water would continue to be supplied to Wilcannia township from the weir pool via the existing intake structure, located about 80 metres upstream of the existing weir.	—
Maintenance activities		
Weir	WaterNSW would periodically inspect the new weir including the weir gates, downstream embankment, erosion protection measures and the weir pool immediately upstream of the weir gates. WaterNSW would need to carry out routine and periodic maintenance including refurbishment and renewal throughout the life of the new weir.	**Figure 3-6**
Fishway	WaterNSW would periodically inspect the fishway including the fishway gates and approach pool. It is likely that mud and debris would occasionally need to be removed from the fishway to ensure that the fishway functions as designed and fish passage is facilitated. This may require the use of a vacuum truck and/or an excavator.	**Figure 3-8**

3.2 Proposal area

The new weir site is on a reach of the river downstream of Union Bend where the river channel is about 12 metres deep and the surrounding area is characteristic of the broader river landscape with relatively flat topography and undisturbed riverine vegetation (refer to **Photo 3-2**).

Photo 3-2 New weir site – view from the right riverbank looking upstream, the trees on the left riverbank closest to the river channel visible in this photo would be removed

The existing Wilcannia Weir is not listed as an asset by either Water NSW or Central Darling Shire Council. Historical records show that Central Darling Shire Council constructed the existing weir, but despite this it is not listed on their asset register.

The proposal would involve activity on the parcels of land listed in **Table 3-2** and shown in **Figure 16-1** during construction and operation. Note the content of this table summarises the advice provided by DPE Crown Lands in Attachment A to the SEARs.

Table 3-2 Land requirements for construction and operation

Property details	Owner	Proposal aspect	Land title and access
Lot 3445 DP765734	Wilcannia Local Aboriginal Land Council	Access and construction (proposed new weir)	Access agreement for construction activities is in place, including the proposed access track upgrade. Exclusive native title rights.
		Maintenance	WaterNSW would operate and maintain the new weir. Section 32 of the *Water NSW Act 2014* provides WaterNSW with the authority to enter and occupy land for several purposes including to repair and maintain its works. Alternatively, WaterNSW may choose to enter into a lease agreement with the landowner.

Property details	Owner	Proposal aspect	Land title and access
Lot 4143 DP766648	Wilcannia Local Aboriginal Land Council	Access (proposed new weir)	Access agreement for construction activities is in place, including track upgrade. Exclusive native title rights.
		Maintenance	WaterNSW would operate and maintain the new weir. Section 32 of the *Water NSW Act 2014* provides WaterNSW with the authority to enter and occupy land for several purposes including to repair and maintain its works. Alternatively, WaterNSW may choose to enter into a lease agreement with the landowner.
Lot 7314 DP1181235	Crown land	Access and construction (proposed new weir) Permanent installation of powerline easement, power infrastructure, switchboard and control rooms	Land administered under the *Commons Management Act 1989* and managed by the DPE Crown Lands. Non-exclusive native title rights. Water Infrastructure NSW would seek an easement of up to 20 metres through this property for power supply to the new weir under section 5.4.7 of the *Crown Land Management Act 2016*.
		Maintenance access during operation	WaterNSW would operate and maintain the new weir. Agreement for access for ongoing maintenance activities would be secured with the DPE Crown Lands.
Lot 7315 DP1181235	Crown land	Community river place	Land reserved under the *Crown Land Management Act 2016* and managed by Central Darling Shire Council. Non-exclusive native title rights. The community river place is subject to further consultation with the local Aboriginal community, Barkandji Native Title Group Aboriginal Corporation, Central Darling Shire Council and Heritage NSW. The DPE would decide which entity would access this property to construct the community river place.
Lot 7301 DP1181254	Crown land	Access (existing weir)	Reserve 301 for the purpose of travelling stock is managed by DPE on behalf of the Minister. Non-exclusive native title rights. Access permitted by function of section 80 of the *Public Works and Procurement Act 1912*, which grants the Water Administration Ministerial Corporation the power as a constructing authority to enter and occupy land to construct public works.

Property details	Owner	Proposal aspect	Land title and access
Lot 4 DP757028	Crown land	Access (existing weir)	Dedication 1004988 for Public Recreation (known as Victory Park), managed by Central Darling Shire Council. Non-exclusive native title rights. Access permitted by function of section 80 of the *Public Works and Procurement Act 1912*, which grants the Water Administration Ministerial Corporation the power as a constructing authority to enter and occupy land to construct public works.
Darling River (Baaka)	Crown land	Construction and operation of the new weir including storing water being the weir. Partial removal and decommissioning of the existing weir.	Access permitted by function of section 80 of the *Public Works and Procurement Act 1912*, which grants the Water Administration Ministerial Corporation the power as a constructing authority to enter and occupy land to construct public works.

3.3 Design development

3.3.1 Approach to avoiding or minimising impacts during construction

The approach to design development and preliminary construction planning undertaken to date has included a focus on avoiding and/or minimising, as far as practicable, the potential for impacts during all stages of construction. The study area has a number of constraints and characteristics such as items of heritage significance which have influenced the development of the construction methodology to date. These constraints and how the potential impacts related to them have been avoided or minimised are identified in **Table 3-3**.

Table 3-3 Key constraints and how the potential construction approach has avoided or minimised impacts

Key constraint	Approach to avoiding or minimising impacts
Aboriginal heritage	Several Aboriginal heritage items are located near the new weir. The construction compound, materials laydown areas, staging area and new access tracks have been located to avoid these items to the greatest extent possible. Specific attention has been made to identify and avoid all scar trees where possible.
Water quality	Cofferdams are proposed to create dry in-stream work sites and to allow water in the river to flow past the works. any water that collects within the sites would be pumped into sediment basins on the riverbanks and treated (if necessary) before being discharged back into the river.
Terrestrial ecology	Direct impacts to vegetation have been minimised by using existing tracks to access the construction sites and avoiding trees and other vegetation of significance as far as practicable. Staging and laydown areas have been situated to use areas that are mostly cleared where possible.
Aquatic ecology	The construction methodology for the new weir has been prepared with the objective of reinstating fish passage past the new weir work site once the new fishway channel structure is complete and flow diversion requirements allow the fishway baffles to be fully installed.

3.3.2 Design standards

The preliminary concept design for the weir and fishway has been prepared in accordance with relevant standards and design requirements, including the following:

- WaterNSW specifications, standards, guidelines and technical directions
- Local council requirements
- Australian standards
- Utility authority design standards
- NSW workplace health and safety standards.

3.4 Proposal details

The key features of the construction of the new weir are shown in **Figure 3-2** and **Figure 3-3** and the key features of the partial removal and decommissioning of the existing weir are shown in **Figure 3-11**. The key components of the proposal are described in detail in the following sections. Artist's impressions of the new weir when it is in normal operation mode and drought security operation mode are provided in **Figure 3-4** and **Figure 3-5** respectively.

- Clearing boundary
- Construction footprint
- Construction access tracks
- Existing access tracks
- Fishway
- Fishway gate control room
- Permanent access track for fishway maintenance
- Switch room
- Temporary bank reshaping for construction and access
- Temporary coffer dam for construction of fishway and right side of weir
- Temporary crane staging pad
- Temporary wharves

0 25 50 75 100 m

N

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IS350400-EIS-021_Construction_of_fishway

Figure 3-2 Indicative site layout during construction of the fishway

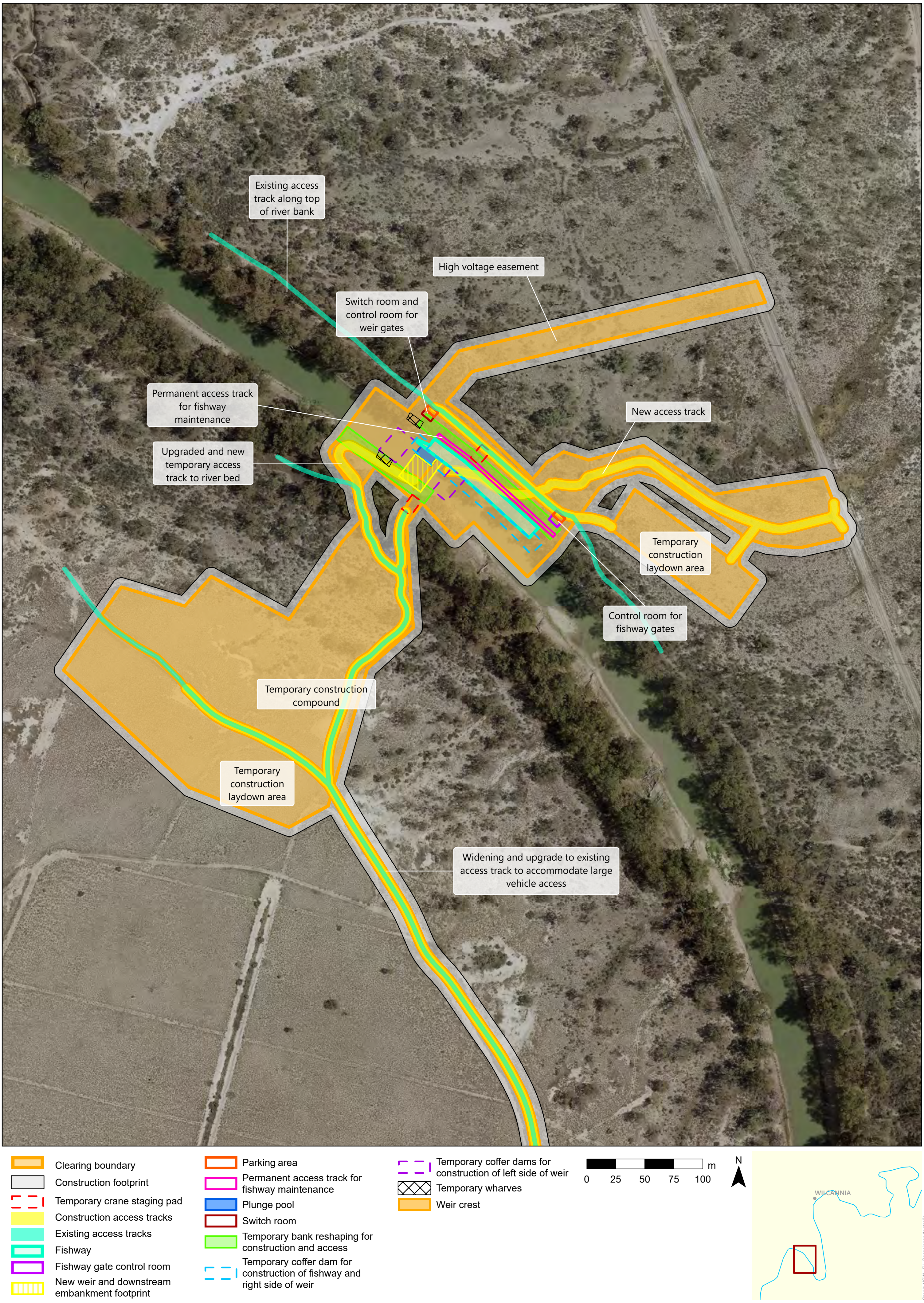

Figure 3-3 Indicative site layout during construction of the new weir

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Figure 3-4 Artist’s impression of the new weir in normal operation mode

Figure 3-5 Artist’s impression of the new weir in drought security operation mode

3.4.1 New weir – fixed crest portion

The fixed crest portion of the new weir would comprise a sheet piled rock filled barrier across the Darling River (Baaka), about five metres high and 21.5 metres wide. The top of the weir main crest wall would sit at 66.71 metres AHD, which would be about 4.7 metres below the top of the left (southern) riverbank and 6.5 metres below the top of the right (northern) riverbank at the proposed location.

The fixed crest portion of the new weir would have rock fill embankments with internal impermeable clay core earthfill. The weir wall would be supported by a sheet pile foundation to a depth of about 12 metres below the level of the riverbed and this would also control seepage under the weir. A shallower sheet pile foundation may also be constructed to support the toe of the downstream embankment, to a depth of about six metres. The downstream embankment would have a flatter gradient than the upstream embankment and would accordingly be longer. The flatter gradient of the downstream embankment would reduce the size of rock armouring required and the potential for scouring of the riverbed downstream of the fixed crest portion of the new weir by dissipating some of the energy in water flowing over the top of the weir crest. A cross section of the proposed fixed crest portion of the new weir is provided in **Figure 3-6.**

The 21.5 metres wide fixed weir crest would extend across about 45 per cent of the width of the river, which is 47.5 metres wide at the drought full supply level. The adjacent weir gate bay structure and fishway would fill the balance of the river's width. A sheet pile foundation would be constructed along the length of the weir axis between the southern embankment and the fishway, and along the dividing wall between the fishway and the weir pool and would also extend along the upstream entrance to the fishway. Further details on the fishway are provided in **Section 3.4.6**.

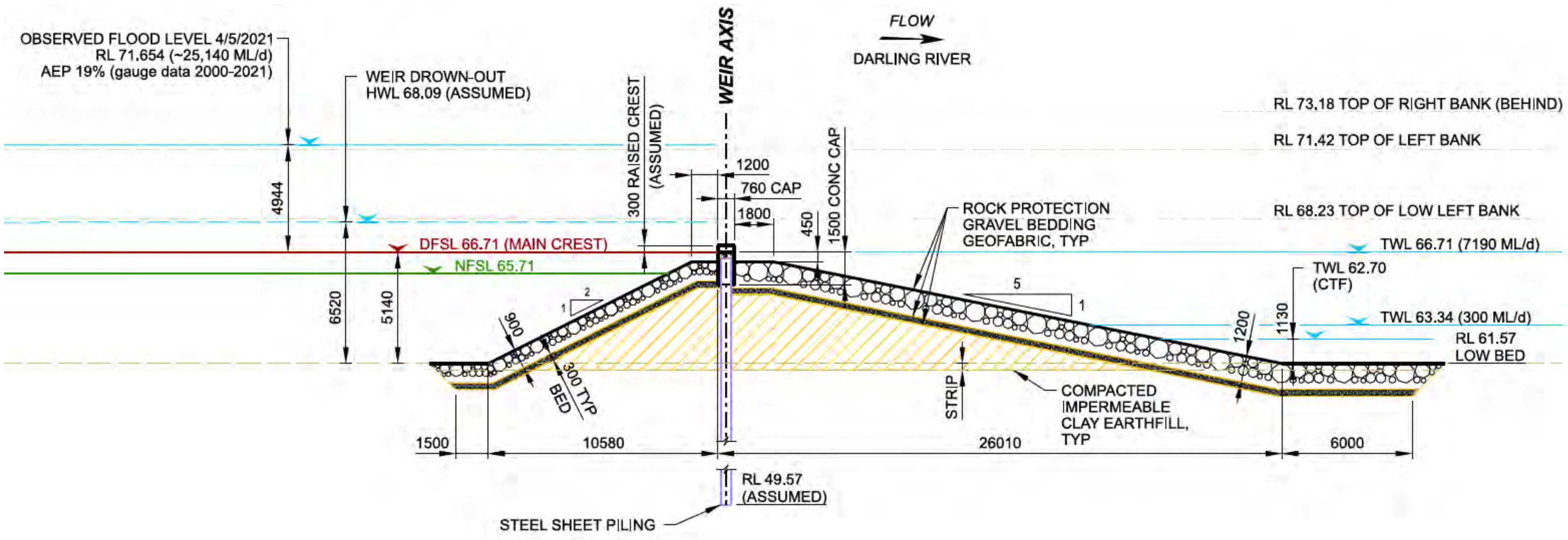


Figure 3-6 Cross section of the fixed crest portion of the new weir

3.4.2 Weir gates

The proposal includes weir gates between the fixed weir crest and the fishway. The weir gates would be operated to manage the water level in the weir pool, deliver downstream flows and manage water quality in the weir pool by controlling the water velocity through the weir pool, subject to favourable inflows.

The weir gates included in the preliminary concept design comprise two stainless steel overshot gates that are each 3.5 metres wide and 2.5 metres in height. A third weir gates may be required to optimise weir operations and the fishway design. Whether a third weir gate is needed would be decided during the design refinement that would occur in the detailed design phase of the proposal.

The weir gates would be hydraulically operated and able to be remotely controlled with equipment located in a control room situated on the northern embankment close to the weir gates. Hydraulic pipelines would be installed between the weir gates and the control room.

The weir gates would regulate flows of up to at least 350 megalitres per day between the gates being fully raised (closed) to the crest level of 66.71 metres AHD (the drought full supply level), and the gates being fully lowered (open) to the sill level of 64.21 metres AHD (the drought full supply level minus 2.5 metres). This provides for a minimum discharge of 350 megalitres per day over the top two metres (noting a nominal 0.5-metre head on the gates when fully open) of the 3.06-metres-depth of accessible drought storage in the weir pool (i.e. the drought full supply level (66.71 metres AHD) minus the level of the dead storage (63.65 metres AHD)).

3.4.3 Weir gate bay

The weir gates would be housed within a weir gate bay about 22 metres long (extended downstream) and about eight metres wide. A plunge pool 1.6 metres deep and 12 metres long at the downstream side of the weir gate bay would provide energy dissipation of flows downstream of the weir gates. The downstream and upstream ends of the weir gate bay would be in alignment with the toes of the downstream and upstream weir embankments.

The weir gate bay would be constructed of in-situ reinforced concrete. The two weir gates would be installed between the two supporting walls of the weir gate bay structure at the weir axis. The supporting wall would be about 6.5 metres high from the plunge pool level and about 4.4 metres below the top of the right (southern) riverbank.

A cross-section of the proposed weir gate bay is provided in **Figure 3-7**.

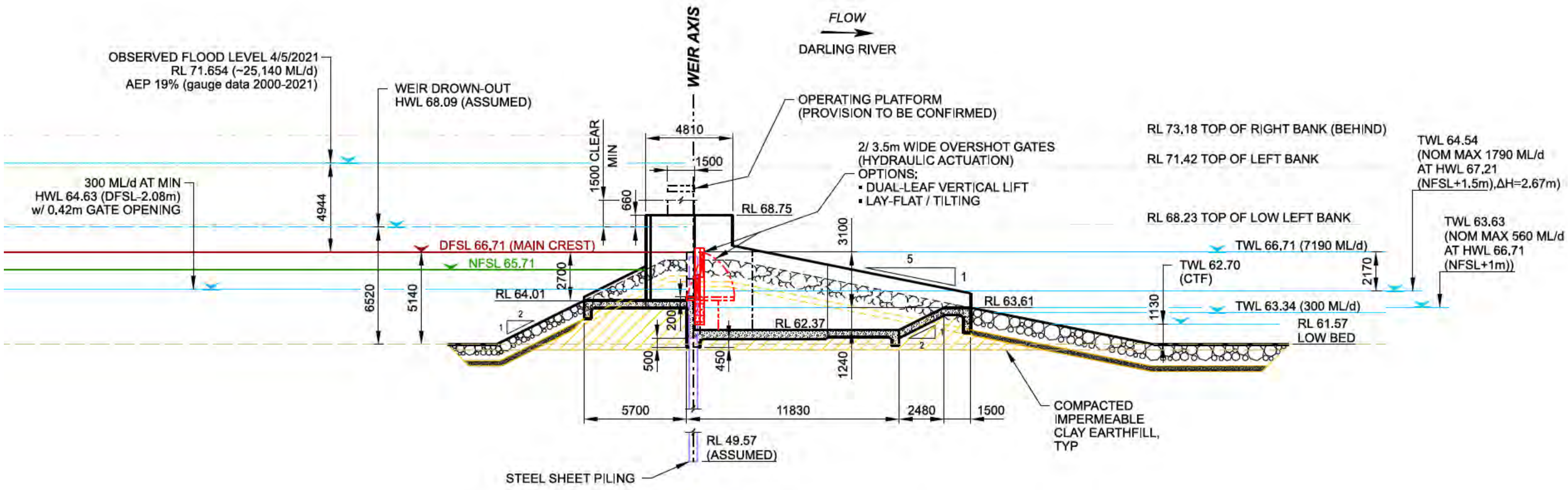


Figure 3-7 Cross section of the proposed weir gate bay

3.4.4 Riverbank reshaping

The riverbanks at the new weir site would be modified to accommodate the fishway within the river channel and also to enable access into the river by construction vehicles and plant for the construction works, and for ongoing maintenance activities.

Following construction, the right riverbank would be pushed back and slightly flatter than existing to accommodate the fishway maintenance access track and to ensure the bank is stable. The top of the right riverbank would be about 4 to 6m further back than at present, depending on the final design.

The reinstated left riverbank would be in a similar position to the existing riverbank.

3.4.5 Scour protection

The weir fixed crest embankment section would be protected from scouring by upstream and downstream rockfill:

- 0.9 metre-thick upstream rockfill protection would be provided at a gradient of 1:2
- 1.2 metre-thick downstream rockfill protection would be provided at a gradient of 1:5.

A 0.3 metre-thick gravel bedding layer underalid with geofabric would be provided under all rockfill protection. The size of rock for upstream and downstream rockfill protection would be about 0.6 metres diameter and 0.9 metres in diameter respectively.

3.4.6 Fishway

The proposal includes a fishway to allow the movement of fish upstream and downstream of the new weir when in normal operation mode. An innovative castellated ridge type fishway would be installed on the right side of the new weir. The fishway would be a rectangular concrete channel about 115 metres long. The downstream end of the fishway would be aligned a short distance upstream of the toe of the downstream weir embankment, while the upstream end of the fishway would extend beyond the upstream embankment of the weir. The fishway channel would be constructed of mainly cast insitu concrete supported on compacted earthfill foundations and piles.

The fishway would comprise a series of minimum 1.05-metre deep pools separated by baffle ridges. The preliminary concept design includes 28 baffles to delineate 27 internal fishway pools each of about 4.25 metres length and 10.4 metres width (internal width). The fishway design would be optimised during detailed design and this could result in a slight change in the number of baffles and size of the pools, and may provide for a potentially shorter fishway length.

The baffles would form ridges within the fishway. Each baffle would have a 'V' shaped crest profile and is proposed to be constructed of precast concrete with evenly-spaced vertical-slot gaps built in to create cascading water between each fishway pool when the river is flowing. There would be two submerged slots near the outsides of each baffle to allow for fish passage during low flows through the fishway. The fishway would also include ramps to enable turtles to pass through the fishway baffles when the weir is in drought security operation mode and the fishway is isolated from the weir pool. The proposed baffle design is provided in **Figure 3-8**.

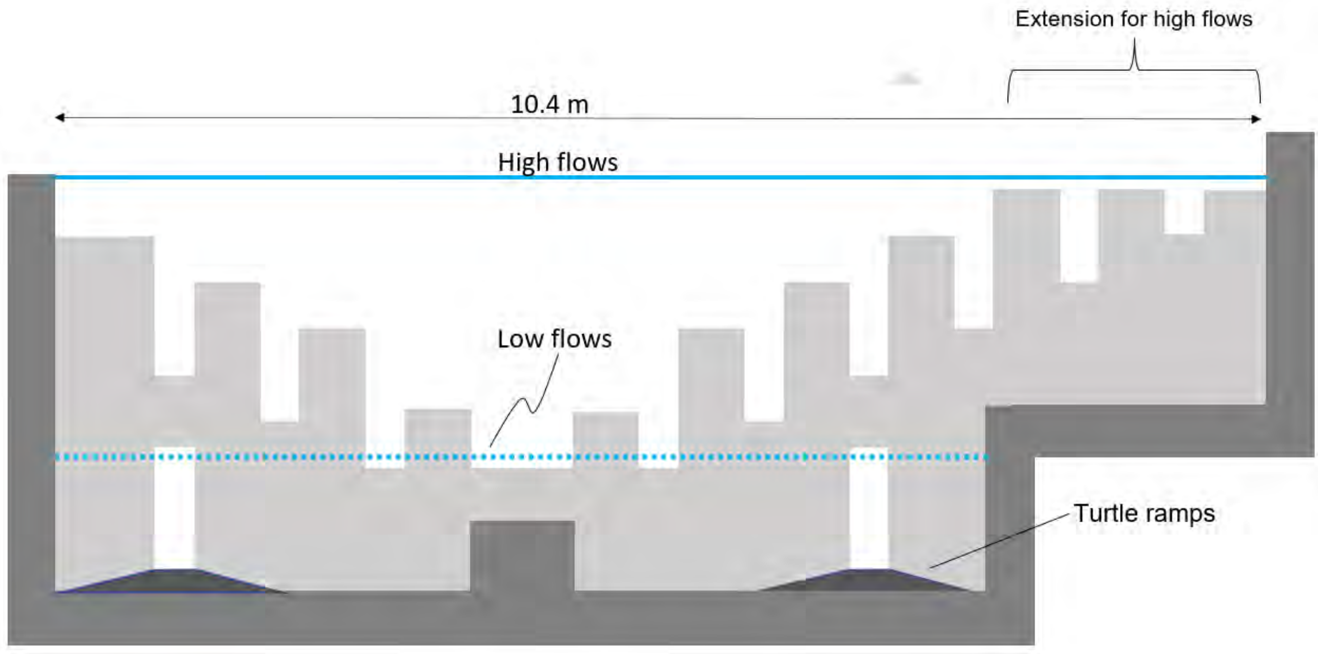


Figure 3-8 Proposed design of the baffles in the fishway

The drops between the pools would each be 110 millimetres. Native fish would use their 'burst speed' to negotiate each baffle ridge in the fishway, before resting in the pools. The fishway would have a shallow gradient of about 1 vertical to 36 horizontal to enable fish to navigate the length of the fishway and access the river habitat upstream of the weir.

The height of the exit (upstream) end of the fishway would be set at the level of the full weir pool during normal operation, so that the fishway does not impact the storage capacity of the weir pool.

The capacity of the weir pool when in drought security operation mode would be protected by installing a hinged lay flat gate at the exit (upstream) end of the fishway that would be closed when the weir enters drought security operation mode.

A vehicle access track of minimum three metres width would be constructed next to the right side of the fishway. The access track would extend along the length of the fishway. The access track would be at a level about 2.64 metres above the fishway floor and a minimum height of about 5.88 metres below the top of the right riverbank. The access track would allow for maintenance of the fishway using light vehicles, excavators and vacuum trucks.

3.4.7 Community river place

In response to community requests, the proposal includes the development of a small recreation area, known as a community river place, on the right riverbank at Union Bend. A concept landscape plan for the community river place is shown in **Figure 3-9** and includes:

- An informal car parking area for up to about 12 vehicles
- Picnic tables and seating
- Informal seating that uses materials won during the construction of the proposal e.g. log from felled trees and rocks from the existing weir
- Low maintenance landscaping including planting of native trees, shrubs and groundcovers and reuse of materials won during the construction of the proposal including logs and rocks

- Opportunity for interpretive signage that could provide information about the new weir and fishway, the history of the existing weir, the history of the area including the canoe tree within the community river place and others nearby, and the natural features of the area including the river red gum trees and the native fish species that would benefit from the fishway
- Other potential features including artwork and commemorative plaques would promote the sense of place.

Union Bend was selected in consultation with the local community as it is a place with cultural significance to the Barkandji and is already a popular fishing location. It is located with the Wilcannia Mission Camps and Cultural Places Aboriginal Place (refer to **Figure 16-1**). The provision of low key amenities (seating and interpretive signage) would support and enhance local cultural practices and recreational activities at this site.

Water Infrastructure NSW would continue to progress the proposed community river place and its design in consultation with the local community, the Barkandji Native Title Group Aboriginal Corporation, Central Darling Shire Council and Heritage NSW. As the community river place is proposed on non-exclusive native title land, an Indigenous Land Use Agreement is required for it to proceed. There is an existing Indigenous Land Use Agreement between Barkandji Native Title Group Aboriginal Corporation and several councils including Central Darling Shire Council that includes the site of the community river place (the Barkandji Interim Licences Indigenous Land Use Agreement, National Native Title Tribunal file number NI2018/007).

Details on the community involvement in the development of the landscape plan for the community river place to date are provided in **Section 5**.

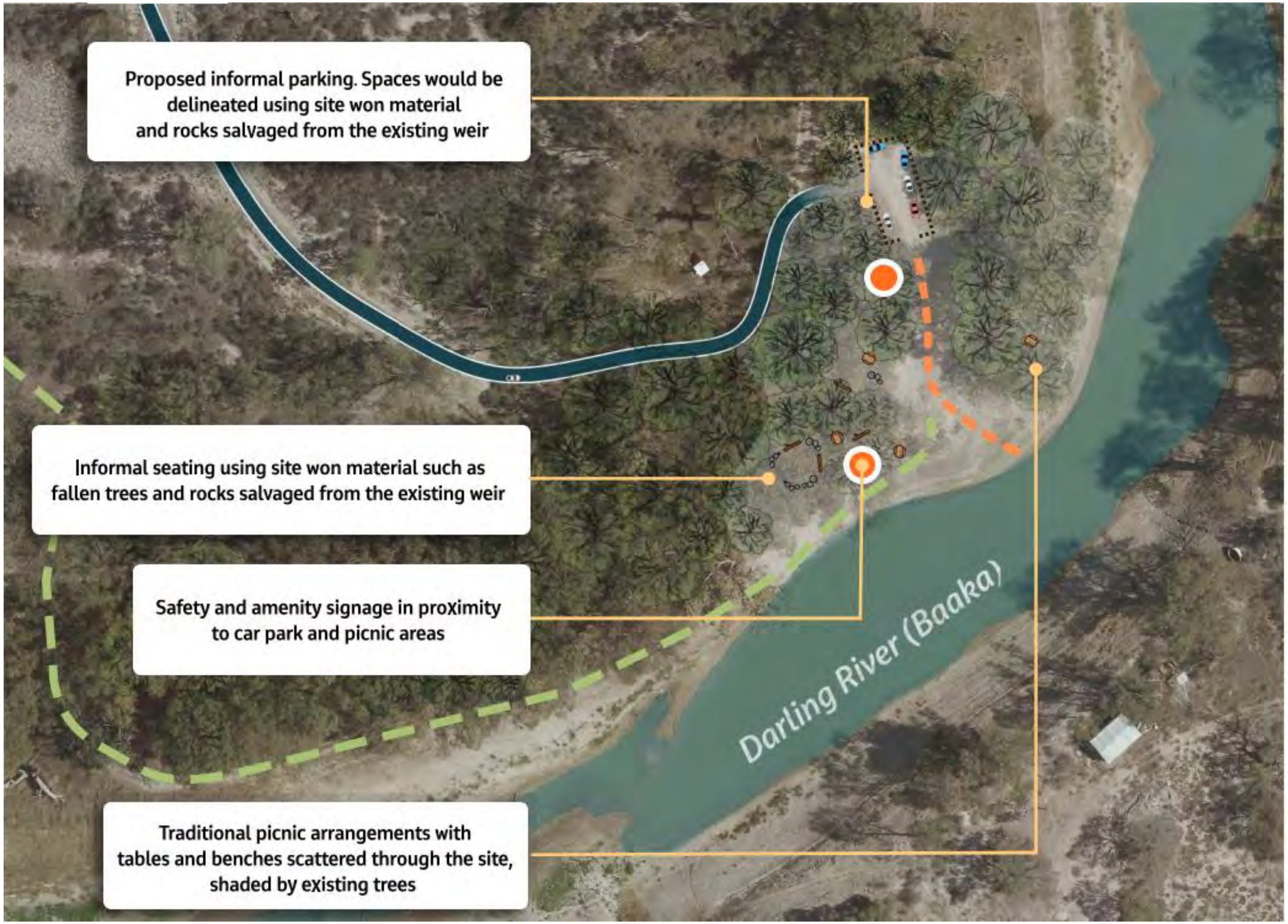


Figure 3-9 Concept landscape plan for the community river place

3.4.8 Exclusion zone

WaterNSW applies exclusion zones upstream and downstream of the weirs that it operates to minimise safety risks to recreational users of waterways. The exclusion zone applied at each weir is based on the risk profile of the asset.

An appropriate exclusion zone for the new weir will be identified as part of a safety in design process carried out during the detailed design phase of the proposal.

Awareness of the exclusion zone and its location would be raised through signage. Fishing, swimming, canoeing, boating and other water-based recreational activities would be prohibited within the exclusion zone.

3.4.9 Power supply

The new weir would have an estimated power requirement of about 415 volts (three phase 30A supply) to allow for remote control of the weir and fishway gates.

A 360-metre-long three phase overhead extension would be constructed from the existing overhead high voltage infrastructure on Union Bend Road to the new weir. Electricity cables would be strung on power poles spaced about 100 metres apart along the power supply route. A substation would be installed overhead on a pole at the end of the power line supply route. The power supply would extend a short distance from the substation to a switch room and weir gate control room. The building would be located about five metres from the top of the right riverbank and a short distance downstream of the axis of the new weir.

The switch room building would have a two-hour fire protection rating as per WaterNSW Electrical Works Specification with fire rated doors and no windows. An eight metre wide bush fire asset protection zone would be maintained around the switch room building in accordance with Table A1.12.6 of *Planning for Bush Fire Protection* (NSW Rural Fire Service, 2019).

Essential Energy would own and maintain the power infrastructure from Union Bend Road to the switchboard, including all overhead lines, poles, the pole substation and power supply cables, in accordance with their relevant standards and procedures. The high voltage power infrastructure may be designed by Essential Energy or an accredited ASP 3 designer, and the high voltage power infrastructure may be constructed by Essential Energy or an accredited ASP 1 contractor. Water Infrastructure NSW would seek the granting of an easement under the *Crown Land Management Act 2016* for the new power supply infrastructure between Union Bend Road and the switchboard. The preliminary concept design has allowed for clearing of an powerline easement of up to 20 metres width.

A 150-metre-long underground consumer main would be constructed from the switchboard to the fishway gate control room along the maintenance access way parallel to the fishway to enable the fishway gate to be remotely controlled. Electricity cables would be pulled through a plastic conduit laid about one metre below design finished level with 1.2 metres square precast concrete maintenance pits spaced about 50 metres apart along the route. A total of four maintenance pits would be installed. Trafficable classed metal lids would be installed over each pit. The finish levels of the pits would be flush with the design finish levels of the surrounds to avoid trip hazards.

WaterNSW would own and maintain the switch room and the power infrastructure between the switchboard and the weir and fishway gates.

3.4.10 Equipment control

The weir and fishway gates would be operated by hydraulic power from separate hydraulic power units.

Each hydraulic power unit would be installed within a prefabricated concrete control room building about five metres long, three metres wide and 3.2 metres tall, anchored to a 150-millimetre-thick reinforced concrete slab above the design ground level. The control room buildings would be located within five metres of the top of the river embankment. Stainless steel hydraulic pipes would connect each hydraulic power unit to the gates being powered. The weir gates control room would be located near the weir gates to reduce the hydraulic pressure required for operation, and similarly the fishway gates control room would be located near the fishway gates. The hydraulic power units would be controlled by a programmable logic controller and have a human-machine interface panel for control inputs or monitoring. Each hydraulic power unit would have an oil reservoir and two pump and motor sets to operate the gates. Integrated bunding would be provided to contain any potential loss of hydraulic fluid from the reservoir.

The control room buildings would have a two-hour fire protection rating as per WaterNSW Electrical Works Specification with fire rated doors and no windows. An eight-metre-wide bush fire asset protection zone would be maintained around the control rooms in accordance with Table A1.12.6 of *Planning for Bush Fire Protection* (NSW Rural Fire Service, 2019).

3.4.11 Gauging stations

WaterNSW operates water monitoring stations (gauging stations) across NSW to take systematic readings of water levels and flow rates in waterways. There are several gauging stations located within the Darling River (Baaka) basin. Gauging station number 425008 measures flows in the main channel of the Darling River (Baaka) at Rock Bar, downstream of the existing weir. It also measures water temperature and electrical conductivity. This gauging station is upstream of the new weir and would be inundated once the new weir commences operation.

In May 2020, a new gauging station was installed about 2.49 kilometres downstream of the proposed new weir site and about 3.18 kilometres upstream of the confluence of Woytchugga Creek and the Darling River (Baaka). This gauging station, number 425058, is known as the Moorabin gauging station and is currently being used to measure water levels, electrical conductivity, water temperature and dissolved oxygen levels. This data is being correlated with historical data from existing gauging stations.

Once the new weir starts operation, the Moorabin gauge would be used to measure flow rates downstream of the new weir pool, thereby serving the same function as the existing gauging station at Rock Bar.

The existing gauging station at Rock Bar would be retained following the commencement of operation of the new weir to monitor water levels in the weir pool. A dissolved oxygen sensor would be fitted to measure dissolved oxygen levels in the weir pool. The gauging station would continue to measure water temperature and electrical conductivity.

3.4.12 Partial removal and decommissioning of the existing weir

The existing weir comprises:

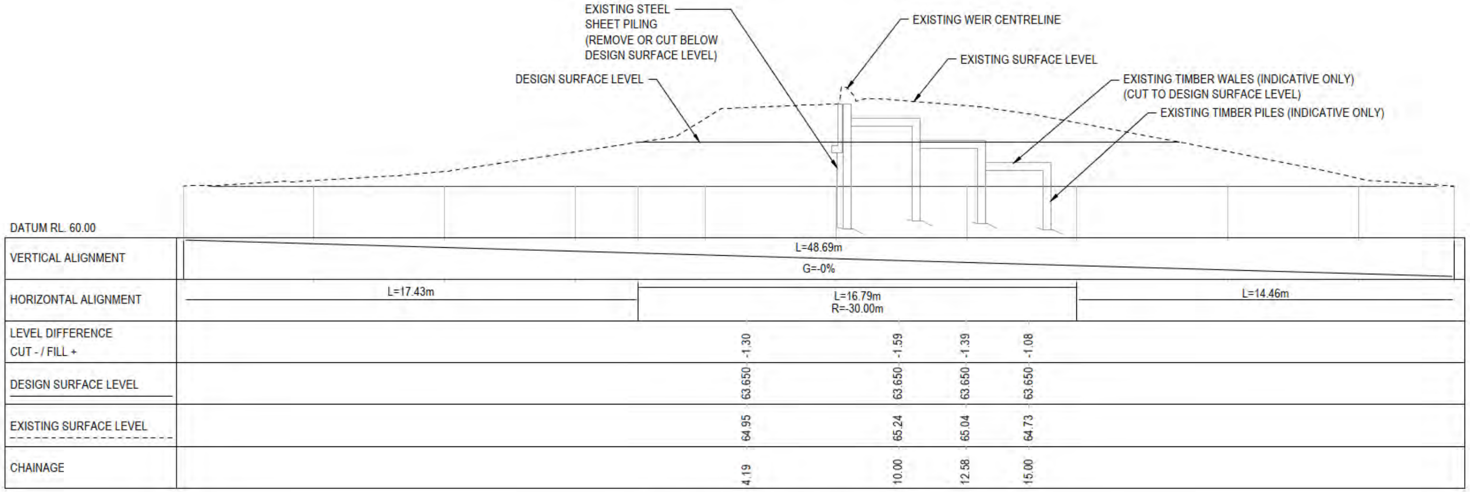
- An impervious clay earthfill embankment core
- A central line of steel sheet piling with concrete capping, serving as the main provision for seepage control along with the clay core. The refurbishment works carried out in 1987 modified the concrete capping and raised the main crest and associated full supply level by 0.3 metres to a level of RL 65.71 metres AHD. Additional capping modifications included the provision of 0.3-metre high wing walls next to each abutment.
- Timber piling at each bank abutment

- Stepped timber crib work on the downstream side filed with stone and anchored at each step with additional timber piling
- Rockfill scour protection on both upstream and downstream embankment batters.

The full supply level of the new weir during normal operation mode is the same full supply level as the existing weir and, as a result, the new town pool would inundate the central main crest of the existing weir. Partial removal of the existing weir is proposed to ensure the continuity of the weir pool between the new town pool and the existing raw water intake pipe located about 80 metres upstream of the existing weir, and to prevent the existing weir from obstructing fish passage and navigation. Decommissioning of the remaining weir is also proposed to declassify the structure as a weir asset.

Partial removal of the existing weir

Partial removal of the existing weir would involve excavating a 16-metre wide section of the central portion of the weir down to a level of 63.65 metres AHD, which is 2.06 metres below the level of the existing weir crest. The excavation would be battered to the existing crest level as indicated in the long-section shown in **Figure 3-10**. The works would avoid directly impacting most of the area on the rock embankment on the downstream side of the weir crest that the local Aboriginal community uses for fish trapping. The fish traps would be submerged most of the time with new weir operations and are likely to become instream habitat for aquatic species.



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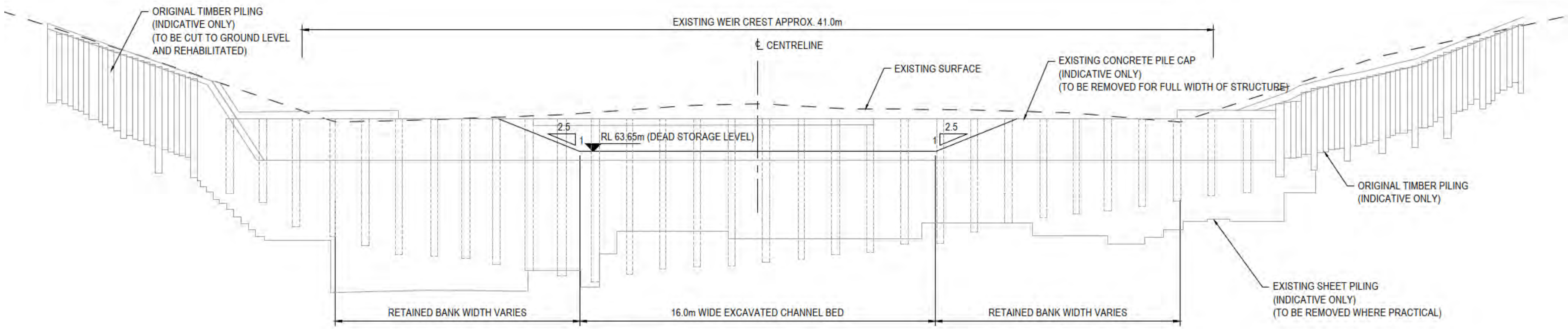

LONG SECTION
SCALE 1:100

Figure 3-10 Cross-section and long-section of the proposed partial removal and decommissioning of the existing weir

Decommissioning of the existing weir

The remaining weir would be decommissioned such that the structure is no longer classified as a barrier on the waterway. Decommissioning of the remaining structure would include:

- Removal of the concrete capping over the sheet piles
- Removal of the sheet piles where practical, or otherwise cutting off to below ground level, to ensure the remaining structure cannot retain water
- Retention of the existing earth and rockfill embankment with timber in the abutment areas, cut off to below ground level
- Rehabilitation of the disturbed areas.

A layout of the construction site for the partial removal and decommissioning of the existing weir is shown in **Figure 3-11**.

Construction footprint

Clearing boundary

Temporary crane staging pad

Pump hardstand

Temporary coffer dams for partial removal of the existing weir

Major watercourses

Roads

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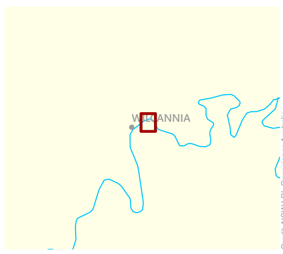


Figure 3-11: Key construction features - existing weir site

3.5 Operation and maintenance of the new weir

3.5.1 Operations plan

WaterNSW would operate the new weir in accordance with an operations plan approved by the DPE Water. The operations plan will:

- Outline governance arrangements for operating the new weir including roles, responsibilities, accountabilities, risk management, and reporting requirements
- Define the operating rules for the normal and drought security operation modes and filling and reset phases
- Document the approvals process for any future amendments and updates to the operations plan, which will involve a consideration of the consistency of the proposed changes with the Water Sharing Plan for the Barwon-Darling Unregulated River Water Source 2012 (the Barwon-Darling WSP), planning approval conditions of consent, and requirement for additional consultation with relevant stakeholder agencies.

The operations plan for the new weir is being prepared in consultation with the DPE Water, DPI Fisheries, the DPE (Environment and Heritage), the Murray-Darling Basin Authority and WaterNSW. The operations plan will continue to be developed with the stakeholder agencies.

An outline operations plan is provided in **Appendix H** that shows the likely structure of the plan and the type of content that it is expected to contain. It is intended that the operations plan will be finalised prior to the approval of the proposal by the Minister for Planning.

3.5.2 Accessible storage

The accessible storage of a weir is that portion of the weir pool that can be accessed for water supply purposes. It typically excludes upstream pools that becomes isolated from the point of extraction when the surface level of the weir pool drops below the level of upstream bars. It also excludes the portion of the weir pool that is below the level at which the intake pumping station can extract water.

The water extraction infrastructure that is used to transfer water to Wilcannia's water filtration and treatment plants is located on the right bank of the river about 80 metres upstream of the existing weir. This existing infrastructure would remain in place to extract water from the new weir pool to supply Wilcannia. The existing infrastructure is able to extract water to a depth of 63.65 metres AHD i.e. about 2.06 metres below the current full supply level.

A longitudinal schematic profile of both the new and existing weir pools is provided in **Figure 3-12**. It shows that the existing weir pool comprises four pools. Pool 1 extends about 5.43 kilometres upstream from the existing weir and includes the water extraction infrastructure. Water in Pool 1 is accessible down to the maximum operating depth of the intake pump i.e. 63.65 metres AHD.

Upstream of Pool 1, there are three apparent main river bars that isolate sections of the existing weir pool from the extraction infrastructure when the water level in the weir pool is lowered:

- Bar 1 — Bar 1 is located about 5.43 river kilometres upstream of the existing weir. Bar 1 has an elevation of about 65.27 metres AHD, which is 44 centimetres below the normal full supply level. Immediately upstream of Bar 1 there is up to about 24.69 kilometres of river that is below the level of Bar 1, which is known as 'Pool 2'. Pool 2 extends upstream to Bar 2. Pool 2 can store an accessible isolated volume of about 1,200 megalitres of water below 65.27 metres AHD. Due to this large potentially accessible storage capacity of Pool 2 and its proximity to the existing water extraction infrastructure, it is assumed that during a severe drought temporary pumping works would be installed to transfer isolated water in Pool 2 over Bar 1 and into Pool 1, where it would be accessible using the existing water extraction infrastructure, although any such extension of the existing water extraction infrastructure does not form part of this proposal. Therefore, Pool 2 has been considered as accessible down to the maximum operating depth of the intake pump i.e. 63.65 metres AHD. About 149 megalitres of water in Pool 1 and about 699 megalitres in Pool 2 that is below the maximum operating depth of the intake pump would be inaccessible and is known as 'dead' storage as it cannot be used for the purpose of supplying water to Wilcannia

- Bar 2 — Bar 2 is located about 30.12 river kilometres upstream of the existing weir. Bar 2 has an elevation of about 65.52 metres AHD, which is only 19 centimetres below the normal full supply level. Immediately upstream of Bar 2 there is up to about 19.08 kilometres of river that is below the level of Bar 2, which is known as 'Pool 3'. Pool 3 extends upstream to Bar 3. Pool 3 can store about 798 megalitres of water below 65.52 metres AHD. Pool 3 is 'dead' storage that cannot be accessed for the purpose of supplying water to Wilcannia
- Bar 3 — Bar 3 is located about 49.20 river kilometres upstream of the existing weir. Bar 3 has an elevation of about 65.59 metres AHD, which is only 12 centimetres below the normal full supply level. Immediately upstream of Bar 3 there is up to about 12.59 kilometres of river that is below the level of Bar 3, which is known as the 'End Pool'. The end pool can store about 388 megalitres of water below 65.59 metres AHD. The end pool is 'dead' storage that cannot be accessed for the purpose of supplying water to Wilcannia.

At the normal full supply level, the new weir would extend the weir pool about 4.92 river kilometres downstream from the existing weir to the new weir. This new section of the weir pool is known as the 'new town pool'. With the partial removal of the existing weir, Pool 1 and the new town pool would be continuous. Like Pool 1, the new town pool would be accessible down to the maximum operating depth of the intake pump i.e. 63.65 metres AHD.

Additionally, when the new weir is in drought security operation mode and the weir pool is at the drought full supply level, about 18.81 river-kilometres of the Darling River (Baaka) at the upstream end of the existing weir pool would be inundated to a depth of up to one metre.

Table 3-4 identifies the maximum volume of water that can be stored in the existing weir pool and how much of this is accessible to Wilcannia, and the maximum volume of water that can be stored in the new weir pool and how much of this would be accessible when the new weir is in normal and drought security operation modes.

Table 3-4 Maximum total and accessible storage volumes in the existing and new weir pools

Weir pool		**Maximum storage volume (megalitres)**	
Description	**Full supply level**	**Total**	**Accessible**
Existing weir pool	65.71 metres AHD	4,207	2,173
New weir pool – normal operation mode	65.71 metres AHD	4,755	2,577
New weir pool – drought security operation mode	66.71 metres AHD	7,832	5,654

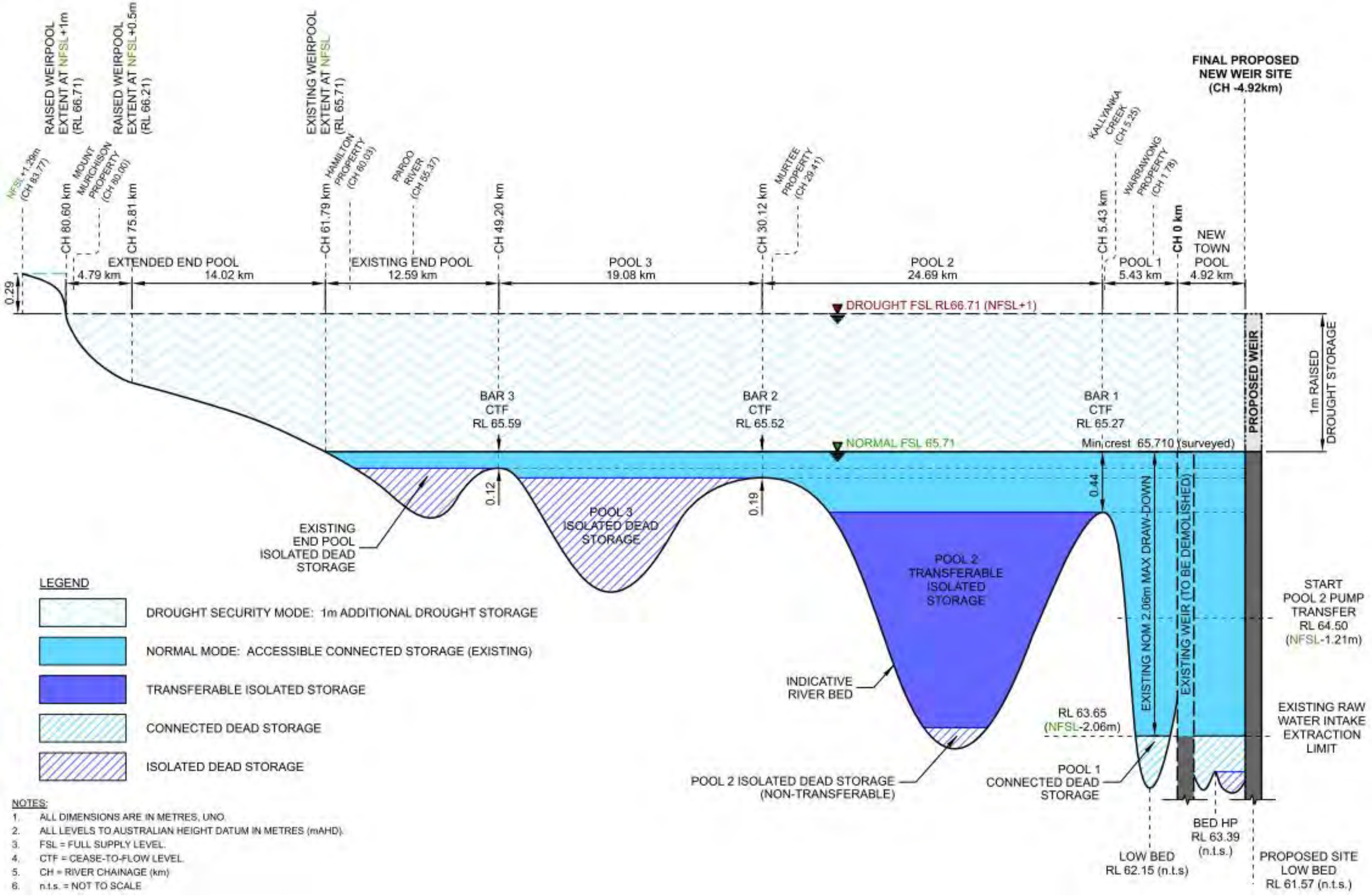


Figure 3-12 Longitudinal schematic profile of the new and existing weir pools

3.5.3 Weir operating regime

The inclusion of fishway gates and weir gates at the new weir would enable its operation to be managed to optimise water security for Wilcannia as well as reduce environmental impacts to the river. Preliminary operating rules have been developed for use in the storage behaviour modelling of the new weir to determine its capacity to provide water security for Wilcannia and its impact on river flows and upstream river levels. The preliminary operating rules have also been developed to ensure that the new weir performs within design requirements.

A key consideration in the development of the preliminary operation rules is the relationship between the upstream water surface level, known as the headwater level, and the flow discharging from the weir. This relationship is called the headwater rating and is typically presented as a rating table or, if plotted, a rating curve. The provision of fishway gates and weir gates and consequent different structure operating configurations results in the potential for multiple headwater ratings.

For the new weir, the headwater rating is influenced at higher flows by elevated downstream water levels, known as tailwater levels, due to gate and weir crest submergence affects that reduce flow discharges. A tailwater rating has been established for the new weir to enable submergence of the new weir to be accounted for in the development of headwater rating information.

As discussed in **Section 3.1**, the weir would have dual operating modes and transitionary modes between these two operating modes. Details on how the weir would be managed during these modes are provided in the following subsections.

Normal operation mode

The primary objective for management of the new weir during normal operation mode would be to prioritise flow discharge via the fishway to promote upstream fish passage. The fishway gates would be fully opened (lowered) and the weir gates would be operated in accordance with preliminary operating rules that have been developed with the objective of balancing the need to minimise upstream impacts with the need for efficient rules for operating the weir gates. The preliminary operating rules would create a dynamic storage where the storage capacity of the weir would vary as the weir gates are raised (closed) or lowered (opened) in response to inflows as follows:

- At low flows the crest of the weir gates would be set at the normal full supply level and a maximum flow depth of 0.5 metres would be allowed to pass over the top of the weir gates. This maximum gate opening of 0.5 metres has been applied for headwater levels up to 67.21 metres AHD (drought full supply level plus 0.5 metres) to control downstream energy dissipation at lower tailwater depths. The minimum fishway flow discharge would be 60 megalitres per day when the crest of the weir gates is at the normal full supply level and no flow is passing over the weir gates
- If flows over the weir gates increase above a flow depth of 0.5 metres, the weir gates would start to be raised (closed) to continue to limit the maximum overtopping of the weir gates to 0.5 metres. i.e. the weir gate crest level would be equal to the headwater level minus 0.5 metres. Raising (closing) of the weir gates would occur progressively in sync with headwater level increases. Flows over the weir gates would peak at a nominal minimum flow of about 350 megalitres per day up to about 374 megalitres per day when the headwater level is between 66.21 metres AHD and 67.21 metres AHD, when the gates would be fully raised (closed) at 66.71 metres AHD
- For headwater levels above 67.21 metres AHD, the weir gates are unable to be raised above the drought full supply level (66.71 metres AHD) and hence gate overflows would become greater than 0.5 metres. For the preliminary concept design, this is assumed to be manageable considering the expected relatively high total discharge and significant associated higher tailwater levels and depths
- At higher headwater levels and discharges the weir gates would be progressively lowered to maximise waterway area for the purpose of minimising the weir drown-out flow when the weir would cease to be the main control/influence on upstream water levels.

The preliminary operating rules for dynamic storage have been selected as they are less operationally intensive and complex than if the weir gates were initially operated with the aim of maintaining a weir pool at the normal full supply level during periods of relatively low inflows.

Discharges via the weir and fishway gates at different headwater levels in accordance with the preliminary operation rules are detailed in **Table 3-5**. A headwater rating curve showing the relationship between the flow volume discharging from the new weir (gates and fixed crest) and fishway against headwater level during normal operation mode is shown in **Figure 3-13**.

Table 3-5 Headwater rating table during normal operation mode

Headwater level (metres AHD)	Weir gates		Fishway discharge (ML/day)	Total discharge (ML/day)
	Crest level	Volume discharging (ML/day)		
65.71 (normal FSL)	65.71	0	60	60
66.21	65.71	374	159	533
66.71 (drought FSL)	66.21	374	420	794
67.21	66.71	374	716	1,862*

* Includes discharge of 772 megalitres per day over the fixed crest.

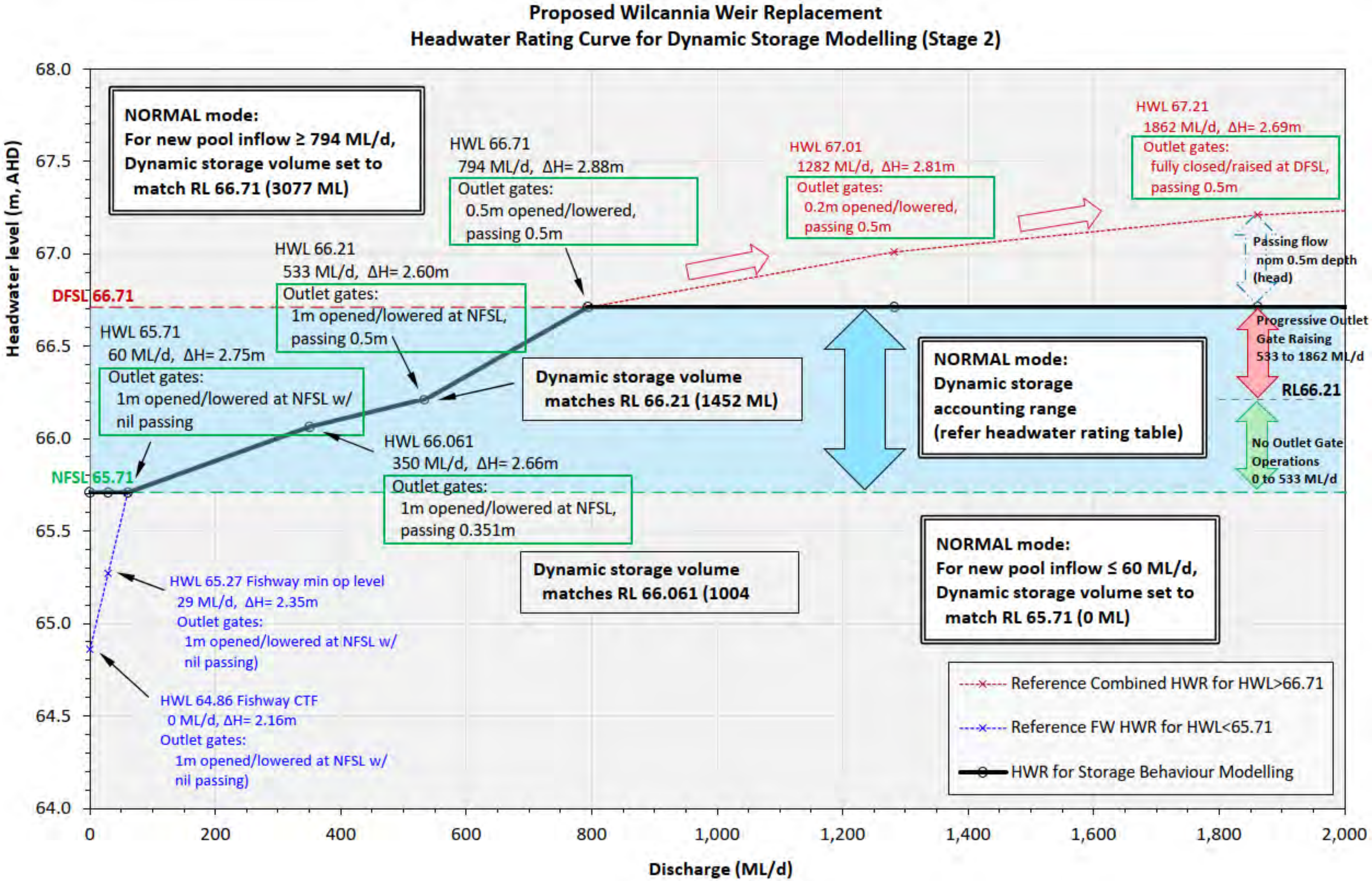


Figure 3-13 Headwater rating curve of the new weir during normal operation mode

Filling phase

As noted in **Table 3-1**, the filling phase would transition the weir from normal operation mode to drought security operation mode. The preliminary operating rules include a trigger for the filling phase to start when flows in the Darling River (Baaka) fall below 250 megalitres per day past the Bourke Town Weir, represented by the location of the Myandetta gauge (gauging station no. 425038 (Darling River at Myandetta).

Filling of the weir pool would only be required above the prevailing flow dependent headwater level up to the drought full supply level of 66.71 metres AHD. At flows above about 800 megalitres per day the weir pool would effectively already be full at the time of the filling phase trigger. Accordingly, the impacts of weir pool filling are typically limited to periods when inflows are less than 800 megalitres per day.

The primary objective for management of the new weir during the filling phase would be to avoid a sudden reduction in river flows and potentially water levels downstream of the new weir.

Drought security operation mode

The weir and fishway gates would be closed upon the completion of the filling phase to increase the storage capacity of the weir from the normal full supply level (65.71 metres AHD) to the drought full supply level (66.71 metres AHD).

Management of the new weir during drought security operation mode would aim to secure Wilcannia's water supply for the duration of drought periods, protect the quality of the stored water, and to pass any inflows downstream that are not required to secure the town's water supply.

The new weir has been sized so that when it is in drought security operation mode it would provide sufficient storage capacity to meet Wilcannia's forecast water demand for the longest drought on record and for no inflows to occur during this period. The trigger for switching the weir from normal to drought security operation mode has been developed with the aim of ensuring the storage in the weir reaches the drought full supply level during the filling phase. Once the headwater level reaches the drought full supply level, any inflows to the combined new town pool and Pool 1 while the weir remains in drought security operation mode would be surplus to what is expected to be required to sustain Wilcannia through the worst predicted drought and are available for release downstream. This translucency provision is not proposed to be applicable to drought storage levels below 65.54 metres AHD when the remaining accessible storage would fall to 2,173 megalitres (the volume equivalent to that of the existing weir pool at the existing full supply level).

Gated weirs are often operated in accordance with rules that are based on the concept of 'transparency' and 'translucency':

- Transparency — 'Transparent' refers to management of the weir as if it were see-through, or invisible, with inflows to the weir pool being fully passed downstream as if the weir was not there at all. The passage of all inflows past a transparently-operated weir is analogous to all light passing straight through a transparent piece of glass
- Translucency — 'Translucent' refers to management of the weir as if it were a translucent (partly see-through) piece of glass, where some, but not all, of the light (or inflows) can pass through. The exact proportion of light (or inflows) that gets through is expressed as a percentage. For example, 20 per cent translucency means that of the incoming light (or inflows) only 20 per cent is passed through the piece of glass (or weir). If the translucency was set as zero per cent, no light would get through at all (an opaque piece of glass) and the weir would store and extract all inflows, passing nothing to the other side (downstream of the weir).

It is proposed to operate the weir gates and fishway gates, if necessary, during drought security operation mode to provide for translucency of inflows into the combined new town pool and Pool 1. These translucency discharges from the weir during drought security operation mode would occur in accordance with the following rules:

- Translucency discharges would only occur when there are inflows to the combined new town pool and Pool 1

Translucency discharges would occur when the weir pool level is within the range of the increased accessible storage. As shown in **Table 3-4,** the new weir would have an accessible storage volume of 5,654 megalitres at the drought full supply level compared to 2,173 megalitres for the existing weir at the normal full supply level. This extra 3,481 megalitres of storage capacity is equal to the volume of water in the upper 1.17 metres of the weir pool. Therefore, the transparency rules would apply when the weir pool level is between the drought full supply level (66.71 metres AHD) and 65.54 metres AHD (the drought full supply level minus 1.17 metres)

- The discharge rate would aim to match the rate of inflow to the combined new town pool and Pool 1, so as to maximise downstream flows up to at least 374 megalitres per day via the weir gates with potential for supplementary flow discharge via the fishway.

The translucency discharges would result in a dynamic storage that would be managed through operation of the weir gates and fishway gates. When the weir pool level is above the normal full supply level translucency discharges could occur via the weir gates and the fishway gates. The weir gates would be operated until fully lowered to provide inflow translucency releases, subject to the rules described above. The capacity of the weir and fishway gates for transparency releases at key headwater levels is provided in **Table 3-6**.

The overarching preference is for discharges from the new weir to occur via the fishway to promote upstream fish migration, although reliance solely on the fishway for translucency discharges would create the potential for temporary storage of some inflows to the combined new town pool and Pool 1 if the inflows exceed the capacity of the fishway for a given headwater level.

Regulating the discharge by partially opening the fishway gates would have some limitations and disadvantages:

- Upstream fish passage is not possible when the fishway gates are only partially open
- If the only downstream flow is via partially opened fishway gates then debris would be drawn into the fishway, which would increase the need for maintenance cleaning of the fishway.

Potential inflow translucency cases are:

- Inflow exceeds the fishway discharge for a given headwater level — Inflow translucency would occur via fully open fishway gates with any surplus inflows discharged via the weir gates within the limits on gates operation. With the fishway gates fully open, the fishway discharge would be governed by the fishway headwater rating. If the required inflow translucency is greater than the total discharge capacity of the weir gates and fishway gates the portion of inflow in excess of the discharge capacity would be banked and carried forward until able to be discharged either via the weir and fishway gates or by spilling over the crest of the new weir
- Inflow is less than the fully open fishway discharge capacity — Discharge would occur via the weir gates within the limits on gates operation with any surplus inflows discharged via partially open fishway gates. Translucency inflows of up to about 374 megalitres per day (nominal minimum 350 megalitres per day) may be passed via the weir gates (within the limits on gates operation), prior to the need for any additional inflow to be discharged via the fishway. There would be less potential for debris to be drawn into the fishway for this case since the fishway would not be the primary flow discharge route.

If there are inflows to the combined new town pool and Pool 1 and the headwater level is at the drought full supply level, the weir pool would be spilled over the crest of the new weir.

Table 3-6 Capacity for translucency discharges past the new weir via the weir gates and fishway during drought security operation mode

Headwater level[1]	**Fishway discharge capacity (fishway fully open) (ML/day)**	**Weir gate level[1]**	**Weir gates discharge capacity (ML/day)**	**Translucency discharge capacity (ML/day)**	**Total weir pool storage volume (ML)**
65.54 (DFSL – 1.17m)	48	65.11	302	0 / 350	4073.1
65.71 (NFSL = DFSL – 1.0m)	60	65.29	290	350	4754.9
65.81				350	5041.0
65.91				350	5327.1
66.01				350	5613.2
66.061	129	65.71 (NFSL)	221	350	5759.1
66.11				410	5899.3
66.21 (DFSL – 0.5m)	159	65.71 (NFSL)	374	533	6206.7
66.31				585	6528.3
66.41				637	6849.9
66.51				689	7171.5
66.61				742	7493.1
66.71 (DFSL)	420	66.21 (DFSL – 0.5m)	374	794	7832.1

Notes:

1 DFSL = Drought full supply level, NFSL =Normal full supply level

Water quality management

When the new weir is in drought security operation mode there are likely to be long periods when inflows to the weir pool are low. Low inflows would result in non-flowing water conditions in the weir pool, which are conducive to thermal stratification and blue green algae, particularly if these conditions are accompanied by long retention times, light winds and minimal turbulence.

Thermal stratification in a water storage occurs when the top layer of water becomes warmer and the lower layer remains cooler. If the two layers stop mixing due to the factors described above, blooms of buoyant blue-green algae can establish. When a water body is stratified, bottom waters often become depleted of oxygen (anoxia) which may lead to increased nutrient release from the sediments. Pulses of nutrients from the colder bottom layer may feed algal growth in the top layer.

Management of stored water quality when the new weir is in drought security operation mode is subject to sufficient inflows to the weir pool that can be used to promote mixing, dilution and water volume exchange via the controlled release of water from the new weir in accordance with translucency rules. To maximise mixing flow velocities for the greatest length of the weir pool it is desirable to discharge flows from the weir simultaneously with the occurrence of inflows to the weir pool. However, a difficulty with this approach is quantifying the inflow volume that could be released, without impacting the security of the town water supply during drought security operation mode.

Destratification of the weir pool is likely to be achieved at a minimum average cross-sectional velocity of 0.035 metres per second. The required flows to achieve this minimum velocity have been calculated by considering survey data of river cross-sections of the new town pool and Pool 1 (20 river cross sections) and Pool 2 (25 river cross sections) that was collected in 2020. These river cross-sections were typically at intervals of up to about one kilometre along the about 35 kilometres of river between the new weir and Bar 2.

Based on an assessment of the surveyed cross-sections, a maximum flow of 596 megalitres per day is required to achieve a minimum destratification velocity of 0.035 metres per second when the weir pool is at the drought full supply level (66.71 metres AHD). However, it is assumed reasonable that destratification would not be required over at least the top 0.5 metres of the raised weir pool, in which case the required destratification flow would reduce to 520 megalitres per day for a 0.5 metres draw down of the raised weir pool i.e. 66.21 metres AHD.

In line with the inflow translucency rule, such flows would be passed through the structure via a combination of outlet gates and fishway. Meaning destratification would be achievable within the discharge functionality of the structure but is dependent on the volume of inflows to achieve destratification across the entire weir pool during drought security operation mode.

Reset phase

As noted in **Table 3-1**, during the reset phase the weir would transition from drought security operation mode to normal operation mode. The actions taken in the reset phase would depend on the headwater level when the reset phase is triggered:

- If the reset phase is triggered when the headwater level is below the normal full supply level then refilling of the storage to the normal full supply level would occur. Once the headwater level reaches the normal full supply level the weir would start normal operation mode
- If the reset phase is triggered when the headwater level is above the normal full supply level then the fishway gates would be lowered and the weir gates managed so that the maximum overtopping is 0.5 metres. Lowering of the weir pool would only start once inflows to the weir pool are greater than 60 megalitres per day, which is the minimum normal operation mode discharge for the fishway. This would avoid the potential for start stop downstream flows, which would occur if the weir pool were lowered prior to the arrival of inflows and all gates needed to be closed again to persevere the normal full supply level.

During the reset phase lowering of the gate crest (weir pool) would be limited to 100 millimetres per day with the aim of maintaining riverbank stability.

3.5.4 Trigger levels for operating the weir and fishway gates

As noted in **Table 3-1,** preliminary trigger levels for transitions between the normal and drought security operation modes have been adopted based on the flow rate in the Darling River (Baaka) at the Myandetta gauging station (gauging station no. 425038 (Darling River at Myandetta)). The filling phase would be triggered by flows past Bourke Town Weir falling below 250 megalitres per day and the reset phase triggered by flows past Bourke Town Weir rising above 300 megalitres per day. A schematic of transitions between the modes of operation being triggered by flows over Bourke Weir is provided in **Figure 3-14.**

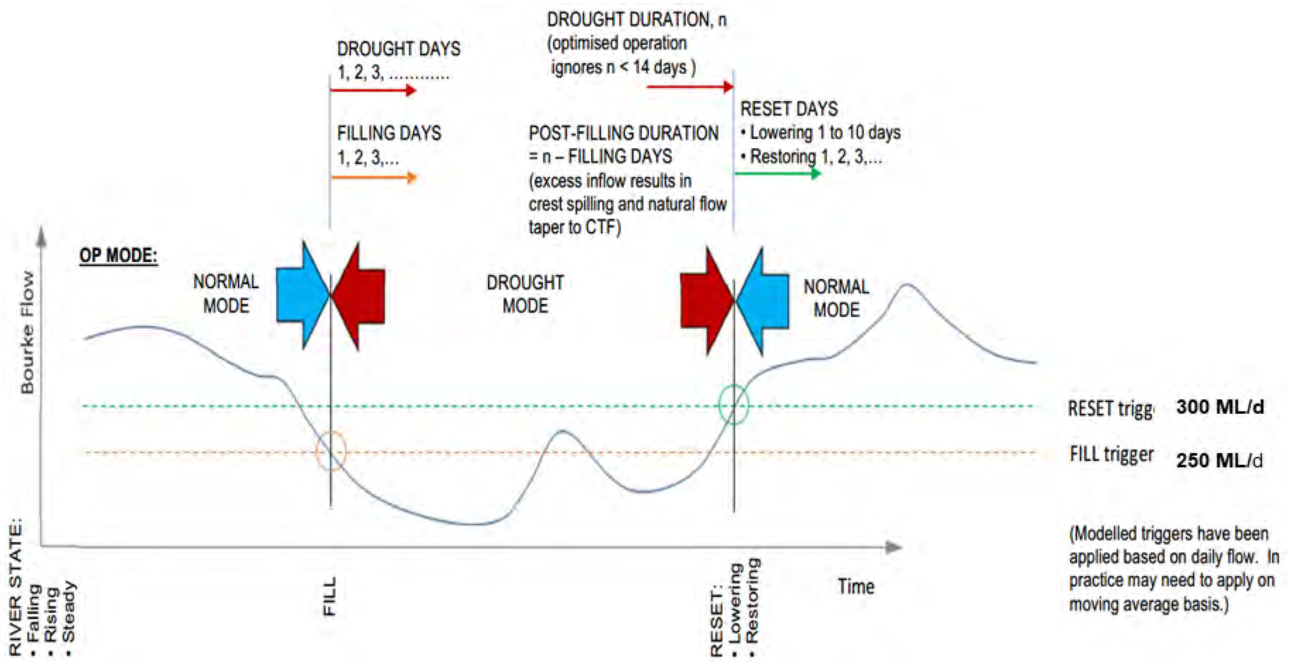


Figure 3-14 Triggers for the filling and reset phases

Preliminary trigger levels based wholly on daily flows past Bourke Town Weir have been adopted for the purposes of storage behaviour modelling. The preliminary trigger levels are considered to be a conservative oversimplification of the range of factors likely to be considered when deciding whether and when to implement a change in weir operation mode.

The operations plan will detail the trigger levels for opening and closing the weir and fishway gates. The operations plan is expected to include a broader consideration of the state of the river system than just the flow rate in the river at the Bourke gauging station considered in the preliminary operating rules. For example, if the flow rate at Bourke drops below the trigger level for closing the weir and fishway gates but flows within either the Warrego or Paroo Rivers (located downstream of Bourke) are sufficiently high, closing of the gates may be delayed.

An adaptive management regime is proposed for the operation of the new weir, whereby over time the trigger levels for operation of the weir and fishway gates may be refined to reflect operational experience and any future changes in the nature of river flows and local demand for water. This approach is expected to provide an opportunity to refine the trigger levels to achieve the best balance possible between the primary need for town water security and minimisation of environmental impacts. Optimising the operation of the new weir to minimise unnecessary mode changes could include consideration of anticipated river system flows from upstream, climatic conditions, prevailing weather and downstream tributary inflows from the Warrego River and/or Paroo River, for example.

3.5.5 Weir maintenance

WaterNSW would routinely inspect the new weir structure including the left and right abutments, weir embankment, weir gates, rock scour protection, access walkway and instrumentation. These inspections would be carried out to monitor the condition of the new weir and to identify any damage caused to the weir by objects carried in water flowing through the weir gates, or water flowing over the weir crest.

WaterNSW would also inspect the new weir for damage following floods. These inspections would consider erosion at the downstream weir embankment and weir abutments as well as the downstream riverbed.

WaterNSW would need to carry out routine and periodic maintenance including refurbishment and renewal throughout the life of the weir. This would include preventative maintenance of mechanical, electrical and civil assets and repair of these as required. WaterNSW may also need to carry out investigations and testing for monitoring and remediation purposes e.g. using divers to assess whether any bed scour has occurred at the toe of the downstream embankment or gate bays.

Additionally, WaterNSW may undertake preparatory actions in advance of an impending flood event that would completely submerge the new weir and fishway structures and remove or secure any inspection and maintenance temporary works. Further actions would be undertaken during flood rise and fall to ensure the structure is operated optimally and that flood waterway area is appropriately maximised within structure operating requirements.

The weir gates would infrequently need to be removed for repairs or to undertake long-term maintenance. The operational site layout includes a crane pad and laydown area on the right (northern) riverbank near the weir gate bay. A crane pad 12 metres long and 10 metres wide has been included in the preliminary concept design to accommodate a 250-tonne mobile crane with a lifting capacity of 6.5 tonnes. The crane would need to be positioned parallel to the river to remove the weir gates.

3.5.6 Operation and maintenance of the fishway

As previously described, in normal operation mode the weir and fishway gates would be operated, where possible, so that the fishway is the primary means of river flows passing the weir. This requires no adjustment of the fully open gates for the fishway structure with operational focus on the movement of the weir gates to maximise discharge through the fishway.

When the new weir is in drought security operation mode, the weir and fishway gates are closed upon the completion of the filling phase, to increase the storage capacity of the weir from the normal full supply level (65.71 metres AHD) to the drought full supply level (66.71 metres AHD), triggered by the flows over Bourke Weir falling below 250 megalitres per day.

While in drought security operation mode, flows through the fishway would be dependent on both the inflows to the new town pool and the headwater level of the weir pool when these inflows occur, as discussed in **Section 3.5.3**. Discharges of up to 420 megalitres per day can be passed via the fishway at the drought full supply level without the need to operate the weir gates. However, the preferred operating configuration would discharge translucency inflows less than the discharge capacity of a fully opened fishway via the weir gates. This would avoid partial fishway gate openings and minimise the potential to draw debris into the fishway. This approach increasingly becomes the more practical option as the weir pool is drawn down during a drought and the fishway discharge capacity progressively reduces while that of the weir gates remains at up to a nominal minimum of 350 megalitres per day (374 megalitres per day).

WaterNSW would routinely inspect the fishway on a frequent and regular basis to inspect for debris accumulation within the fishway, particularly across baffle slots, with clearing undertaken as required to ensure the fishway is able to facilitate fish passage as intended. Additionally, routine and periodic inspections would be undertaken of the fishway including the baffle ridges, concrete channel and dividing wall, fishway gates, rock scour protection at the downstream end of the fishway and adjacent bank areas, access walkway and instrumentation.

WaterNSW would also need to carry out routine and periodic maintenance including refurbishment and renewal throughout the life of the fishway. The fishway would occasionally need to be cleared of sediment and debris using a vacuum truck and/or an excavator, which would generally occur when the weir is in drought security operation mode and the fishway is not in use. WaterNSW may also need to carry out investigations and testing for monitoring and remediation purposes e.g. dewatering of the fishway to assess whether any internal siltation or debris accumulation has occurred.

The fishway gates would infrequently need to be removed for repairs or to undertake long-term maintenance. The operational site layout includes a crane pad and laydown area on the right (northern) riverbank near the upstream end of the fishway. A crane pad 12 metres long and 10 metres wide has been included in the preliminary concept design to accommodate a 250-tonne mobile crane with a lifting capacity of 6.5 tonnes. The crane would need to be positioned parallel to the fishway to remove the fishway gates.

3.5.7 Key operational comparison between existing and new weir

Table 3-7 provides a comparison of the key aspects of operation of the existing weir and the proposed new weir.

Table 3-7 Key operational comparison between the existing weir and the proposed new weir

Operation criteria	Existing weir	Proposed new weir
Weir location	The existing weir is located about 460 metres upstream of Wilcannia Bridge. River levels downstream through the town are dependent on a full weir pool and the size of river flows that spill over the weir crest. During no-flow drought periods the riverbed through the town becomes exposed.	The proposed new weir would be located about 4.46 kilometres downstream of Wilcannia Bridge. River levels upstream through the town would be dependent on the weir operating mode and river flows. In normal operation mode (assuming no-flow), the weir pool water level at the bridge would be typically not less than 65.71 metres AHD (or a water depth of up to 4.5 metres).
Fish passage	No current fish passage provisions for flows less than weir drown-out (above 5,000 megalitres per day).	Legislative requirements for incorporation of fish passage into the design of the new weir would provide fish passage between upstream and downstream of the new weir site.
Weir pool length and water storage capacity	Length at full supply level of 65.71 metres AHD: 61.79 river kilometres Total storage at full supply level: 4207 megalitres At times of no inflows and a small 44 centimetre reduction in weir pool, weir Pool 2 becomes isolated from Pool 1 requiring temporary pumps to be installed to pump from Pool 2 to Pool 1 (refer to **Figure 3-12**). With no inflows the existing weir has storage supply of six months.	Length at normal full supply level of 65.71 metres AHD: 66.71 river kilometres Length at drought full supply level of 66.71 metres AHD: 85.52 river kilometres Storage at normal full supply level: 4,755 megalitres Storage at drought full supply level: 7,832 megalitres Apart from the 4.92 river kilometre new town pool, the one metre increase in drought storage is built upon the existing storage of the existing weir pool, hence Pool2 does not become isolated from Pool 1 until the drought storage reduces by 1.44 metres.

Operation criteria	Existing weir	Proposed new weir
Weir height	Four metres in height. RL 65.71 metres AHD at full supply level.	Increase in height by one metre, to a final five metres high weir. RL 66.71 metres AHD at drought full supply level.
Weir pool riverbank height	11 to 12 metres in height. Overtopping of the riverbanks during normal operations is not possible prior to the existing weir becoming fully submerged and drowned-out.	11 to 12 metres in height. Overtopping of the riverbanks during either normal operation mode or drought security operation mode is not possible prior to the new weir becoming fully submerged and drowned-out. This is despite an increase in weir drown-out from above 5,000 megalitres per day (existing) to about 11,160 megalitres per day (proposed).
Bank stabilisation	The existing weir is located about 50 metres upstream of a river bend which may have contributed to observed destabilisation and erosion of the riverbank on the outside of the bend.	The new weir is located upstream of a straight section of the river, and about 780 metres downstream of the end of Union Bend. The nearest downstream bend from the new weir starts about 480 metres away. Positioning of the new weir on a relatively straight section of the river with a long distance downstream to the nearest bend is expected to minimise impacts to the riverbanks during operation.
Owner operator	WaterNSW operates the existing weir.	WaterNSW would own and operate the new weir.
Management of downstream flows	Downstream flows are only possible after the weir pool is first filled to the full supply level and the fixed weir crest is able to spill.	The proposed weir gates would allow for downstream flows to be managed including the release of part or all inflows into the new town pool during drought security operation mode in accordance with inflow translucency rules when the weir pool is drawn down below the drought full supply level by up to 1.17 metres. The new weir structure would be able to discharge flows downstream over the top 2.5 metres of the drought storage.
Town water supply	Supply is extracted from Pool 1 of the weir pool (see schematic slide), and processed by the town water treatment plant operated by the Central Darling Shire Council.	Supply would continue to be extracted from the same location and be processed by the town water treatment plant operated by Central Darling Shire Council.
Water quality management	With no inflows the weir pool becomes stagnant and there is no provision to flush or mix the weir pool, until inflows return and the weir fixed crest is able to spill.	The proposed weir gates would enable flushing of the weir pool in accordance with inflow translucency rules to achieve water velocities through the weir pool that promote mixing, subject to adequate inflow rates and duration of inflows.

3.6 Construction activities and methodology

3.6.1 Construction access

The new weir construction site would be accessed from both the left (southern) and right (northern) riverbanks as noted in **Table 3-1**. The southern access and northern access are described in the following sections.

Southern construction access track

The primary access to the new weir construction site would be via an existing track from the Barrier Highway to the left (southern) riverbank (refer to **Photo 3-3**). This track is on private property and is about three kilometres long. The track would be upgraded to make it suitable for use by construction vehicles.

The existing access track is about four metres wide. The track would be widened to 7.5 metres. Also, the access track would be widened where it joins the Barrier Highway to facilitate safe truck turning.

Four material laydown areas are proposed alongside the access road during the upgrade works. Passing bays would be constructed at three of these material laydown areas to improve construction traffic flow.

Water Infrastructure NSW has consulted with the owner of this access track, the Wilcannia Local Aboriginal Land Council, and agreed to leave the proposed improvements to the access track in place at the conclusion of the construction phase. This would provide the Wilcannia Local Aboriginal Land Council with improved access to their property.

Photo 3-3 Existing access track between the Barrier Highway and the southern side of the proposed new weir

Northern construction access road

Construction vehicle access to the new weir site from the north would be via Union Bend Road, an unsealed road that extends south off Reid Street (refer to **Photo 3-4**). A new unsealed access road would be constructed roughly perpendicular to Union Bend Road to provide access to the new weir over a length of about 280 metres. This new road would be about eight metres wide to enable two-way traffic. This road would be retained for maintenance access during operation of the new weir.

Photo 3-4 Union Bend Road

Construction vehicle access to the river

Construction vehicle access tracks would be cut into the riverbank on both sides of the proposed new weir to provide a grade suitable for large heavy vehicles to access the riverbed. The southern access to the riverbed would be removed and rehabilitated following completion of construction. Part of the northern access to the riverbed would be retained for maintenance access to the weir and fishway during operation.

Construction car parking

Car parking for construction workers and visitors to the new weir construction site would be provided within the construction compound and laydown areas. The car parking area would be located to minimise potential for disturbance to vegetation and cultural heritage sites.

Access to the existing weir

Construction vehicle access to the existing weir would be via Victory Park Caravan Park. An existing unsealed road connects the caravan park to the Barrier Highway. Within the caravan park an internal road provides access to caravan parking sites and loops back to the entry road.

A temporary access track would be built to enable construction vehicles to access the existing weir from the internal loop road in the caravan park. This temporary access track would be cut into the left riverbank to enable construction vehicles to access the riverbed.

3.6.2 Construction compounds and material laydown areas

Construction compounds would be established on both sides of the river at the new weir site. Facilities to be provided at each construction compound would be decided by the construction contractor and would depend on the compound's purpose and may change over the construction period depending on works that are occurring. Facilities at each construction compound may include:

- A portable site office
- A portable amenities building including first aid room, meal room and toilet block
- Potable water tanks
- Portable power generators
- Vehicle parking and refuelling areas
- Material laydown areas
- Plant parking, maintenance and refuelling areas
- Temporary spoil stockpiles and rock crushing and screening plant
- Mobile concrete batching plant
- Temporary perimeter fencing
- Signage.

3.6.3 Cofferdams

The construction contractor would use temporary cofferdams to create a dry area for construction of the new weir. Cofferdams would be constructed in two key stages:

- Cofferdam for construction of the fishway - A temporary cofferdam would be built along the right side of the river (northern side) around the work site for the fishway (refer to **Figure 3-2**). Where possible, the cofferdam would be installed during low flows to minimise safety impacts. The cofferdam would extend about halfway across the river from the right (northern) riverbank and be about 12 metres longer than the fishway at both ends i.e. about 144 metres long. Once the cofferdam is in place the fishway work site would be dewatered. All access to this work site would be from the right (northern) bank of the river. When there is low flow in the river water would flow past the work site for the fishway along the natural river channel. Once the construction of the fishway is complete the cofferdam would be removed.
- Cofferdams for construction of the fixed crest weir and weir gate bay - Temporary cofferdams would be built upstream and downstream of the proposed weir site (refer to **Figure 3-3**). These cofferdams would extend from the left riverbank to the left wall of the fishway. Once the cofferdams are in place the weir work site would be dewatered. All access to this work site would be from the left (southern) riverbank. Water would flow past this work site via the fishway. Once the construction of the fixed crest weir and the weir gate bay is complete the cofferdams would be removed in the order of downstream cofferdam then upstream cofferdam.

The cofferdams could be constructed using earth or sheet piles, or a combination of both. The construction contractor would determine the material used to construct the cofferdams and the height of the dams.

A temporary cofferdam would also be used for the partial removal and decommissioning of the existing weir (refer to **Figure 3-11**). This cofferdam would extend out from the left riverbank and include most of the existing weir and its upstream and downstream embankments. Once the cofferdam is in place the in-stream work site would be dewatered. All access to this work site would be from the left riverbank i.e. from Victory Park Caravan

Park. Water would flow past this work site along the right side of the channel. Once the existing weir has been partially removed and decommissioned the cofferdam would be removed.

3.6.4 Silt curtains

Silt curtains would be used to minimise sediment-laden water from flowing beyond in-stream work sites. Silt curtains would be placed so as not to block fish passage past the work sites. For example, silt curtains would be placed around the outside of cofferdams or around piling work sites during construction of cofferdams.

3.6.5 Construction staging

Construction of the proposal would include the following stages:

- Procurement of long lead time items
- Fabrication of the precast concrete fishway
- Pre-construction activities
- Early works including installing a temporary cofferdam around the proposed fishway work site
- Main construction works for the new fishway
- Fishway maintenance access and northern embankment earthworks
- Supplying power to the new weir including the weir gates and fishway gates
- Testing and commissioning of the fishway gates
- Removing the cofferdam from around the completed fishway and installing temporary cofferdams upstream and downstream of the new weir work site, so that water flows past the new weir work site via the fishway
- Construction works for the weir gate bay and fixed crest weir
- Southern embankment earthworks
- Testing and commissioning of the weir gate
- Removing the temporary cofferdams from the new weir work site
- Decommissioning and partial removal of the existing weir
- Completion of the community river place (using rocks from the existing weir)
- Finishing and rehabilitation.

The sequencing of the works within each of the above stages would be determined by the construction contractor. Construction work would be carried out on both sides of the river at the new weir site, although the larger share of the work would be carried out on the right bank (northern side). Construction activities that would be carried out on the right bank would include the fishway, power supply to the weir gate and fishway gate and establishing the community river place and associated car parking area. It is likely that works would be conducted on both sides of the river at the new weir at times.

The following sections provide more detail on the key activities that would be carried out during some of the main stages of the construction works.

Pre-construction activities

Pre-construction activities would include archaeological assessment, establishing the proposed construction compound and material laydown areas. Surveying and marking the boundaries of the construction footprint would also occur during the pre-construction stage.

Early works

The early works stage of construction would include:

- Establishment of erosion and sediment controls
- Minor vegetation clearing and establishment of protection zones for culturally significant trees and hearths (hearths that are near the construction footprint, and any within the construction footprint that can be protected if possible)
- Tree removal at the new weir site
- Upgrading the access tracks to the proposed work sites on both sides of the river
- Installing the cofferdam around the proposed work site for the fishway
- Dewatering the area within the cofferdam to provide a dry work site.

Main construction works for the fishway and new weir

Sheet piling

- Sheet piling would be carried out to provide supports for the weir wall, the toe of the downstream embankment and the wall separating the weir pool from the fishway. The piling rig would be positioned on the riverbed to carry out these works. It is expected that only one piling rig would be used.

Concreting work

- In-situ concrete would be required for the construction of the proposed new weir structure. A mobile concrete plant would be used during construction to ensure a reliable supply of concrete for the works
- Concrete would be used mainly for the weir gate bay and fishway gate bay to construct the structural base slabs and supporting walls for gates. Concrete would also be used to cap the weir wall and for foundation slabs for the switch room and control room buildings
- The mobile concrete batch plant is proposed to be setup of the right bank of the site (norther side) as most of the in-situ concrete works are on the right bank. Although the weir gate bay is currently proposed to be constructed from the left (southern) riverbank, concrete could be pumped from the right (northern) riverbank using a concrete boom pump as the weir gate bay is located closer to the right riverbank than the left riverbank.

Fishway installation

To minimise construction timeframe on site, precast concrete is proposed for the construction of the baffle fishway. A crane would be used during construction to unload the delivery trucks and install the precast concrete sections in place along the fishway as per the design. All activities related to the precast concrete fishway would take place on the right bank of the site (northern side).

Installation of the weir and fishway gates

The weir and fishway gates would be manufactured and fabricated in a factory off site, and would be deliver to site for installation as required. A crane would be used during construction to unload the delivery trucks and install the mechanical components between the supporting walls as per the design. The fishway gates would be installed from the right riverbank (northern side). The weir gates could be installed from either the right or left riverbank, which would be determined by the construction contractor.

Testing and commissioning of the weir gates and fishway

Following construction, the new infrastructure would need to be commissioned to demonstrate its operability and performance. Testing and commissioning would be required for the power supply infrastructure, all powered equipment including the weir gates, fishway gate and the systems for remotely controlling the operation of the gates.

The effectiveness of the fishway in allowing fish passage around the new weir in both the upstream and downstream directions would also need to be observed during the testing and commissioning phase.

Decommissioning and partial removal of the existing weir

Decommissioning and partial removal of the existing weir would be undertaken once the new weir is operational.

The existing weir would be accessed from the left riverbank (southern side) as it is substantially lower than the right riverbank (refer to **Photo 3-5**).

Photo 3-5 The existing weir viewed from the left riverbank

Access to the existing weir would be through the Victory Park Caravan Park, utilising the existing local access road. A temporary access track would be constructed from the internal loop road down to the edge of the existing weir wall (refer to **Photo 3-6**). This proposed access route is consistent with that previously used for maintenance of the existing weir. The track would be at least four metres wide.

Victory Park Caravan Park would be temporarily closed during the work to avoid the safety risks of construction vehicles and plant operating near recreational users of the area.

A temporary construction compound would be established within a grassed area of the caravan park and used for storing plant and equipment, vehicle parking, stockpiling materials, treatment of water pumped out of the in-stream work site, and a temporary construction office.

The work would be carried out in two stages:

- Stage 1 – Cofferdams would be used to create a dry work site that includes about two-thirds the length of the existing weir crest and extends upstream and downstream to include the weir's rock embankments. The piling work would be carried out using a crawler crane. A temporary crane pad would be established on the left riverbank to support the crane while it is carrying out the piling work. A small boat would be used during the piling work to enable construction personnel to guide the sheet piles into place. Once the piling is complete and the work site dewatered, an excavator would be tracked into the work site to rearrange the rocks on the upstream embankment to create an access bench from where the excavator can operate for the next steps of the work. The concrete capping over the weir piles would be saw cut about 300 millimetres below the final surface level and removed using the excavator. The excavator would also be used to excavate the central section of the weir embankment to the design level, rock line the excavated embankment section and shape the rock embankments to the final finished surface. Once complete, the cofferdam sheet piles would be removed, which would result in the river flowing through the deconstructed section of the weir

- Stage 2 **–** The concrete capping over the weir piles in the other about one-third length of the existing weir would be saw cut about 300 millimetres below the final surface level and removed using an excavator. The excavator would also be used to shape the rock embankments to the final finished surface.

Once the weir deconstruction work is complete, the site would be rehabilitated. This would include reprofiling the riverbanks where timber piles were removed with clay and topsoil to match the riverbank upstream and downstream of the existing weir. Landscaping of the site would occur in consultation with Central Darling Shire Council. A preliminary rehabilitation plan for the site is provided in Appendix B of **Technical Report 6**.

Up to about 1,300 cubic metres of rock and concrete would be removed, which is the equivalent of about 130 rigid truckloads of material (10-tonne capacity), or about 43 truck and dog loads (30-tonne capacity), or about 22 A-double truck loads (60-tonne capacity).

The Wilcannia community have expressed a desire for the rocks that make up the existing weir to be salvaged and made available for a range of potential reuses within the proposed community river place at the new weir site and elsewhere in the township. Potential reuse opportunities at the community river place include landscaping features, sculpture and other rock art, delineating car parking areas, access tracks and walking tracks and to protect and delineate cultural heritage items such as canoe trees. There would be similar potential reuse opportunities elsewhere in the town. Rocks removed from the existing weir that are suitable for reuse would be either be transported directly to their proposed reuse location or otherwise transported to Central Darling Shire Council's local depot for temporary storage. It is envisaged that reuse opportunities are likely to be found for about 50 of the larger boulders that make up the existing weir.

Photo 3-6 Location of the proposed temporary access track to the existing weir within Victory Park Caravan Park

Community river place

The community river place at Union Bend would be constructed after the decommissioning of the existing weir. The community river place is a small recreational area at the end of the existing Union Bend Road, on the right bank (northern side) of the river, upstream of the new weir site.

Rocks salvaged from the existing weir decommissioning would be transported to the proposed community river place. The rocks together with suitable site won materials would be used to:

- Delineate spacing at the informal parking area
- Delineate walking tracks
- Delineate recreational areas from vegetated areas
- Provide informal seating.

Urban furniture such as picnic table and benches would be installed scattered through the site shaded by existing trees. It is proposed that these urban furniture could be fabricated locally.

Finishing and rehabilitation

The construction compounds at the new and existing weir sites would be removed at the completion of construction:

- Areas on the left bank of the new weir (southern side) impacted by construction activities would be rehabilitated to similar to their pre-construction condition except for the improvements made to the access road, which would remain in place
- Areas on the right bank of the new weir (northern side) impacted by construction activities would be rehabilitated in accordance with the landscape plan
- Victory Park Caravan Park would be rehabilitated to its pre-construction condition.

The riverbank at the existing weir site would be rehabilitated once the existing weir has been removed. Rehabilitation of the riverbank would include shaping the riverbank to match that upstream and downstream of the existing weir. The riverbank would be stabilised (e.g. with rock) where it has been disturbed to minimise the potential for future scouring.

3.6.6 Plant and equipment

The key plant and equipment required for each of the main components of the construction work would be decided by the construction contractor. The type of plant and equipment required to carry out the work would include:

New weir

Site preparation

- Excavators to remove existing vegetation, tree stumps, topsoil and spoil, and manage topsoil and spoil stockpiles, and load trucks
- An excavator with a tree-shear attachment to remove existing trees
- A tub grinder to mulch cleared vegetation
- An A-double truck to transport excavated materials including green waste, topsoil and spoil
- A bulldozer to clear vegetation and stockpile it
- A grader to prepare laydown and stockpile areas
- A mechanical roller to compact laydown and stockpile areas

- A watercart for environmental control and ensuring the moisture content within the road base material to achieve adequate compaction.

Road works

- A transporter to deliver heavy machinery such as excavators and rollers
- Excavators to excavate out unsuitable material, managed spoil stockpiles and load trucks
- A grader to trim out excess material to comply with design surface levels
- A mechanical roller to compact the various layers of engineered road base material
- A watercart for environmental control and to manage the moisture content within the road base material during its compaction
- An A-double truck to deliver engineered road base material and transport spoil
- Utes and other site vehicles such as tipper trucks to move materials and personnel between the construction compounds and work sites and for management of environmental controls.

Cofferdam installation

- Excavator with sheet pile driver (piling rig) to install the sheet piles
- 50-70 tonne crane
- Excavator
- Water pump to extract water from the enclosed work site created by the sheet piles
- A generator to power the water pump.

Sheet piling of the fishway side wall and weir wall

- A 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack to pick up and install the steel sheet piles
- A flat-bed truck to deliver the sheet piles to the new weir site
- A Franna crane to unload the sheet piles from the flat-bed delivery truck.

Concreting work

- A mobile concrete plant to batch ready-mixed concrete onsite
- An A-double truck to delivery quarry material such as sand and aggregates for concrete production
- A cement delivery truck to deliver cement for concrete production
- A front end loader to feed quarry material to mobile concrete plant
- A flat-bed truck to deliver reinforcement steel bars and other materials for form-working
- A Franna crane and a forklift to unload the flat-bed delivery truck
- Concrete agitator trucks
- A mobile concrete pump
- Utes and other site vehicles such as tipper trucks to move materials and personnel between the construction compounds and work sites and for management of environmental controls
- A pump to dewater the work site
- A generators to power the pump
- Various powered hand tools including hammer drills, jack hammers and scabbing guns.

Clay fill and rock lining

- A-double trucks to delivery quarry and fill materials

- A front end loader to transport quarry and fill materials between the material laydown areas and the work site on the riverbed and for stockpile management
- Excavators to remove unsuitable material at the riverbed and prepare the foundation for the new weir, and to place quarry and fill materials underneath rock lining and on weir embankments
- A mechanical roller to compact the clay fill material in layers
- Compactors to compact fill materials
- Utes and other site vehicles to move materials and personnel between the construction compounds and work sites and for management of environmental controls
- Pumps for dewatering.

Weir gates and fishway gates installation

- Flat-bed trucks to deliver the metal gate and other items
- A Franna crane to lift metal gate off delivery trucks
- A 120 to 150-tonne crane to lift each weir gate from the riverbank into position within the supporting walls of the gate bay
- Elevated work platforms to guide the installation of the metal gate – hinge point connections
- Utes and other site vehicles to move materials and personnel between the construction compounds and work sites and for management of environmental controls
- Pumps for dewatering.

Fishway installation

- Excavators to perform detail excavation for the fishway, manage spoil stockpiles and load trucks
- Flat-bed trucks to deliver pre-cast concrete sections of the fishway and counterweights for the crane
- A 250 to 300-tonne crane to lift pre-cast concrete baffles and other fishway elements from the riverbank into position on the fishway for a 10 tonne unit with working radius of 40 metre
- A Franna crane to move materials around the work site
- A-double trucks to delivery rock material and transport spoil
- Utes and other site vehicles such as tipper trucks to move materials and personnel between the construction compounds and work sites and for management of environmental controls
- Generators to provide power onsite for powered tools
- Pumps for dewatering.

Utilities

- A flat-bed truck to deliver timber power poles, cable drums and electrical equipment such as the switchboard and pole mounted substation
- A transporter to deliver the prefabricated concrete buildings
- An excavator with auger attachment / piling rig to drill foundation for timber power poles
- A pole holding truck to erect and install timbe power poles
- An elevated work platform for overhead wiring works
- A Franna crane to lift material and equipment off delivery truck
- A 120 to 150-tonne crane to unload and place the prefabricated concrete buildings
- A concrete agitator truck to delivery concrete for timber pole foundation and switch room / control room supporting slabs.

Construction compounds and material laydown areas

- Flat-bed trucks to deliver portable buildings and other items
- Franna cranes and forklifts to transfer materials from delivery vehicles to the ground and to organise laydown areas
- Generators to provide power to site offices and amenity buildings.

General – use of a work boat

A work boat is proposed during construction of the new weir to assist with the installation, inspection and maintenance of the cofferdams. The boat is expected to be initially lifted into the water by the crane but would then likely remain in the river tied to a temporary wharf so that it can be easily accessed and operated. The wharf would be a 10 to 15 metre long sheet pile line at the riverbank with imported gravel behind it to form a flat pad. Wharves are proposed on both the right and left riverbanks downstream of the cofferdams proposed for stages 1 and 2 of the construction works respectively.

Existing weir

Decommissioning

- A transporter to deliver heavy machinery such as excavators and a crane
- Excavators with rock breaking or vibrator attachments to remove existing rock revetments and other materials, stockpile management and load trucks
- A 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack to remove any existing concrete material and sheet piles
- Dump trucks to transport excavated rock revetment and other waste materials from the weir to the stockpile area
- A-double trucks to transport excavated rock revetment and other waste materials off-site
- Flat-bed trucks to transport any recovered sheet piles off-site.

Site rehabilitation

- An excavator with a rock grab to place rock on the excavated river embankment as scour protection
- An A-double truck to transport rock to the site for use as scour protection.

3.6.7 Earthworks and waste

The new weir would require about 2,600 cubic metres of rock fill material. The construction contractor would be responsible for selecting suitable rock supplies to construct the new weir. The nearest quarry to the proposal that can produce the oversized rock required for the new weir is Broken Hill.

Fill materials would also be temporarily required should the construction contractor choose to use earth or rock-fill cofferdams. These materials would need to be removed from the work site at the conclusion of the works.

Earthworks would be required at the new weir to enable construction vehicles to access the riverbed from both sides of the river and to accommodate the fishway. The riverbanks would be cut back and some of the removed material would be temporarily stored at the construction compounds for later reuse in rehabilitating the riverbanks. **Table 3-8** provides estimates of the volume of spoil that would be generated at the new weir site.

Table 3-8 Estimated volumes of spoil at the proposed new weir site

Location	Estimated volume of spoil (cubic metres)		
	Temporarily store on site for reuse in riverbank rehabilitation works*	**Offsite disposal or other onsite reuse opportunities**	**TOTAL**
Left riverbank	3,450	4,400	**7,850**
Right riverbank	14,300	7,280	**21,580**
TOTAL	**17,750**	**11,680**	**29,430**

*This assumes that the excavated material is suitable for use as backfill.

The partial removal of the existing weir would generate up to about 600 cubic metres (or about 1,300 tonnes) of rock and concrete waste.

Waste generated during the construction of the proposal that cannot be beneficially reused would be disposed at a suitably licenced waste facility.

Further discussion on waste management for the proposal is provided in **Section 21.2**.

3.7 Crime prevention through environmental design

Crime prevention through environmental design (CPTED) is a situational crime prevention strategy that focuses on the design, planning and structure of the environment. It reduces opportunities for crime by using design and place management principles that reduce the likelihood of essential crime ingredients (law, offender, victim or target, opportunity) from intersecting in time and space.

There are four principles used in the assessment of projects to minimise the opportunity for crime (Department of Urban Affairs and Planning, 2001). These are described in **Technical Report 6** and summarised below, with a discussion of how the proposal has considered each principle. Incorporating these four principles of CPTED can help to create a safe and secure environment that encourages activity, vitality and viability, enabling a greater level of security. They can also assist in minimising the incidence of crime and contribute to perceptions of increased public safety. The intention is that they should be applicated selectively and flexibly to address crime risk within the context of the setting, and not as a checklist (Department of Urban Affairs and Planning, 2001).

3.7.1 Passive surveillance

People feel safe in public areas when they can see and interact with others, particularly people connected with that space, such as shopkeepers or adjoining residents. Criminals are often deterred from committing crime in places that are well supervised (NSW Police, 2020).

The proposal includes the following landscape design strategies to maximise surveillance:

- The community river place is linked to the new weir site via an existing walking track, which would encourage foot traffic to the new weir site
- Murals on the new weir wall and control room walls and celebration of a nearby canoe tree would encourage visitors to spend time at the new weir site
- Informal amenity including seating and picnic areas along with the recreational opportunities presented by the new town pool would encourage visitors to spend time at the community river place and guests at the Victory Park Caravan Park to spend time alongside the river at the existing weir.

3.7.2 Access control

Access control treatments restrict, channel and encourage people and vehicles into, out of and around the development. Way-finding, desire-lines and formal/informal routes are important crime prevention considerations. Effective access control can be achieved by using physical and symbolic barriers that channel and group pedestrians into areas, therefore increasing the time and effort required for criminals to commit crime (NSW Police, 2020).

The proposal includes the following landscape design strategies to provide access control:

- An access gate or other physical barrier is proposed to restrict public access to the fishway maintenance track at the new weir site
- The riverbank alongside the fishway maintenance track and fishway would comprise recycled rock and gravel interspersed with endemic riparian grass seeds to discourage public access to the fishway
- A new informal car park at the community river place would provide a clear entry to the community river place
- An upgraded access track at the existing weir would provide better access from Victory Park Caravan Park to the river
- Signage would delineate an exclusion zone around the new weir.

3.7.3 Territorial reinforcement

Community ownership of public space sends positive signals to the community. Places that feel owned and cared for are likely to be used, enjoyed and revisited. People who have guardianship or ownership of areas are more likely to provide effective supervision and to intervene in crime than passing strangers, and criminals rarely commit crime in areas where the risk of detection and challenge are high. Effective guardians are often ordinary people who are spatially 'connected' to a place and feel an association with, or responsibility for it (NSW Police, 2020).

Territorial re-enforcement uses actual and symbolic boundary markers, spatial legibility and environmental cues to 'connect' people with space, to encourage communal responsibility for public areas and facilities, and to communicate to people where they should/not be and what activities are appropriate (NSW Police, 2020).

The proposal includes the following landscape design strategies to provide territorial reinforcement:

- Engagement with the local community and key stakeholders for the murals and artworks proposed at the new weir site and community river place would provide opportunities to foster community ownership and place attachment
- The existing weir site holds significance for the Wilcannia township due to local residents being involved in its construction and reuse of materials from the existing weir in landscaping and artwork at the community river place and new and existing weir sites would sensitively integrate the town’s historical context
- Interpretive signage that provides information about the history of the canoe tree and existing weir would reinforce the land’s significance to the Barkandji people and the Wilcannia community at the new and existing weir sites.

3.7.4 Space management

Space/activity management strategies are an important way to develop and maintain natural community control. Space management involves the formal supervision, control and care of the development. All space, even well planned and well-designed areas need to be effectively used and maintained to maximise community safety. Places that are infrequently used are commonly abused (NSW Police, 2020).

The proposal includes the following landscape design strategies to provide space management:

- Endemic species would be planted in a naturalistic design at the new and existing weir sites and community river place to create landscapes that do not require maintenance
- Seating and picnic tables at the community river place and existing weir site would be constructed from site won materials (e.g. fallen trees/logs) and rocks salvaged from the existing weir that require little to no maintenance.

4. Statutory context

This section identifies the relevant statutory requirements for the proposal and addresses the following:

- The legal pathway under which approval of the proposal is being sought, why the pathway applies, and who the approval authority is
- The relevant provisions affecting the permissibility of the proposal
- Other approvals that are required to carry out the proposal and why they are required, or would have been required if the proposal was not State significant infrastructure
- How the relevant environmental planning instruments have been considered in this environmental impact statement.

4.1 Power to grant approval

The EP&A Act and Environmental Planning and Assessment Regulation 2021 establish the framework for development assessment in NSW. They contain provisions which ensure that the potential environmental impacts of development that is State significant infrastructure will be considered in the decision-making and assessment process before development can be carried out.

The proposal involves the construction and operation of a new weir and the decommissioning of the existing weir at Wilcannia and is declared, pursuant to section 5.12(2) of the EP&A Act, to be State significant infrastructure under section 2.13(1) and section 1(1) of Schedule 3 of the State Environmental Planning Policy (Planning Systems) 2021. The approval authority for State significant infrastructure is the Minister for Planning, under section 5.14 of the EP&A Act. Therefore, Water Infrastructure NSW must obtain approval from the Minister before carrying out the proposal.

The key steps in the assessment process for State significant infrastructure are described below and shown in **Figure 4-1.**

The planning approval pathway for the proposal was originally based on it being declared as critical State significant infrastructure under Schedule 3 of the former *Water Supply (Critical Needs) Act 2019*, which expired on 21 November 2021. Therefore, Water Infrastructure NSW is instead following a planning approval pathway under section 2.13(1) and section 1(1) of Schedule 3 of the State Environmental Planning Policy (Planning Systems) 2021 as outlined above. Water Infrastructure NSW notified the Department of Planning and Environment of this change to the planning approval pathway for the proposal in September 2021. The Department of Planning and Environment acknowledged this change to the planning approval pathway for the proposed in a letter to Water Infrastructure NSW dated 28 September 2021.

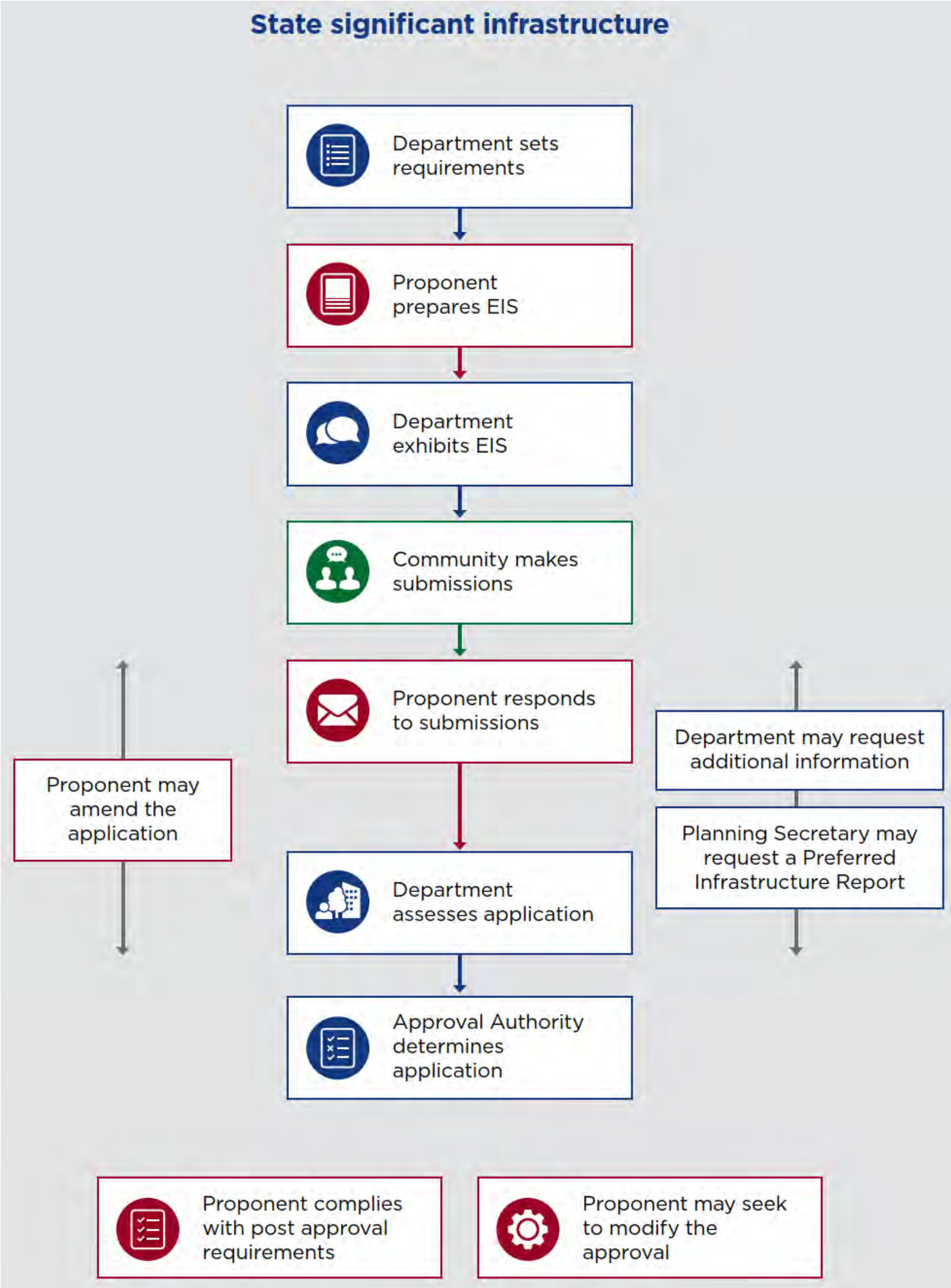


Figure 4-1 State significant infrastructure assessment steps

Source: State Significant Infrastructure Guidelines (DPIE, 2021a)

Environmental assessment requirements

As the proposal is State significant infrastructure, it is subject to the environmental assessment requirements in Part 5 Division 5.2 of the EP&A Act and the SEARs.

In accordance with section 5.15(2) of the EP&A Act, an application for State significant infrastructure needs to describe the infrastructure and contain any other matter required by the Planning Secretary. Once an application is made for the Minister's approval for State significant infrastructure, the Planning Secretary is to prepare environmental assessment requirements in respect of the infrastructure (SEARs) in accordance with section 5.16(1) of the EP&A Act. The final SEARs for the proposal, issued on 28 August 2020, sets out the matters the Secretary requires the environmental impact statement to address. The requirements detailed in the SEARs, together with where they are addressed in this environmental impact statement, are provided in **Appendix A**.

This environmental impact statement provides the information required to support Water Infrastructure NSW's application for approval of the Wilcannia Weir Replacement proposal and addresses relevant legislative requirements and the SEARs. The form and content requirements for the environmental impact statement are contained in sections 190 and 192 of the Environmental Planning and Assessment Regulation 2021. These requirements, and how they are addressed by the environmental impact statement, are provided in **Appendix A.3**.

Public exhibition

Once the environmental impact statement is submitted and then checked by the DPE it will be publicly exhibited for a minimum of 28 days in accordance with clause 12 of Schedule 1 of the EP&A Act and written submissions can be made during this period. Following the exhibition of the environmental impact statement, the DPE will provide Water Infrastructure NSW with a copy of the submissions and ask them to respond to the issues raised in a response to submissions report. The DPE will publish the submissions report on the major projects website.

Water Infrastructure NSW may modify the application for the proposal in response to the issues raised by submissions before it is determined, with the approval of the Planning Secretary under section 179(2) of the Environmental Planning and Assessment Regulation 2021. In that context, an application to amend the application by an amendment report will be prepared to describe the scope of the revised proposal amongst other matters. The amendment report will be made public.

Further information on the proposed approach to consultation during the public exhibition period is provided in **Section 5**.

Assessment and approval

Following the public exhibition period, DPE will review the environmental impact statement and the submissions/ any amendment report (where relevant) and may seek comment on this report from relevant government agencies. DPE will prepare an assessment report, which is submitted to the Minister for Planning for consideration in accordance with section 5.18 of the EP&A Act. The Minister may disapprove the carrying out of the proposal, or approve it with such modifications or on such conditions as the Minister may determine under section 5.19 of the EP&A Act. The Minister's decision (including the reasons for the decision and consideration of community views) and the assessment report will be published on the DPE Major Projects website following determination.

4.2 Permissibility

Development for the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land in accordance with section 2.158(1) of the State Environmental Planning Policy (Transport and Infrastructure) 2021. Water reticulation systems are a type of water supply system but also includes water supply reservoirs in accordance with the definitions in section 2.157 of the State Environmental Planning Policy (Transport and Infrastructure) 2021. The proposal is considered to be a water supply reservoir for the purposes of the State Environmental Planning Policy (Transport and Infrastructure) 2021 and, therefore, is permissible without consent.

4.3 Other approvals and notices

The following approvals and notices would be required for the proposal:

- Consent under section 138 of the *Roads Act 1983* for works at the Barrier Highway (classified Crown road)
- Notice to the landowner – section 181(6) of the Environmental Planning and Assessment Regulation 2021
- Notice of dredging or reclamation work – section 199 of the *Fisheries Management Act 1995* (FM Act)
- Notice of construction and modification of a weir – section 218(5) of the FM Act.

Further information on these approvals and notices is provided in the following sections.

4.3.1 Approvals that should be substantially consistent

Section 5.24 of the EP&A Act provides that certain authorisations under other acts cannot be refused if it is necessary for carrying out approved State significant infrastructure and is to be substantially consistent with the approval. One authorisation is necessary for the carrying out of the proposal:

- A consent under section 138 of the *Roads Act 1993*.

The approval requirements of the *Roads Act 1993* as they relate to the proposal are summarised in **Section 19.1**.

4.3.2 Approvals that are not required

Section 5.23 of the EP&A Act provides that some authorisations under other legislation are not required for approved State significant infrastructure.

The following authorisations that would otherwise have been required for the proposal are not required due to the application of section 5.23(1) of the EP&A Act (and accordingly the provisions of any act that prohibit an activity without such an authority do not apply):

- A permit under sections 201, 205 or 219 of the FM Act (refer to **Section 13.1.2**)
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977* (refer to **Section 15.1.2**)
- An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974* (NPW Act) (refer to **Section 14.1.1**)
- A bush fire safety authority under section 100B of the *Rural Fires Act 1997* (refer to **Section 21.3.1**)
- A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000* (WM Act) (refer to **Section 7.1.1**).

Additionally, in accordance with section 5.23(2) of the EP&A Act, Division 8 of Part 6 of the *Heritage Act 1977* does not apply to prevent or interfere with the carrying out of approved State significant infrastructure. Division 8 of Part 6 of the *Heritage Act 1977* allows for the issuance of orders by the Minister for Environment and Heritage or the Chairperson of the Heritage Council to cease work that they believe would cause harm to a building, work, relic or place that is not on the State Heritage Register or the subject of an interim heritage order.

4.3.3 EPBC Act approval

The EPBC Act is the primary Commonwealth legislation relating to the environment and provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places. Under Part 3 of the EPBC Act, proposed 'actions' that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land, and/or the environment generally when being carried out by an Australian Government agency, must be referred to the Australian Minister for the Environment for assessment. If the Minister determines that a referred proposal is a 'controlled action' under the EPBC Act, the approval of the Minister would be required.

Preliminary considerations of the proposal were identified in a scoping report which identified the potential for significant impact on protected matters, and Water Infrastructure NSW referred the proposal to the Australian Minister for the Environment (EPBC Referral 2020/8713). Water Infrastructure NSW was notified on 11 August 2020 that the proposal is a controlled action, with the controlling provision being 'listed threatened species and communities' (sections 18 and 18A of the EPBC Act).

The notification confirmed that the proposal will be 'assessed under the assessment bilateral agreement with NSW'. The final SEARs for the proposal include the assessment requirements in relation to the EPBC Act. These requirements have been assessed by the biodiversity assessment (see **Section 12**, **Section 13** and **Technical Report 2**).

Following consideration of the results of the assessment by the DPE in accordance with the EP&A Act, the Australian Minister for the Environment will make a separate decision whether or not to approve the proposal under the EPBC Act.

In accordance with the bilateral agreement, the environmental impact statement prepared for the proposal must consider the assessment requirements of the EPBC Act for potential impacts on matters of national environmental significance (specifically listed threatened species and ecological communities). The bilateral agreement assessment is required in addition to those listed in the SEARs.

Bilateral agreement

The recent amendments to the bilateral agreement between the NSW Government and the Commonwealth Government (Amending Agreement No.1 March 2020) means that the Commonwealth Department of Agriculture, Water and the Environment has endorsed the NSW Biodiversity Offsets Scheme created under the BC Act. The Biodiversity Offset Scheme includes the Biodiversity Assessment Method, the biodiversity credit system, and the offset rules set out in the Biodiversity Conservation Regulation 2017. The endorsement of the Biodiversity Offset Scheme applies to all NSW projects that require EPBC Act approval, and it means both NSW and Commonwealth listed threatened species and communities that may be impacted by a proposal can be assessed through a single set of assessment and approval processes.

The proposal has been assessed under the bilateral agreement and is required to address matters outlined in Schedule 4 of the Commonwealth Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) and sections 190 and 192 of the NSW Environmental Planning and Assessment Regulation 2021.

The BDAR provides assessment of the proposal as a controlled action and its potential impacts on listed threatened species or communities are considered in full in **Technical Report 2** and **Technical Report 3**.

Appendix A.1 provides a summary of where the matters required to be considered under the EPBC Act and the bilateral agreement have been addressed in this environmental impact statement.

4.3.4 Other approvals

Landowner's consent/notification

Section 181(5)(a) of the Environmental Planning and Assessment Regulation 2021 provides that consent of the owner is not required for an application for State significant infrastructure that will be carried out by a proponent that is a public authority.

Section 181(3) provides that if an application relates to land owned by a Local Aboriginal Land Council and requires the consent of the Local Aboriginal Land Council, the consent of the NSW Aboriginal Land Council is also required.

In accordance with section 181(6), if owners consent is not required under section 181(5), the proponent must arrange for the Minister (or an appropriate delegate where relevant) to publish notice of the application on the NSW Planning Portal website and must give notice of the application by:

- Giving written notice to the owner of the land before, or no later than 14 days after, the application is made, or
- An advertisement published in a newspaper circulating in the area in which the infrastructure will be carried out at least 14 days before the environmental impact statement relating to the infrastructure is publicly exhibited.

Water Infrastructure NSW has a contract with the Wilcannia Local Aboriginal Land Council for the temporary lease and access over land owned by the local Aboriginal land council on the left bank of the Darling River (Baaka) at the new weir site. There would be no permanent weir infrastructure located on land owned by Wilcannia Local Aboriginal Land Council.

It is proposed to develop a service delivery arrangement between the Water Administration Ministerial Corporation and Water Infrastructure NSW under which the Water Administration Ministerial Corporation would delegate powers to Water Infrastructure NSW under section 377 of the WM Act to access Crown land to construct the proposal.

Water Infrastructure NSW would enter into an agreement with Central Darling Shire Council to temporarily use Victory Park Caravan Park as a work site during the partial removal and decommissioning of the existing weir.

No landowner notification to private landholders would be required.

4.4 NSW environmental planning instruments

Section 5.22(2)(a) of the EP&A Act provides that environmental planning instruments (such as State environmental planning policies and local environmental plans) do not apply to or in respect of State significant infrastructure, except where they apply to the 'declaration of infrastructure as State significant infrastructure or as critical State significant infrastructure (and to the declaration of development that does not require consent)'.

Environmental planning instruments have been considered during the preparation of this environmental impact statement despite this not being mandatory for the proposal. **Table 4-1** identifies how relevant environmental planning instruments have been considered in the assessment.

Table 4-1 NSW environmental planning instruments

NSW environmental planning instrument	Relevance to the proposal
State Environmental Planning Policy (Transport and Infrastructure) 2021	The State Environmental Planning Policy (Transport and Infrastructure) 2021 aims to facilitate the effective delivery of infrastructure across the State. Division 24 of the State Environmental Planning Policy (Transport and Infrastructure) 2021 applies to the development of water supply systems. Section 2.158 provides that development for the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land. Section 2.157defines water reticulation systems to include water supply reservoirs. The proposal is considered to be a water supply reservoir for the purposes of the State Environmental Planning Policy (Transport and Infrastructure) 2021 and, therefore, is permissible without consent.

NSW environmental planning instrument	Relevance to the proposal
	Accordingly, development consent is not required under Part 4 Division 4.1 of the EP&A Act, however environmental assessment and approval is required under Part 5 Division 5.2 of the EP&A Act.
State Environmental Planning Policy (Planning Systems) 2021	The aims of the State Environmental Planning Policy (Planning Systems) 2021 are to identify development that is State significant development, State significant infrastructure, critical State significant infrastructure and regionally significant development. Section 2.13(1) of the State Environmental Planning Policy (Planning Systems) 2021 provides that development is declared to be State significant infrastructure pursuant to section 5.12(2) of the EP&A Act if, by operation of a State environmental planning policy, it is permissible without development consent under Part 4 of the EP&A Act and is development specified in Schedule 3. Section 1(1) of Schedule 3 of the State Environmental Planning Policy (Planning Systems) 2021 refer to: *Infrastructure or other development that … would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent, require an environmental impact statement to be obtained under Part 5 of the [EP&A] Act.* Water Infrastructure NSW formed the opinion that the proposal is likely to significantly affect the environment and would require an environmental impact statement to be prepared (refer to **Section 4.1**). Consequently, the proposal is declared to be State significant infrastructure under Division 5.2 of the EP&A Act.
State Environmental Planning Policy (Resilience and Hazards) 2021	The State Environmental Planning Policy (Resilience and Hazards) 2021 provides a state-wide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. In accordance with section 4.6(1), a consent authority must not consent to the carrying out of any development on land unless: ▪ It has considered whether the land is contaminated ▪ If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out ▪ If the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose. The policy identifies two categories of remediation work: category 1 – works that require development consent, and category 2 – works that may be carried out without development consent. Section 4.8 of the policy sets out classes of category 1 remediation work. The policy contains standard operational requirements for category 2 remediation work to ensure that the remediation work will not have an adverse effect on the community and the environment. The contamination assessment in **Section 18.5** has considered State Environmental Planning Policy (Resilience and Hazards) 2021. It concludes that there is a low likelihood of the presence of contamination on areas where construction or decommissioning would occur and no need for remediation has been identified.

NSW environmental planning instrument	Relevance to the proposal
State Environmental Planning Policy (Primary Production) 2021	The State Environmental Planning Policy (Primary Production) 2021 is intended: *(a) to facilitate the orderly economic use and development of lands for primary production* *(b) to reduce land use conflict and sterilisation of rural land by balancing primary production, residential development and the protection of native vegetation, biodiversity and water resources* *(c) to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations* *(d) to simplify the regulatory process for smaller-scale low risk artificial waterbodies, and routine maintenance of artificial water supply or drainage, in irrigation areas and districts, and for routine and emergency work in irrigation areas and districts* *(e) to encourage sustainable agriculture, including sustainable aquaculture* *(f) to require consideration of the effects of all proposed development in the State on oyster aquaculture* *(g) to identify aquaculture that is to be treated as designated development using a well-defined and concise development assessment regime based on environment risks associated with site and operational factors.* The weir pool upstream of the existing weir pool extends through areas zoned for primary production. There are currently six water extraction licences issued for the purpose of irrigation at extraction points located within the existing weir pool extent or the weir pool extension (drought security operation mode). Operation of the new weir would not adversely impact the extraction of water from the river in accordance with these licences or on the use of land zoned for primary production.
State Environmental Planning Policy (Biodiversity and Conservation) 2021	The State Environmental Planning Policy (Biodiversity and Conservation) 2021 gives effect to new world heritage area management processes. Chapter 12 contains provisions to protect, conserve and manage the Willandra Lakes Region, which is listed on the World Heritage List. The Willandra Lakes Region is located 340 kilometres due south of Wilcannia. The Willandra Lakes Region and the Mungo National Park are located upstream of the confluence of the Darling River (Baaka) and Murray River. The Willandra Lakes are disconnected from the Darling River (Baaka) today, although the lake system drained into the Darling River (Baaka) and Lachlan River more than 18,000 years ago. Some provisions from the repealed Willandra Lakes Regional Environmental Plan No 1 – World Heritage Property have been transferred to chapter 12 of the State Environmental Planning Policy (Biodiversity and Conservation) 2021. The potential for the proposal to impact flows and aquatic ecology in the Darling River (Baaka) downstream of Wilcannia is discussed in **Section 7** and **Section 13** respectively.
Central Darling Local Environmental Plan 2012	The Central Darling Local Environmental Plan 2012 establishes the land use planning framework for the Central Darling local government area. While the provisions of the Central Darling Local Environmental Plan 2012 do not apply to this proposal, the relevant land use objectives have been considered in **Section 16.1.3**.

4.5 Other NSW legislation

A statutory compliance table that identifies all relevant statutory requirements for the proposal and identifies where they have been addressed in this environmental impact statement is provided in **Appendix C**.

5. Engagement

This section provides a summary of consultation undertaken by Water Infrastructure NSW with relevant local, NSW and Commonwealth government authorities, service providers, community groups and affected landowners.

5.1 Consultation approach

Since 1986, Wilcannia Weir has been the subject of four investigation reports and associated consultations to determine if a replacement weir is required and what the potential options would be. The number of investigations and the time span across which they have occurred has resulted in a strong consensus in the Wilcannia community and more broadly that sufficient time has been spent investigating the replacement of the weir and in selecting the preferred option and that implementation is needed.

WaterNSW as the initial proponent, then Water Infrastructure NSW from September 2019, have adopted a proactive approach to consultation with the local community and other project stakeholders. One of the goals of Water Infrastructure NSW's engagement strategy for the proposal has been to give the Wilcannia community an active voice in the development of the preliminary concept design. It was recognised that meaningful engagement and collaboration in line with the OCHRE Plan (refer to Section G.2.14 of **Appendix G**) was essential. It was acknowledged early on that the development of concepts for the replacement of the existing weir required the consideration of a wide range of social, cultural and environmental issues that were not related directly to the construction of the new weir. The collaborative approach that has been adopted has allowed the input of local understanding to find solutions to problems and issues and to guide the direction of proposal development from the options assessment and business case phases through to the environmental assessment phase.

WaterNSW from 2019, then Water Infrastructure NSW from September 2021, have engaged the local community to achieve the following consultation objectives:

- Re-engage with the Wilcannia community and interest groups at an early stage regarding the position and design of the new weir, taking into account everything the community has communicated in previous investigations
- Enhance the ultimate weir design by understanding the needs of the local community including the need for access to the river
- Remind the community about the proposal objectives, benefits and reasons why the downstream location for the new weir was selected, without re-entering into discussions and debate about alternative weir locations
- Continuing where the previous engagement carried out for the 2016 business case left off, be sensitive to the needs of stakeholders, understand community issues and respect stakeholder views and opinions
- Communicate openly and honestly, and respond to enquiries in a timely manner to maintain trust with the community
- Ensure engagement is guided by the principles of the International Association for Public Participation (IAP2). The targeted level of engagement for the proposal on the IAP2 spectrum (https://iap2.org.au/wp-content/uploads/2019/07/IAP2_Public_Participation_Spectrum.pdf) is 'involve' with elements of 'collaborate'.

Engagement with the local Aboriginal community is guided by Water Infrastructure NSW's (2021) *Strategy for Delivering Aboriginal Community Outcomes*, which identifies priority initiatives for delivering outcomes for Aboriginal communities including conducting best class, sustainable and ongoing engagement with Aboriginal communities, creating employment pathways and opportunities for Aboriginal communities during the delivery of water infrastructure projects, and delivering economic benefits to Aboriginal communities from infrastructure investments.

The approach to community engagement has also been guided by the *Wilcannia Community Working Party Community Action Plan 2019* (Murdi Paaki Regional Assembly, 2019), which identifies the following values held by the Wilcannia Community Working Party:

- Trust, unity and honesty
- Equity, representation and opportunity
- Accountability and responsibility
- Culture, heritage and responsibility
- Achievements and success.

Collectively these demonstrate the importance of community and communication for the local community and this has deeply informed the consultation and engagement approach implemented for the proposal.

Water Infrastructure NSW's approach to communication and engagement for the environmental impact statement is to ensure that:

- There is a planned and coordinated approach to community and stakeholder engagement
- Communication is timely and continues to build understanding of the proposal and its benefits
- All communication is culturally appropriate, inclusive and utilises local Aboriginal expertise
- Communication is transparent and enquiries are responded to in a timely manner to maintain trust with the community
- The environmental impact statement reflects feedback gathered from stakeholders and the community to assist with the delivery of the proposal.

From March 2020, strict COVID-19 protocols have been in place for all face to face meetings with the local community to protect the health of all involved. These protocols were communicated to local community leaders in advance and agreement to accept proposal teams to visit the community was secured prior to any visits or field work being scheduled.

5.2 Stakeholder identification

Understanding the local community and identifying stakeholders is critical to the success of the proposal. A stakeholder is defined as any individual, group of individuals, organisation or political entity with an interest in the outcome of a decision. Stakeholders may be, or perceive that they may be, affected directly or indirectly by the outcome of a decision.

The key stakeholders for the proposal during the environmental assessment phase include:

- Elected government members (Commonwealth and NSW Governments and Central Darling Shire Council) and representatives of relevant government agencies and organisations, including statutory authorities
- Interest groups, including peak bodies, community, environment, water user and other specialist groups
- Wilcannia Local Aboriginal Land Council, Barkandji Native Title Group Aboriginal Corporation and other Aboriginal groups/organisations and communities
- Landowners, landholders and utility companies with properties/assets that could be affected by the proposal
- Local/regional businesses
- The general public/local community.

5.3 Consultation during options development, design and environmental assessment process

5.3.1 Consultation activities

Engagement with the community and key stakeholders has focused on culturally appropriate engagement and collaboration. Thorough consultation has been underway since 2019 which has been fair, accessible, inclusive and involved each family clan grouping.

Water Infrastructure NSW holds regular meetings with the Wilcannia Local Aboriginal Land Council, Murdi Paaki Regional Assembly, Wilcannia Community Working Party, Regional Enterprise Development Institute, traditional owners and elders and community leaders to provide updates on the proposal and identify issues or concerns that the community may be expressing. Water Infrastructure NSW has proactively kept the Barkandji Native Title Group Aboriginal Corporation informed about the proposal (refer to **Section 16.1.2** for details of engagement with Barkandji Native Title Group Aboriginal Corporation).

Landholders along the length of the proposal extent have been advised of the proposal and are included in regular updates. No property acquisition is required for either the construction or operation of the proposal.

Consultation has included regular events to keep the community updated and to seek feedback, as summarised in **Table 5-1.**

Table 5-1 Community consultation events

Proposal phase	Consultation	Timing
Options development	▪ Four community information sessions ▪ Three community barbeques	22-24 October 2019
Preliminary concept design	▪ Two community information sessions ▪ Community site visit to the river	26-27 February 2020
Environmental assessment	▪ Two community information sessions	13-15 October 2020
Environmental assessment	▪ Cultural heritage forum attended by registered Aboriginal parties ▪ Cultural heritage site walks	3-6 November 2020
Environmental assessment	▪ Two community information sessions ▪ Cultural heritage forum attended by registered Aboriginal parties	8-10 December 2020
Environmental assessment	▪ One community information session ▪ Cultural heritage forum attended by registered Aboriginal parties	21-26 March 2021
Environmental assessment	▪ Meeting with registered Aboriginal parties ▪ Site visit with registered Aboriginal parties to the community river place (when it was proposed at the new weir site)	3-7 May 2021
Environmental assessment	▪ One community information session ▪ Site visit with registered Aboriginal parties to the existing weir	7-9 December 2021
Environmental assessment	▪ Meeting with registered Aboriginal parties regarding the proposed partial removal of the existing weir	1-2 February 2022

Proposal phase	Consultation	Timing
Environmental assessment	▪ Meetings with Murdi Paaki Services, Central Darling Shire Council. TAFE NSW Wilcannia campus and Regional Enterprise Development Institute ▪ Education activities around environmental science and water sampling were delivered to about 70 students at Wilcannia Central School, St Therese's Catholic School and WINGS Drop-in Centre	4-5 April 2022
Environmental assessment	▪ One community information session ▪ Site visit to the new and existing weir sites with one representative from the registered Aboriginal parties	26-27 April 2022

Water Infrastructure NSW has regularly engaged with the following government stakeholders:

- DPE – Includes the planning and assessment group, the water group, Crown Lands and the environment and heritage group, which includes the Biodiversity, Conservation and Science (BCS) Directorate and Heritage NSW
- WaterNSW
- Department of Regional NSW – DPI Fisheries
- Central Darling Shire Council
- Murray-Darling Basin Authority
- Commonwealth Department of Agriculture, Water and the Environment.

Additionally, engagement has also included Transport for NSW, the NSW Environment Protection Authority, and NSW State Emergency Service during the preparation of the environmental impact statement in accordance with the requirements of the SEARs.

Briefings were provided to government stakeholders in December 2020 and March 2021 to inform them of the status of the proposal and the key findings that have emerged during the environmental assessment phase.

The purpose of Water Infrastructure NSW's engagement with government stakeholders was to raise awareness about the need to replace the existing weir, demonstrate how issues raised by the community have been addressed in the preliminary concept design for the proposal, and obtain their feedback on the preliminary concept design to help shape the proposal's location, design and environmental assessment.

Victory Park Caravan Park

In December 2020, a meeting was held with Central Darling Shire Council, the operator of Victory Park Caravan Park, to brief them on the proposed works at the existing weir and to discuss the potential to lease the caravan park during these works.

Community river place

Opportunities are being pursued with the Department of Regional NSW to obtain funding for the local Aboriginal community to maintain the community river place. Pursuit of this opportunity would continue during later phases of the proposal.

5.3.2 Consultation tools

A summary of the consultation tools used during the environmental assessment phase is provided in **Table 5-2.**

Table 5-2 Consultation tools

Tool	Purpose	Target audience	Timing
Wilcannia Weir Project Reference Group	To be a key communication channel for the proposal, particularly when COVID-19 restrictions limited face-to-face engagements. The group allows members and their community groups to share information and discuss concerns	Project Reference Group members and their community groups	Third week of every month
Community information sessions	To provide key details of the proposal, benefits, needs, timings and contact details	Wider community and key stakeholders	Refer to **Table 5-1** and **Figure 5-1**
Proposal factsheets	To provide key details of the proposal, benefits, needs, timings and contact details Presented in an easy to understand question and answer format	Wider community	To support key milestones
Phone calls, emails and short message service (SMS)	To contact community members and stakeholders directly and advise of timely information	Community members, stakeholders	To support key milestones
Meetings	To discuss proposal details and concerns. Can be held in person or via teleconference/online	Community members, stakeholders	As required
Proposal website https://water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/wilcannia-weir	Provides a central point of contact for proposal information and latest proposal updates	Wider community	Regularly updated
Advertisements – print, radio, online	To contact the community about key milestones of the proposal – these channels are trusted sources of information in the community	Wider community	To support key milestones
Proposal 1800 line and inbox wilcanniaweir@dpie.nsw.gov.au 1300 662 077	Provides a free and accessible point of contact for enquiries and complaints relating to the proposal	All stakeholders and community	Ongoing
Maps / diagrams	A visual way of communicating the proposal and its benefits	Wider community	To support key milestones

Posters and maps from the community information sessions and events and copies of the newsletters are typically displayed at the Wilcannia Roadhouse following the event to allow for further dissemination of the latest updates.

As well as collaborative consultation via community events, a number of other approaches were established based on community feedback and customised for Wilcannia. These are shown in **Figure 5-1** and include:

- Wilcannia Weir Project Reference Group – established in June 2020 to act as a link between the project team and the wider community. The Project Reference Group's formation has enabled close engagement with the community despite COVID-19 restrictions that prevented face-to-face consultation during much of 2020 and 2021
- Community training program – a package of training courses is being provided in Wilcannia to provide locals with a pathway to employment. The training is being provided in partnership with TAFE NSW Wilcannia campus, Regional Enterprise Development Institute and Murdi Paaki Services. As of December 2021, eight students had completed either a Certificate II in Construction or gone on to complete a Certificate I in Construction, six students had completed a Certificate II in Hospitality and four students had completed a Certificate II in Tourism as part of the program. Further training is proposed including plant operator training and a business training course
- Community and school arts workshops – held in early November 2020, several workshops were facilitated at local schools and the Courthouse to encourage participants to create artworks that could be used at the new weir location. Over 150 artworks were submitted. A second workshop was held in December 2020 to develop story telling skills using the artworks. Some of the artwork developed at the workshops is featured in the headers of this environmental impact statement and the landscape and rehabilitation plans presented in the Landscape Design Report (refer to **Technical Report 6**)
- Wilcannia Weir video production project – Broken Hill Productions has been engaged to document the construction of the new weir and associated infrastructure, in addition to producing storytelling videos over the course of construction. The production team are working closely with the Wilcannia community to train and mentor young people in aspects of digital media such as planning, production and post-production. Filming carried out during the preliminary concept design phase of the proposal has captured the local engagement and interest in the proposal and the pride the community have in their town (refer to **Photo 5-1**) and can be viewed on the proposal website (https://water.dpie.nsw.gov.au/water-infrastructure-nsw/regional-projects/wilcannia-weir)
- Children's activity booklet – to support community engagement and awareness of the weir replacement project "A Baaka Adventure with Gillie" activity booklet was developed, providing educational information on local river life and ecology. Workshops have been conducted in local schools to explore the themes in the workbook.

These activities have brought the community together and show Water Infrastructure NSW's commitment to providing leadership in the Wilcannia community beyond the proposal.

Photo 5-1 Filming for the Wilcannia Weir video production project

Figure 5-1 Community consultation sessions

5.4 Summary of issues raised and responses to feedback received

5.4.1 Where issues relevant to the environmental impact statement have been addressed

A summary of the key issues raised during consultation relevant to the environmental impact statement and where issues are addressed is provided in **Appendix D**.

5.4.2 How the proposal has responded to the inputs received

As discussed in **Section 2.2**, extensive community consultation was undertaken to arrive at the preferred location for the new weir, taking into consideration a range of local concerns and opportunities.

Examples of design refinements and construction commitments that have been adopted for the proposal based on feedback received include:

- The canoe tree at the new weir site would be avoided and protected
- Site D was not selected due to cultural concerns about location (refer to **Section 2.2.3**)

- No permanent access or weir infrastructure on land owned by Wilcannia Local Aboriginal Land Council (temporary access may however be required by Water NSW in accordance with section 32 of the *Water NSW Act 2014*)
- Construction footprint refined following the Aboriginal site survey in November 2020 to avoid as many known heritage items as possible
- Identification of site specific mitigation and management measures taking into consideration local requests, such as a 3D scanning of an archaeological site to provide cultural interpretation material (refer to **Section 14**)
- Significant trees (scar trees and prominent river red gums), which have been identified as holding cultural and social values, have been individually identified and mapped to avoid impacting them if possible.

5.5 Future consultation

5.5.1 Consultation during exhibition of the environmental impact statement

As described in **Section 4.1**, the EP&A Act requires exhibition of an environmental impact statement for a minimum of 28 days. The environmental impact statement will be placed on public exhibition by DPE and submissions will be invited. The environmental impact statement will be available for viewing at the following locations:

- Wilcannia Local Aboriginal Land Council
  72 Woore Street
  Wilcannia
- Regional Enterprise Development Institute
  35 Reid Street
  Wilcannia
- Central Darling Shire Council
  21 Reid Street
  Wilcannia.

The environmental impact statement will also be made available for viewing on the DPE Major Projects website and the Water Infrastructure NSW website.

To support public exhibition and provide opportunities for the community and stakeholders to ask questions and find out more information before making a submission, a range of consultation tools will be used (refer to **Table 5-3**).

Table 5-3 Consultation during exhibition of the environmental impact statement

Tool	Purpose	Target audience
Public display	Display of the environmental impact statement to meet statutory requirements and provide the community an opportunity to learn more about the proposal and its impacts and provide feedback.	Wider community
Summary report	A stand-alone plain English summary of the environmental impact statement to support the public exhibition – to be provided at any community sessions, on the proposal website and sent by email.	All stakeholders and community
Community information sessions	Attendance by Water Infrastructure NSW at information sessions in Wilcannia to provide access to hard copies of the environmental impact statement, distribute hard copies of the summary report, explain how to make a submission and answer questions about the proposal, public exhibition and planning approval process.	Wilcannia community

Submissions are made to DPE. At the completion of the public exhibition period, DPE will provide Water Infrastructure NSW with a copy of all submissions. Water Infrastructure NSW will deal with submissions received in accordance with the requirements of the EP&A Act and Environmental Planning and Assessment Regulation 2021. A submissions report will be prepared that responds to the issues raised. The submissions report will be made publicly available on DPE's Major Projects website. Water Infrastructure NSW will continue to liaise directly with stakeholders regarding the proposal's progress. If changes to the proposal need to be made, an amendment report will be prepared.

While all submissions received will be posted on the DPE website, if requested, the privacy of submitters will be protected by removing names from submissions.

5.5.2 Consultation during design and delivery of the proposal

Consultation and community feedback

Comprehensive consultation with the community and other agency stakeholders would provide key inputs for managing potential impacts during the detailed design, construction and operation phases of the proposal. Effective communication and engagement are important in reducing risks and minimising potential impacts and would contribute to the successful delivery of the proposal.

Should the proposal be approved, Water Infrastructure NSW would continue to engage with the community and government stakeholders in the lead up to, and during construction. A communication and stakeholder management plan would be developed for the construction phase to ensure that:

- Landowners/landholders and community members with the potential to be affected by construction activities are notified in a timely manner about the timing of proposed activities and potential for impacts
- Enquiries and complaints are managed and a timely response is provided for concerns raised
- Accurate and accessible information is made available
- Feedback from the community is encouraged
- Opportunities for input are provided where appropriate.

Further details on the communication and stakeholder management plan are provided in **Section 24.6.2**.

The contact facilities (including 1800 phone number and email address) would continue to be available during construction, along with a 24-hour construction response line. Targeted consultation methods such as letters, notifications, signage and posters, and face-to-face communications would continue to be used. The Water Infrastructure NSW website would also include updates on the progress of the proposal.

Other communication tools and activities that would be used in the lead up to and during construction include:

- A community complaints and response management system
- Notifications regarding work outside standard working hours and work that might impact residents, businesses, local facility users and stakeholders
- Emails or SMS updates
- Newsletters, information fact sheets and posters
- Regular community updates on the progress of the construction program
- Meetings with key stakeholders as required
- Traffic alerts
- Site signage around construction facilities.

Complaints management

A complaints management system would be developed and implemented before construction begins. It would be maintained throughout the construction phase and for a minimum of 12 months after construction finishes. The complaints management system would include:

- A 24-hour, seven days a week response line for complaints and enquiries
- A postal and email address to which complaints and enquiries may be sent
- Publication of contact details in local newspapers and on the Water Infrastructure NSW website.

6. Assessment approach and methodology

This section provides a description of the overall approach and methodology used to complete the environmental impact statement. Detailed methodologies for individual technical assessments are described in the technical reports and in **Sections 7** to **21** for each environmental aspect assessed.

6.1 Impact scoping

The first step of the impact assessment process involved identifying key potential environmental issues, impacts and risks that would be subject to detailed assessment as part of the environmental impact statement. The SEARs identify the following as key issues for the environmental impact statement:

- Statutory and strategic context
- Water
- Flooding
- Biodiversity assessment
- Aboriginal heritage
- Non-Aboriginal heritage
- Social impacts
- Land
- Contamination
- Waste
- Sediment, erosion and air quality controls
- Ecologically sustainable development
- Transport
- Noise and vibration
- Bush fire
- Design
- Staging
- Construction hours.

The key issues identified by the SEARs were informed by the scoping report, which was submitted to support the request for the SEARs in May 2020.

The general requirements for the environmental impact statement as specified in the SEARs state that the environmental impact statement must be prepared in accordance with, and meet the minimum requirements of sections 190 and 192 of the Environmental Planning and Assessment Regulation 2021. A checklist of how the environmental impact statement has met the requirements of sections 190 and 192 of the Environmental Planning and Assessment Regulation 2021 is provided in **Appendix A.3**.

The SEARs require that, notwithstanding the identified key issues, the environmental impact statement must include an environmental risk assessment to identify the potential risks of each environmental impact associated with the infrastructure.

The approach to the environmental risk assessment was informed by the principles of the *Australian/New Zealand Standard AS/NZS ISO 31000:2009 Risk management – Principles and guidelines* (Standards Australia/Standards New Zealand Standard Committee, 2009). This involved identifying foreseeable risks associated with the proposal and understanding the implications that could occur from each risk, that is, the potential impact. The risk of each potential impact was evaluated by identifying the consequence of the potential impact and the likelihood of each impact occurring.

Through the process, environmental issues associated with the proposal were further refined as either 'key issues' or 'other issues' (refer to **Table 6-1**). This was carried out to identify those issues that will require a more detailed assessment in this environmental impact statement to ensure potential impacts are properly identified and proposal specific management measures are developed.

Table 6-1 Environmental risk categories

Risk category	Description
Key issue	Potential for moderate to high impacts (including perceived impacts) requiring a more detailed assessment and associated project specific management measures to mitigate identified impacts.
Other issue	Potential for low impacts that can be adequately managed through the implementation of standard and best practice management measures.

6.2 Environmental risk analysis methodology

The first step in the risk analysis involved evaluating the consequences of an identified potential impact, which requires making professional judgements about the possible results of an impact if it occurs. The definitions of the consequences used are provided in **Table 6-2**. This was followed by identifying the likelihood of the potential impact occurring. The definitions of likelihood are provided in **Table 6-3**. It is noted that positive impacts have not been considered in the environmental risk analysis, as they would not introduce an environmental risk.

Table 6-2 Consequence of environmental risks definitions

Consequence	Definition
Catastrophic	▪ Long-term (greater than 12 months) and irreversible large-scale environmental impact with loss of valued ecosystems ▪ Extended substantial disruptions and impacts to stakeholder(s) or community members.
Severe	▪ Long-term (six to 12 months), long-term environmental impairment in neighbouring or valued ecosystems. Extensive remediation required ▪ Severe disruptions or long-term impacts to stakeholder(s) or customers.
Major	▪ Medium-term (between three and six months), impacts external ecosystem and considerable remediation is required ▪ Major impacts or disruptions to stakeholder(s) or customers.
Moderate	▪ Medium-term (between one and three months), short-term and/or well-contained environmental effects. Minor remedial actions probably required ▪ Moderate impacts or disruptions to stakeholder(s) or customers.
Minor	▪ Short-term (less than one month), change from normal conditions within environmental regulatory limits and environmental effects are within site boundaries ▪ Minor or short-term impacts to stakeholder(s) or customers.
Insignificant	▪ No noticeable or visible changes to environment and/or highly localised event ▪ Negligible impact to environment, stakeholder(s) or customers.

Table 6-3 Likelihood of environmental risks definitions

Likelihood level	Description	Likelihood
Almost certain	Expected to occur frequently during time of activity or project (10 or more times every year).	More than 90%
Very likely	Expected to occur occasionally during time of activity or project (one to 10 times every year).	75% to 90%
Likely	More likely to occur than not occur during time of activity or project (once each year).	50% to 75%
Unlikely	More likely not to occur than occur during time of activity or project (once every one to 10 years).	25% to 50%
Very unlikely	Not expected to occur during the time of activity or project (once every 10 to 100 years).	10% to 25%
Almost unprecedented	Not expected to ever occur during time of activity or project (less than once every 100 years).	Less than 10%

Following the application of a likelihood and consequence rating, an overarching risk rating was assigned for each identified environmental impact using the risk matrix shown in **Table 6-4.**

If a residual risk rating has not been lowered or remains at a 'high' rating or above following the implementation of management measures, additional management measures were identified, or justification was provided for the risk where additional mitigation cannot be implemented and the risk is unavoidable.

Table 6-4 Risk matrix

Likelihood	Definition					
	Insignificant	Minor	Moderate	Major	Severe	Catastrophic
Almost certain	Medium	High	High	Very high	Very high	Very high
Very likely	Medium	Medium	High	High	Very high	Very high
Likely	Low	Medium	Medium	High	High	Very high
Unlikely	Low	Low	Medium	Medium	High	High
Very unlikely	Low	Low	Low	Medium	Medium	High
Almost unprecedented	Low	Low	Low	Low	Medium	Medium

Very high and high impacts were considered the highest priority and, where present, were the focus of the preliminary concept design and environmental assessment. In general, the following was applied (in conjunction with the SEARs) when scoping requirements for the environmental assessment.

- Very high impacts – Assessment and planning is necessary to avoid these impacts to the greatest extent possible
- High impacts – Detailed specialist investigation as part of the environmental assessment is desirable, to address some uncertainties. In general, impacts could be mitigated by applying best-practice environmental management measures and controls
- Medium impacts – Further investigation as part of the environmental assessment is desirable, to address some uncertainties. In general, impacts could be mitigated by applying best-practice environmental management measures and controls

- Low impacts – May not require specialist investigations, particularly where identifiable management/mitigation guidelines exist. Impacts could be mitigated through other working controls (such as detailed design requirements, normal working practice, safety and quality controls).

The results of the environmental risk assessment are provided in **Section 23**.

The environmental issues identified for the proposal are assessed in **Sections 7** to **21**, where mitigation and management measures have also been identified to mitigate each identified impact. The assessment of key issues is supported by detailed investigations and have been provided in the technical assessment reports in **Technical Report 1** to **Technical Report 8**. Cumulative impacts that may be associated with the proposal are assessed in **Section 22**.

The following sections provide an assessment of the key environmental issues for the proposal as identified in the SEARs and as per the relevant requirements of section 192 of the Environmental Planning and Assessment Regulation 2021. For each key issue the existing environment is described, and the potential impacts (both direct and indirect) of the proposal during construction and operation are assessed. In addition, the influence of relevant planning policies, guidelines and tools are considered, and proposed mitigation and management measures are described.

6.3 Impact assessment method

6.3.1 Defining the environmental baseline/existing environment

The identification and assessment of baseline environmental values/conditions provides the foundation against which potential impacts are assessed. The approach to describing and defining the existing environment was specific to each impact assessment, and was undertaken in accordance with relevant guidelines and best practice. Specific tasks employed included mapping, fieldwork, review of previous studies, database searches, stakeholder interviews and modelling.

The environmental baseline (or existing environment) is described in detail in the technical reports. A summary of the key features of the existing environment in relation to each environmental issue is provided in the respective **Section 7** to **Section 21.5**.

6.3.2 Assessment of potential impacts

The assessment of identified environmental impacts was based on the preliminary concept design for the proposal as presented in **Section 3**. Potential impacts considered by each individual assessment include those specified by the SEARs and identified as an outcome of the environmental risk assessment. Impacts for each identified environmental issue were assessed at a level commensurate to the degree and significance of the likely impact, with a focus on avoiding or minimising impacts, for example through altering the design or construction method.

The assessment methodologies applied were specific to each key issue, and defined in accordance with the requirements of the SEARs and relevant issue-specific guidelines and policies. For many of the key issues, the SEARs specify the guidelines that define the assessment methodologies.

Potential impacts were assessed using a (predominantly) qualitative or quantitative approach, depending on the nature of the issue and the requirements of relevant guidelines and policies.

A summary of the individual assessment methodologies is provided in the respective **Sections 7** to **22**, with further detail provided in the technical reports.

6.3.3 Cumulative impacts

For an environmental impact statement, cumulative impacts can be defined as the successive, incremental, and combined effect of multiple impacts. Each of the impacts considered may in themselves be minor, but could become significant when considered together.

The SEARs require "consideration of the potential cumulative impacts due to other developments in the vicinity (completed, underway or proposed)".

As assessment of potential cumulative impacts has been undertaken for relevant key issues in accordance with the SEARs (refer to **Section 21.5.1**).

6.3.4 Mitigation and management measures

To minimise potential impacts on an acceptable level, mitigation and management measures were developed for those identified impacts that could not be avoided. The proposed mitigation measures for all key and other issues are summarised in **Appendix E**.

Environmental management measures will be implemented during construction under a construction environmental management plan. Detailed design will further seek to avoid and minimise identified environmental impacts where practicable. The identified management measures will also be reassessed during detailed design for their effectiveness and appropriateness.

The key residual impacts of the proposal that may remain in the medium to long term, even after the implementation of the identified mitigation measures, are identified in **Section 24.5.**

7. Hydrology

Hydrology is the change in river discharge or flow through time. A hydrology impact assessment has been carried out to assess the potential for the proposal to affect flows in the Darling River (Baaka) and is provided in **Technical Report 1** and summarised in this section.

SEAR no. 2 includes requirements for the assessment of the proposal's potential hydrology impacts. The requirements of SEAR no. 2 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

7.1 Legislative and policy context

7.1.1 Water Act 1912 and Water Management Act 2000

The *Water Act 1912* and the WM Act are the two key pieces of legislation for the management of water in NSW and contain provisions for the licensing of water access and use. The *Water Act 1912* is being progressively phased out and replaced by the WM Act.

The aims of the WM Act are to provide for the sustainable and integrated management of the State's water sources for the benefit of both present and future generations. The WM Act implicitly recognises the need to allocate and provide water for the environmental health of rivers and groundwater systems, while also providing license holders with more secure access to water and greater opportunities to trade water through the separation of water licenses from land.

Section 50 of the WM Act allows for the preparation of water sharing plans, which establish rules for the sharing of water in a particular water source between water users and the environment, and rules for the trading of water in a particular water source.

The WM Act provides protection for basic landholder rights, which include domestic and stock rights, harvestable rights and native title rights. Sections 52 to 55 of the Act allow for extraction under these rights without the need for water access licences. The Act requires water sharing plans to protect basic landholder rights by taking these rights into consideration before designing rules for licenced water extractions.

Section 89 of the WM Act requires a water use approval for the use of water for a particular purpose at a particular location. However, as the proposal is State significant infrastructure a water use approval is not required in accordance with section 5.23 of the EP&A Act. Therefore, Water Infrastructure NSW would not be required to obtain a water use approval to extract water for use during construction of the proposal.

Section 90 of the WM Act requires an approval to undertake a water management work, which includes water supply work. The definition of a water supply work includes any work that has, or could have, the effect of impounding water in a water source. However, as the proposal is State significant infrastructure a water management work approval is not required in accordance with section 5.23 of the EP&A Act.

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. As the proposal would involve construction of a new weir and fishway within the river channel and ancillary road/facility within 40 metres of the riverbanks, the proposal would meet the definition of 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.

Furthermore, as noted in **Section 4.3.2**, State significant infrastructure is exempt from requiring an activity approval (other than an aquifer interference approval) under section 91 of the WM Act.

7.1.2 Water Sharing Plan for the Barwon-Darling Unregulated River Water Source 2012

The Darling River (Baaka) is subject to the Barwon-Darling WSP.

The Barwon-Darling WSP has several environmental, economic, Aboriginal cultural and social and cultural objectives; the objectives that are most relevant to the proposal include:

- To protect, and contribute to the enhancement of, the ecological condition of the water source and its water-dependent ecosystems
- To maintain, and where possible improve, the spiritual, social, customary and economic values and uses of water by Aboriginal people.

In accordance with sections 20 and 21 of the WM Act, the Barwon-Darling WSP applies a range of strategies to achieve these objectives including establishing and maintaining compliance with a long-term average annual extraction limit and a long-term average sustainable diversion limit, restricting the take of water to protect 'active environmental water' and to restore connectivity within and between water sources following an extended dry period, and providing access to water for basic landholder rights, town water supply, and for licensed domestic and stock purposes.

The Barwon-Darling WSP divides the water source into four sections and 14 management zones. The proposed new weir is located in River Section 4, which extends from Bourke to Upstream Lake Wetherell. Two management zones are relevant to the proposal: the Tilpa to Wilcannia Management Zone and the Wilcannia to Upstream Lake Wetherell Management Zone.

The Barwon-Darling WSP identifies the volume of water that is available for use each year, the demand for water in each river section, limits (caps) on the availability of water, and planned environmental water to maintain fundamental ecosystem health and other specific environmental purposes. It also includes a resumption of flow rule that is designed to ensure that flows that follow a prolonged low or no flow period are able to pass through the system to achieve connectivity from the Queensland border to Menindee Lakes. Extraction of water for town water supply is exempt from the resumption of flows rule in accordance with clause 49 of the Barwon-Darling WSP.

Requirements for water in the water sources are identified in Part 5 of the Barwon-Darling WSP for basic landholder rights and for extraction under access licences. An amended Barwon-Darling WSP came into effect on 1 July 2020 that includes active management rules, whereby WaterNSW announces when water in a management zone can be accessed, depending on flow forecasts. This allows for improved control of environmental flows.

Amendments are required to the Barwon-Darling WSP to reflect the proposed operation of the proposal as well as changes to gauging locations (including upgrades). The Department of Planning and Environment – Water (DPE Water) is responsible for water sharing plans including their amendment. DPE Water has advised Water Infrastructure NSW that a new Barwon-Darling WSP is being developed to replace the 2012 plan and is expected to be placed on public exhibition in about April/May 2022. The amendments required to the Barwon-Darling WSP for the proposal would only be made after the public exhibition of the environmental impact statement for the proposal is completed. DPE Water would carry out targeted consultation on the amendments to the Barwon-Darling WSP.

The proposal represents a significant shift away from fixed crest weirs, which have been constructed in the Barwon-Darling River system since the 1900s. The proposal has varying gate operational parameters that need to be implemented based on modes of operation and their transition phases to maximise the passing of flows and fish passage in balance with providing town water security. An operations plan is being developed to document how the new weir would be managed and maintained by the river operator, WaterNSW. A high level version of the proposed operations plan which has been informed by WaterNSW and agency stakeholders is provided in **Appendix H**. This outline operations plan will be refined into a detailed operations plan in collaboration with WaterNSW, and DPE Water will extrapolate the relevant information to be inserted into the new Barwon-Darling WSP.

7.1.3 Barwon-Darling Long-Term Water Plan

The *Barwon–Darling Long-Term Water Plan* (DPIE, 2020a and 2020b) is one of nine plans being developed to cover the NSW portion of the Murray–Darling Basin. The Long-Term Water Plan identifies strategies for maintaining and improving the long-term health of the Barwon–Darling riverine and floodplain environmental assets and the ecological functions they perform.

The Long-Term Water Plan comprises two parts:

- Part A provides a catchment-scale description of the flow regimes required to maintain or improve environmental outcomes in the Barwon-Darling (Baaka)
- Part B describes the flow regimes required to maintain or improve environmental outcomes in the Barwon-Darling at a planning unit scale.

Environmental water requirements for the Tilpa to Wilcannia and Wilcannia to Upstream Lake Wetherill planning units are provided in Table 17 and Table 18 respectively of Part B of the Long Term Water Plan and are reproduced in **Table 7-1**.

Table 7-1 Environmental water requirements for the Tilpa to Wilcannia and Wilcannia to Upstream Lake Wetherell planning unit (Darling River at Wilcannia 425008)

Flow category	Environmental water requirement code	Flow rate (ML/d)	Timing	Duration	Frequency	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CtF	<1	Can occur anytime of year, but more common October to March	Maximum duration: Typically, events should not persist for more than 20 days. In very dry years, events should not persist for more than 160 days.	Cease-to-flow events should occur in no more than 50% of years	Not applicable	When managing water to restart flows, avoid harmful water quality impacts, such as de-oxygenation of refuge pools.
Very-low-flow	VLF	>30	Anytime	In typical years, at least 340 days per year. In very dry years, at least 165 days per year.	Every year	In accordance with maximum duration of cease-to-flow events	Flows that provide replenishment volumes to refuge pools along the Barwon-Darling. Waterhole persistence can also be supported by groundwater.
Baseflows	BF1	>350	Anytime	In typical years, at least 290 days per year. In very dry years, at least 120 days per year.	Every year	155 days	Aiming to provide a depth of 0.3 m to allow fish passage. Also to manage water quality, prevent destratification and reduce risk of blue-green algal blooms.
	BF2	>350	September to March	In typical years, at least 185 days per year (within timing window). In very dry years, at least 60 days per year (within timing window).	Every year	200 days	Aiming to provide a depth of 0.3 m to allow fish passage.

Flow category	Environmental water requirement code	Flow rate (ML/d)	Timing	Duration	Frequency	Maximum inter-event period	Additional requirements and comments
Small fresh	SF1	>1,400	Anytime, but ideally October to April	10 days minimum	Annual (100% of years)	1 year	Ideal timing is based on preferred temperature range for fish spawning - >20°C for most native fish and >18°C for Murray Cod. Aiming to provide a depth of greater than 0.5 metres to allow movement of large fish. Flow velocity ideally up to 0.3 to 0.4 m/s (depending on channel form). Ideally shortly after LF2 for increased likelihood of successful recruitment of fish, productivity and dispersal.
	SF2	1,400 to 14,000	September to April	14 days minimum	5 to 10 years in 10 (75% of years)	2 years	Timing is based on preferred temperature range for fish spawning - >20°C for most native fish and >18°C for Murray Cod. Aiming to provide a depth of greater than 0.5 metres to allow movement of large fish. Flow velocity ideally up to 0.3 to 0.4 m/s (depending on channel form).

Flow category	Environmental water requirement code	Flow rate (ML/d)	Timing	Duration	Frequency	Maximum inter-event period	Additional requirements and comments
Large fresh	LF1	>14,000	Anytime, but ideally July to September	15 days minimum	5 to 10 years in 10 (75% of years)	2 years	This flow in Jul to Sep will improve pre-spawning fish condition. Aiming to provide a depth of 2 m to cover in-stream features and trigger response from fish. Flow velocity ideally 0.3 to 0.4 m/s (depending on channel form).
	LF2	>14,000	October to April	15 days minimum	3 to 5 years in 10 (42% of years)	2 years	Aiming to provide a depth of 2 m to cover in-stream features and trigger response from fish. Flow velocity ideally 0.3 to 0.4 m/s (depending on channel form). Temp preferably >17°C to maximise spawning outcomes. Ideally shortly before SF1.
Bankfull	BK1	>25,000	Anytime	15 days minimum	5 in 10 years (50% of years)	4 years	
Overbank	OB1	>30,000	Anytime	15 days minimum	2 to 4 in 10 years (30% of years)	5 years	Clustered events (i.e. multiple events over 2–3 years) will provide improved conditions for native vegetation recruitment. Multiple events in close proximity will also improve the condition of native veg communities.
	OB2	>31,000	Anytime	15 days minimum	1 to 3 in 10 years (20% of years)	10 years	
	OB3	>43,000	Anytime	15 days minimum	0.5 to 1 in 10 years (10% of years)	15 years	

Source: Table 17 of the *Barwon-Darling Long-Term Water Plan Part B* (DPIE, 2020b))

7.2 Assessment methodology

The operation of the proposal has been simulated by carrying out storage behaviour modelling using the Barwon-Darling Source River System Model operated by WaterNSW. The outputs from this modelling have been used to assess the hydrological impacts of the proposal.

7.2.1 Barwon-Darling River System Model

The Barwon-Darling Source River System Model was used to provide flow time series data at Bourke and Wilcannia in daily time steps. A simulation of the operation of the proposed new weir was carried out based on 119 years of flow data from 01 January 1900 to 20 August 2019. The simulation was of the section of the Darling River (Baaka) from downstream of the existing Bourke Town Weir to a point at the upstream extent of the Wilcannia weir pool. The flow data from the Source model was then used in a storage behaviour water balance model to provide:

- The daily volume of stored water in Wilcannia Weir
- The daily level of the Wilcannia weir pool, for each of pools 1 to 4 (refer to **Figure 3-12**)
- The daily volume of water pumped from Pool 2 to Pool1
- Daily flows downstream of Wilcannia Weir.

Separate simulations were carried out of the existing weir and the new weir and the outputs of these simulations formed the basis of the assessment of the hydrological impacts of the new weir.

7.2.2 Downstream low flow-spell analysis

A spell analysis of low flows downstream of the new weir was undertaken using the outputs of the storage behaviour model simulations. Downstream flows were analysed based on the environmental water requirements for key flow categories in the Wilcannia to Lake Wetherell planning unit identified in the *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) (refer to **Table 7-1**). The analysis considered changes in the following spell characteristics between the new weir and the existing weir for key low flow categories:

- Total number of spells across the entire 119-year simulation
- Number of years with at least one occurrence of a spell commencing
- Longest spell
- Mean spell duration
- Mean period between spells
- Longest period between high spells.

7.2.3 Hydrodynamic analysis of the weir pool

A hydrodynamic modelling investigation was also carried out to simulate changes in the velocity of flows through the weir pool as a result of the proposal. The purpose of the investigation was to identify the potential impacts of the proposal on the depth and speed of flowing water within the weir pool. Flow velocity is a key factor that influences native fish spawning and the investigation accordingly considered flow velocities above and below known flow velocity thresholds for fish spawning.

The hydrodynamic modelling considered flows over an about 105-river-kilometre length of the Darling River (Baaka) between the new weir and a point about 39 river kilometres upstream of the upstream extent of the weir pool when the new weir is in normal operation mode. Hydrodynamic modelling was carried out for both the existing weir and the new weir, enabling the impacts of the new weir on flow velocities to be identified by comparing the two simulations. The modelling considered nine flow scenarios ranging from 100 megalitres per day to 5,000 megalitres per day.

7.3 Risk

The main hydrological risk associated with the proposal is its potential to impact flows downstream of the new weir such that it causes an increase in the frequency and/or duration of low flow spells and, critically, cease-to-flow events. An increase in low flow spells downstream of Wilcannia would worsen environmental conditions in that reach of the Darling River (Baaka) including importantly the availability of flowing water habitat.

7.4 Avoidance and minimisation of impacts

Impacts to hydrology and particularly flows downstream of the new weir have been avoided and minimised by:

- Dual mode of operation – The dual operation modes of the new weir would minimise the time that it operates at a higher full supply level than the existing weir
- Translucency discharges – The new weir would allow for downstream discharge via the weir gates of any inflows to the new town pool and Pool 1 as detailed in **Section 3.5.3**.

7.5 Existing environment

The Barwon-Darling River (Baaka) drains the Northern Basin of the Murray-Darling River system and has a semi-arid hydrology, which means it flows through drylands and has periods of zero discharge. Major tributaries to the Barwon-Darling Valley Floodplain include the Macintyre, Gwydir, Namoi, Castlereagh, and Macquarie rivers. These systems enter the Barwon-Darling River upstream of the township of Bourke. Downstream of Bourke and further west, the Paroo and Warrego rivers contribute intermittent flows to the Darling River (Baaka) and can provide significant volumes during flood events, raising the duration of high flow events in the Barwon-Darling River (Cooney 1994). For most of the time, 'low' flow conditions dominate the Darling River with major floods periodically interrupting these dry periods, however flows decrease downstream of Bourke due to the lack of contributions from tributaries and increased rates of evaporation (Thoms et al. 2004).

Under natural conditions the river flowed for over 90 per cent of the time overall, and in droughts it flowed for 85 per cent of the time at Wilcannia (Mallen-Cooper and Zampatti, 2020). In wet decades it could flow continuously for 19 years, while in dry decades it had cease-to-flow periods that were commonly less than a month but could extend to over 11 months (1902 Federation Drought).

The hydrology of the Barwon-Darling River (Baaka) has been substantially altered from its natural state and although considered 'unregulated', the Barwon-Darling River (Baaka) is not technically free-flowing. It is regulated by a number of headwater storages on tributaries in both NSW and Queensland and by the Menindee Lakes Storage on the lower Darling River (437 kilometres upstream from its confluence with the Murray River). There are also numerous weirs along the entire length of the river as shown in **Figure 1-3**, so that at low flows the river consists mostly of a series of weir-pools where there would once have been flowing habitat (Bowling & Baker 1996).

The Darling River (Baaka) upstream from Menindee is greatly affected by headwater dams, low-level weirs and water extraction, both on upstream regulated and unregulated tributaries and on the Darling itself (Thoms et al. 2004). Flows in the system have been modified by large-scale water extractions for irrigation. Extraction of water and storage of water behind weirs means there are now extended periods of low flows in the river.

7.5.1 Existing users

The Darling River (Baaka) is unregulated and therefore is largely dependent on rainfall and natural flows rather than water released from dams.

The section of the Darling River (Baaka) at Wilcannia is within the Tilpa to Wilcannia Management Zone under the Barwon-Darling WSP. There are currently five approvals issued under the WM Act that are within the Wilcannia weir pool when the existing weir is at full supply level and these are listed in **Table 7-2**.

Table 7-2 Approvals issued under the WM Act located within the existing weir pool

Approval no.	Purpose	Work description	Purpose	Location	Associated water access licence no.	Volume (ML)
85CA753003	Water supply works and water use	Diversion works 1 x 100mm centrifugal pump	Irrigation	Lot 16 DP757028	33608	10
85CA752991	Water supply works and water use	Diversion works: 1 x 100mm centrifugal pump	Irrigation	Lot 95 DP757463	33707	55
85CA752993	Water supply works and water use	Diversion works : 1 x 100mm centrifugal pump 1 x 200mm axial flow pump 1 x 80mm centrifugal pump	Irrigation	Lots 1, 3,17 and 19 DP757447	44021	8
					44022	350
85CA753140	Water supply works and water use	Diversion works: 1 x 150mm centrifugal pump	Irrigation	Lot 4142 DP766647	33737	49
85CA753005	Water supply works and water use	Diversion works: 1 x 400mm centrifugal pump	Irrigation	Lots 4 and 11 DP757447	33780	835
TOTAL						**1,297**

Source: NSW Water Register

There is also one current approval under the WM Act in the section of the Darling River (Baaka) within the Wilcannia to Upstream Lake Wetherell Management Zone of the Barwon-Darling WSP. This approval, number 85CA752947, provides for the use of one 250 millimetre centrifugal pump to irrigate Lot 103 DP757463 and is associated with water access licence number 33643 (377 megalitres). This property is located just downstream of the new weir.

7.6 Assessment of impacts

7.6.1 Construction

The existing weir would continue to operate during construction of the new weir, during which it would remain the primary local influence on hydrology in the Darling River (Baaka) at Wilcannia. Construction of the new weir would require occupation of part of the riverbed at the new weir site (refer to **Section 3.4**). Initially, a work site would be established on the riverbed alongside the right riverbank for construction of the fishway. Once the fishway is complete, flow would be directed down the fishway and a work site established on the riverbed alongside the left riverbank for construction of the fixed crest portion of the weir, weir gate bay and associated upstream and downstream embankments. These work sites on the riverbed would be made dry by isolating them from river flows using cofferdams.

Flows in the river would be maintained past the in-stream work site for the new weir during each stage of construction. The width of river channel available to pass flows would be reduced due to the occupation of part of the riverbed by the construction site and cofferdams. During the initial stage of construction when the fishway would be built, the natural level of the riverbed would be maintained alongside the work site, meaning that flows would only be constricted by the narrowing of the river channel and not by any change in level. Therefore, impacts to flows would only occur to the extent that the narrowing of the river channel at the construction site would cause a backwater effect that results in an increased upstream water level, with water temporarily ponding behind the cofferdam before flowing past the construction site.

During the second phase of construction when the fixed crest portion of the weir, weir gate bay and associated upstream and downstream embankments would be built and flows would be directed into the newly built fishway to pass the work site, the elevation of the upstream end of the bed of the fishway relative to the elevation of the riverbed would result in an increase in upstream water levels before flow would begin to bypass the works via the fishway. The riverbed level at the low point along the axis of the new weir is 61.57 metres AHD and the floor level of the upstream end of the fishway channel would be 64.66 metres AHD assuming no baffles are installed. Hence, water would need to pond to a depth of 3.09 metres before it would spill down the fishway and continue downstream. The time that flows would temporarily not pass downstream would depend on the river flow rate and level at the time of closure of the cofferdam. Extrapolating the proposed storage behaviour modelling, the median time to fill may be less than three days.

7.6.2 Operation

The operational impacts of the proposal have been assessed based on the outcomes of the downstream low flow spell analysis and hydrodynamic modelling described in **Sections 7.2.2** and **7.2.3** respectively.

The results of the downstream flow spell analysis are summarised in the following sections for the relevant key flow categories identified in the *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) for the Wilcannia to Lake Wetherell planning unit (refer to **Table 7-1**).

Cease-to-flow spells

The *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) defines cease-to-flow conditions in the Wilcannia to Lake Wetherell planning unit as flows of less than one megalitre per day (refer to **Table 7-1**). A downstream spell analysis of the instances and durations of cease-to-flow spells predicted using the storage behaviour water balance model for the existing and proposed new weirs is provided in **Table 7-3**.

The main differences between the cease-to-flow spell characteristics predicted for the new weir compared to the existing weir are:

- There is an increase in short duration (less than five days) cease-to-discharge events at the new weir when it is in the filling phase. Whether cease-to-discharge events at the new weir would lead to cease-to-flow conditions downstream of the new weir would depend on the duration of the cease-to-discharge event, the discharge rate prior to the cease-to-discharge event and downstream conditions. The short duration of cease-to-discharge events during the filing phase means their effect on flows downstream of the new weir is likely to attenuate with distance downstream of the new weir, which would limit their effect on downstream cease-to-flow characteristics
- Some long duration cease-to-flow spell in the existing weir simulation are broken into two shorter duration cease-to-flow spells in the new weir simulation due to the application of the translucency operating rules when the new weir is in drought security operation mode. This results in a reduction in the mean duration of cease-to-flow spells, from 57 days to 36 days, as indicated in **Table 7-3**.

Table 7-3 Predicted cease-to-flow spell characteristics downstream of the new and existing weirs over the simulation period, 1900 to 2019

Spell characteristics	Existing weir	New weir	Change
Number of cease-to-flow spells	122	215	+93 (+76%)
Number of years with at least one cease-to-flow spell	87	96	+9 (+10%)
Percentage of years with at least one cease-to-flow spell	73%	81%	+8% (+11%)
Longest cease-to-flow spell (days)	337	342	+5 (+1%)
Mean duration of cease-to-flow spells (days)	57	36	-21 (-37%)
Total duration of cease-to-flow spells over the 119-year simulation period (days)	6,927	7,745	+818 (+12%)

Very-low-flow spells

The *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) defines very-low-flow conditions in the Wilcannia to Lake Wetherell planning unit as flows of more than 30 megalitres per day (refer to **Table 7-1**). A downstream spell analysis of very-low-flows predicted using the storage behaviour water balance model for the existing and proposed new weirs is provided in **Table 7-4**.

Alteration in very-low-flow behaviour caused by the new weir is similar to that for cease-to-flows spells, with the number of very-low-flow spells increasing but the mean duration of these spells decreasing. This is attributed to the new weir interrupting some very-low-flow spells due to the filling phase being triggered with the flow resuming when the weir has filled and the translucency rule is implemented. However, the net result of the predicted increase in the number of very-low-flow spells but decrease in their duration is minor, with the total number of days of very-low-flow spells largely the same across the 119-year simulation period, reducing slightly from 35,915 days to 35,468 days.

Table 7-4 Predicted very-low-flow spell characteristics downstream of the new and existing weirs over the simulation period, 1900 to 2019

Spell characteristics	Existing weir	New weir	Change
Number of very-low-flow spells	136	235	+99 (+73%)
Number of years with at least one very-low-flow spell	119	119	No change
Longest very-low-flow spell (days)	1830	1830	No change
Mean duration of very-low-flow spells (days))	264	151	-113 (-43%)
Mean period between very-low-flow spells (days)	57	35	-22 (-39%)
Longest period between very-low-flow spells (days)	344	345	+1 (0%)
Total duration of very-low-flow spells over the 119-year simulation period (days)	35,915	35,468	-447 (-1%)

Base flow 2 spells

The *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) defines base flow conditions in the Wilcannia to Lake Wetherell planning unit as flows of more than 350 megalitres per day (refer to **Table 7-1**). A distinction is drawn between base flow events that occur between September and March (base flow 2 events) and those that occur at any time throughout the year (base flow 1 events). The environmental water requirements are more stringent for the September to March period (base flow 2 events) and the comparison of the proposal to the existing weir has therefore focussed on this period. A downstream spell analysis of base flow 2 predicted using the storage behaviour water balance model for the existing and new weirs is provided in **Table 7-5**.

As indicated in **Table 7-5**, the number of base flow 2 events would increase by about one-third, but the mean duration of these events would only decrease by about nine per cent, resulting in an increase in the total duration of base flow 2 spells across the 119-year simulation period, from 21,052 days to 25,598 days. This alteration in base flow behaviour is attributed to the application of the translucency rule during drought security operation mode, which would result in discharges from the new weir when there are inflows to the new town pool and Pool1, whereas some of these flows would not have passed the existing weir.

Table 7-5 Predicted base flow 2 spell characteristics downstream of the new and existing weirs over the simulation period, 1900 to 2019

Spell characteristics	Existing weir	New weir	Change
Number of base flow 2 spells	271	361	+90 (+33%)
Number of years with at least one base flow 2 spell	117	117	No change
Longest base flow 2 spell (days)	214	214	No change
Mean duration of base flow 2 spells (days))	78	71	-7 (-9%)
Mean period between base flow 2 spells (days)	57	42	-15 (-26%)
Longest period between base flow 2 spells (days)	208	208	No change
Total duration of base flow 2 spells over the 119-year simulation period (days)	21,052	25,598	+4,546 (+22%)

Small fresh 1 spells

The *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) defines small fresh conditions in the Wilcannia to Lake Wetherell planning unit as flows of more than 1400 megalitres per day (refer to **Table 7-1**). A distinction is drawn between small fresh flows that occur anytime but ideally between October and April (small fresh 1 flows) and those that occur in a slightly longer period between September and April (small fresh 2 flows). The ideal timeframe for the small fresh 1 environmental water requirement is shorter than that for small fresh 2 flows and therefore is the more stringent of the two requirements. Downstream spell analyses of small fresh 1 flows predicted using the storage behaviour water balance model for the existing and new weirs are provided in **Table 7-6** and respectively.

As indicated in **Table 7-6**, the new weir would result in very minor change in small fresh 1 and small fresh two spells. This is due to small fresh 1 and small fresh 2 spells by definition involving flows that are likely to result in the new weir operating to optimise downstream flows.

Table 7-6 Predicted small fresh 1 spell characteristics downstream of the new and existing weirs over the simulation period, 1900 to 2019

Spell characteristics	Existing weir	New weir	Change
Number of small fresh 1 spells	190	192	+2 (+1%)
Number of years with at least one small fresh 1 spell	106	106	No change
Longest small fresh 1 spell (days)	214	214	No change
Mean duration of small fresh 1 spells (days))	59	58	-1 (-2%)
Mean period between small fresh 1 spells (days)	49	50	+1 (+2%)
Longest period between small fresh 1 spells (days)	164	165	+1(+1%)

Spell characteristics	Existing weir	New weir	Change
Total duration of small fresh 1 spells over the 119-year simulation period (days)	11,203	11,130	-73 (-1%)

Table 7-7 Predicted small fresh 2 spell characteristics downstream of the new and existing weirs over the simulation period, 1900 to 2019

Spell characteristics	Existing weir	New weir	Change
Number of small fresh 2 spells	190	189	-1 (-1%)
Number of years with at least one small fresh 2 spell	106	106	No change
Longest small fresh 2 spell (days)	244	244	No change
Mean duration of small fresh 2 spells (days))	68	67	-1 (-1%)
Mean period between small fresh 2 spells (days)	63	62	-1 (-2%)
Longest period between small fresh 2 spells (days)	164	165	+1 (+1%)
Total duration of small fresh 2 spells over the 119-year simulation period (days)	12,835	12,670	-165 (-1%)

Annual analysis

The environmental water requirements in the *Barwon-Darling Long Term Water Plan Part B* (DPIE, 2020b) are expressed in annual terms, whereas the preceding analysis focusses on results across the entire 119-year simulation period. To address this, the results of the simulation are presented in Section 5.4.2 of **Technical Report 1** for each full year of the simulation (1900 to 2018). The inter year results show similar changes in flow spell behaviour to the long-term results presented in the previous sections.

Flow alteration across the complete flow regime

An analysis of the alteration in the percentage of time a flow is exceeded was conducted to compare flows downstream of the new weir to those downstream of the existing weir for changes unrelated to the environmental water requirements and is presented in **Figure 7-1.** The figure shows that both increases and decreases in the frequency of downstream flows caused by the new weir are small and within two per cent of flows downstream of the existing weir. As indicated in the downstream flow-spell analysis, the changes to flows decrease with increasing flows and become less than half a per cent when flows exceed 1,400 megalitres per day. There is no change in the frequency of flows between the new and existing weirs for flows above about 2,500 megalitres per day.

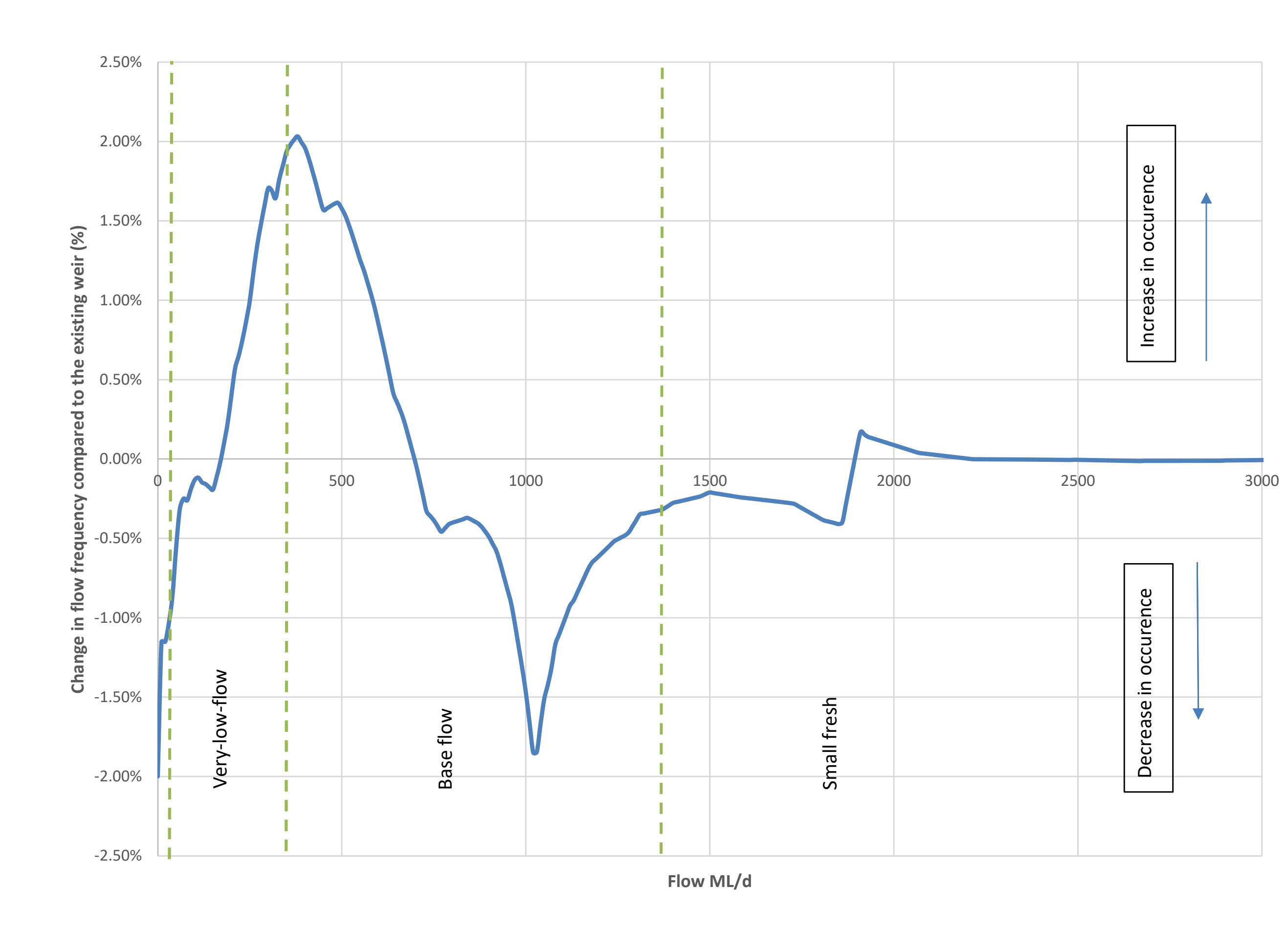


Figure 7-1 Overall flow regime alteration compared to the existing weir, for flows up to 3000 megalitres per day

Resumption of flows rule

As discussed in **Section 7.1.2**, the Barwon-Darling WSP includes a resumption of flows rule to protect the critical first flows after an extended low-flow or dry period. The rule is triggered when a flow event happens after a continuous period of no or low-flow conditions. It prevents water users from accessing the first flow down the Darling River (Baaka). Normal access conditions apply after the flow has reached a target flow.

The settings of the flow resumption rule triggers mean that there are times when the new weir could be in drought security operation mode and filling while irrigation use is restricted. While weir filling may occur at times when a flow resumption restriction is in place, this happens infrequently at only 11 times (321 days) over the 119 year model period (43,696 days).

Changes in upstream water velocity

Water velocities were modelled at 219 locations (cross sections) along a 105-kilometre long reach of the Darling River (Baaka) upstream of the new weir as part of the hydrodynamic modelling of the operation of the proposal. Longitudinal profiles of the modelled reach of the river upstream of the new weir are provided in **Figure 7-2** to **Figure 7-7** for a selection of the modelled flow rates of between 100 and 5,000 megalitres per day. Each longitudinal profile shows the existing water level (light blue coloured line) and predicted water level (dark blue) for the existing and new weirs respectively. The level of the riverbed (black) is also shown to provide a reference point for the water levels. The existing water velocity (light red) is shown in each longitudinal profile together with the difference between the existing and predicted water velocities (bold red). The figures show that water velocity is greater and more variable upstream of the existing weir pool (upstream of chainage 61790) and slows and becomes less variable when water enters the weir pool, with the velocity gradually reducing further as water flows through the weir pool to the existing weir crest at chainage 0. The water velocity spikes as water flows over Bar 3 (chainage 49200), Bar 2 (chainage 30120) and Bar 1 (chainage 5430). Water velocities return to levels similar to those upstream of the existing weir pool when water spills over the existing weir and flows downstream (chainages -5000 to 0). The reduction in water velocities as water flows through the weir pool is more pronounced at low flow rates. As flow rates increase, existing water velocities in the weir pool are only slightly lower than those upstream of the weir pool, particularly at the upstream end of the weir pool.

The longitudinal profiles show that the new weir would have a significant impact on water velocities in the new town pool where the river would change from a flowing river reach to weir pool. However, elsewhere the impact of the new weir on water velocities would be minor, particularly at lower flow rates. Within the existing weir pool, the effect of the new weir on water velocities diminishes with distance upstream, with the difference in water velocities being well less than 0.1 metres per second for all the modelled flow rates except at Bar 1 and Bar 2 when flow starts to exceed 600 megalitres per day. The figures show that the difference in the water velocities between the new and existing weirs is negligible upstream of the existing weir pool (chainage 61790).

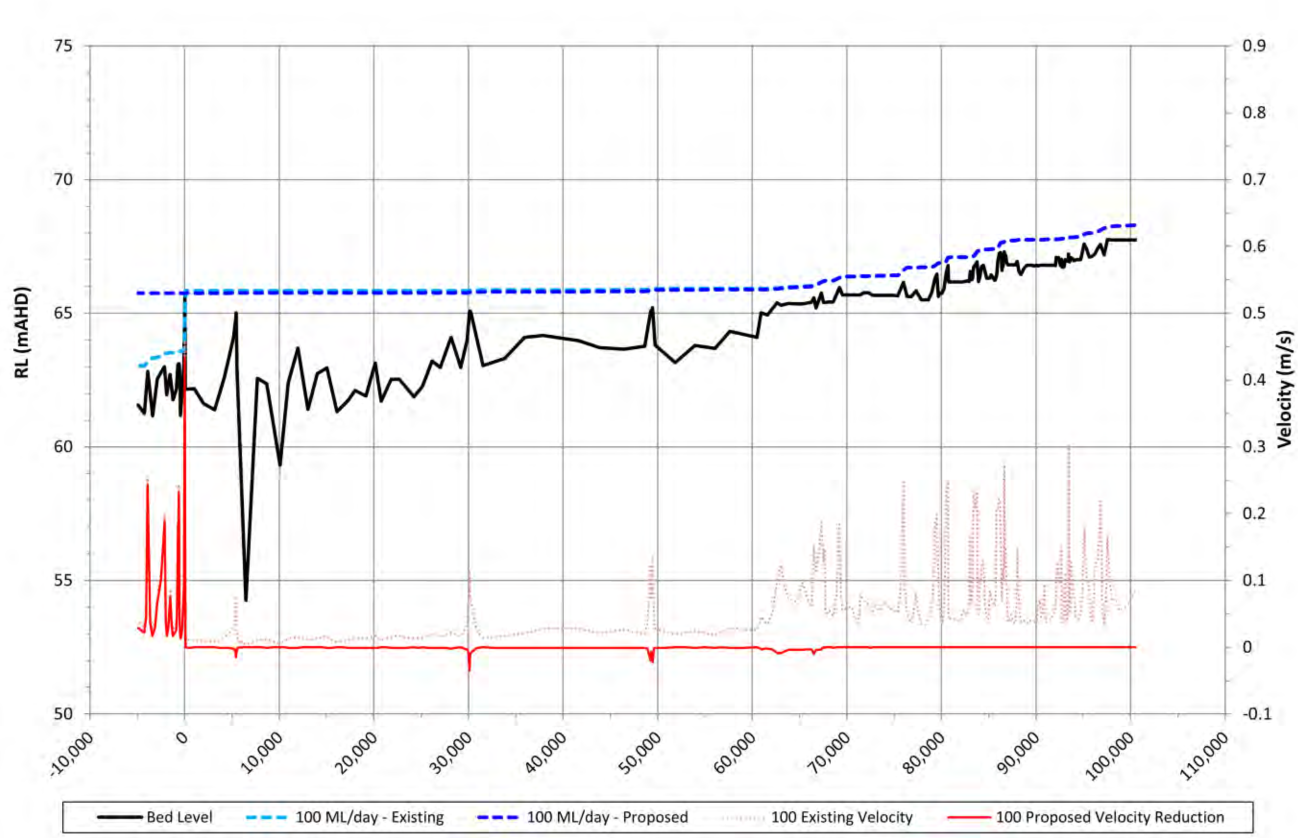


Figure 7-2 Predicted change in water velocities for flows of 100 megalitres per day

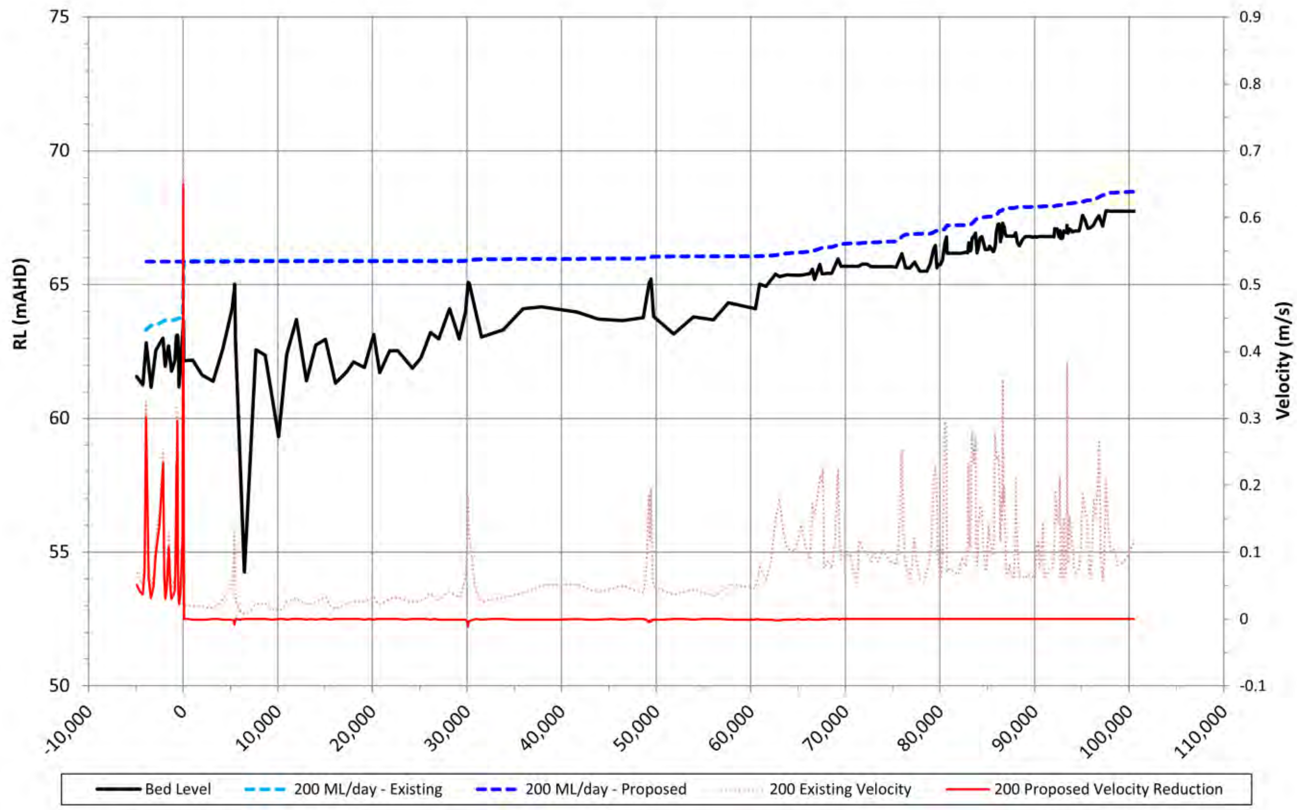


Figure 7-3 Predicted change in water velocities for flows of 200 megalitres per day

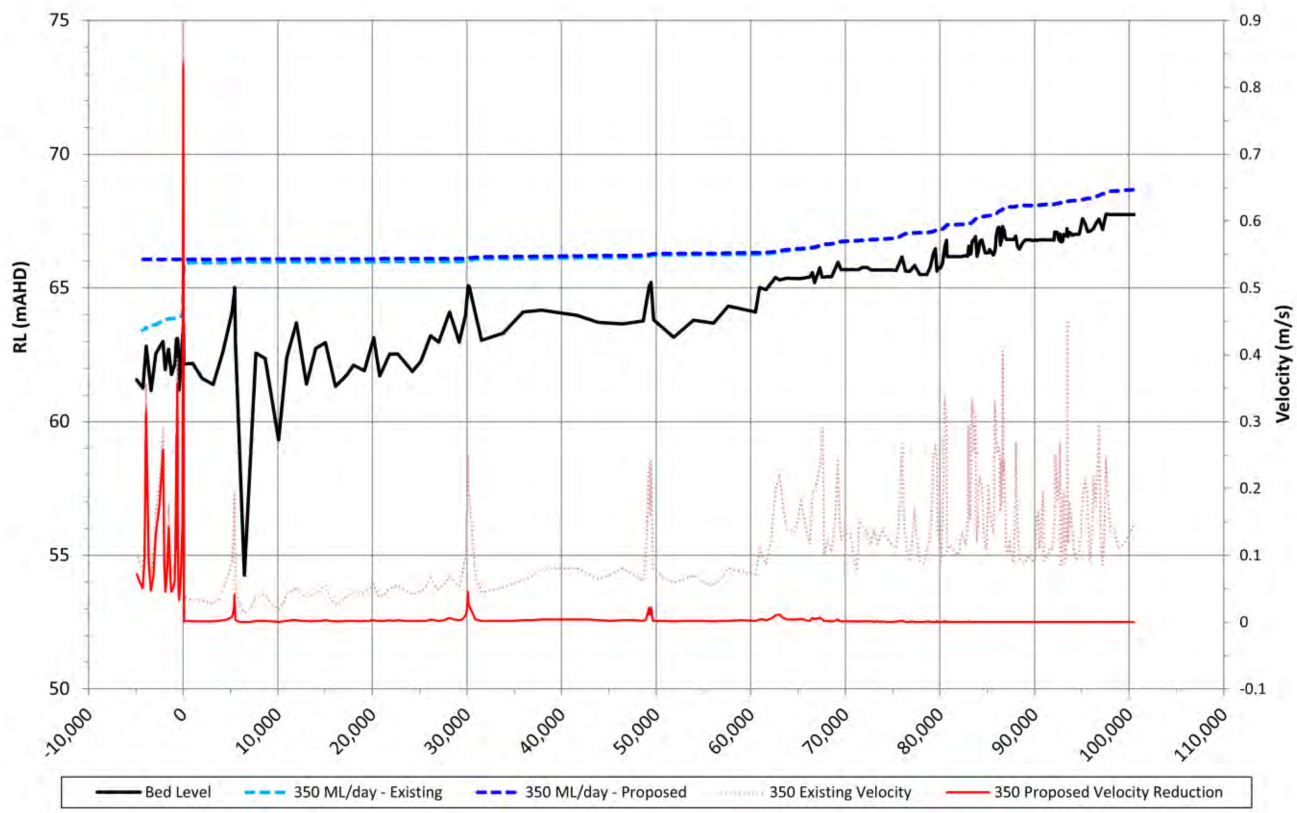


Figure 7-4 Predicted change in water velocities for flows of 350 megalitres per day

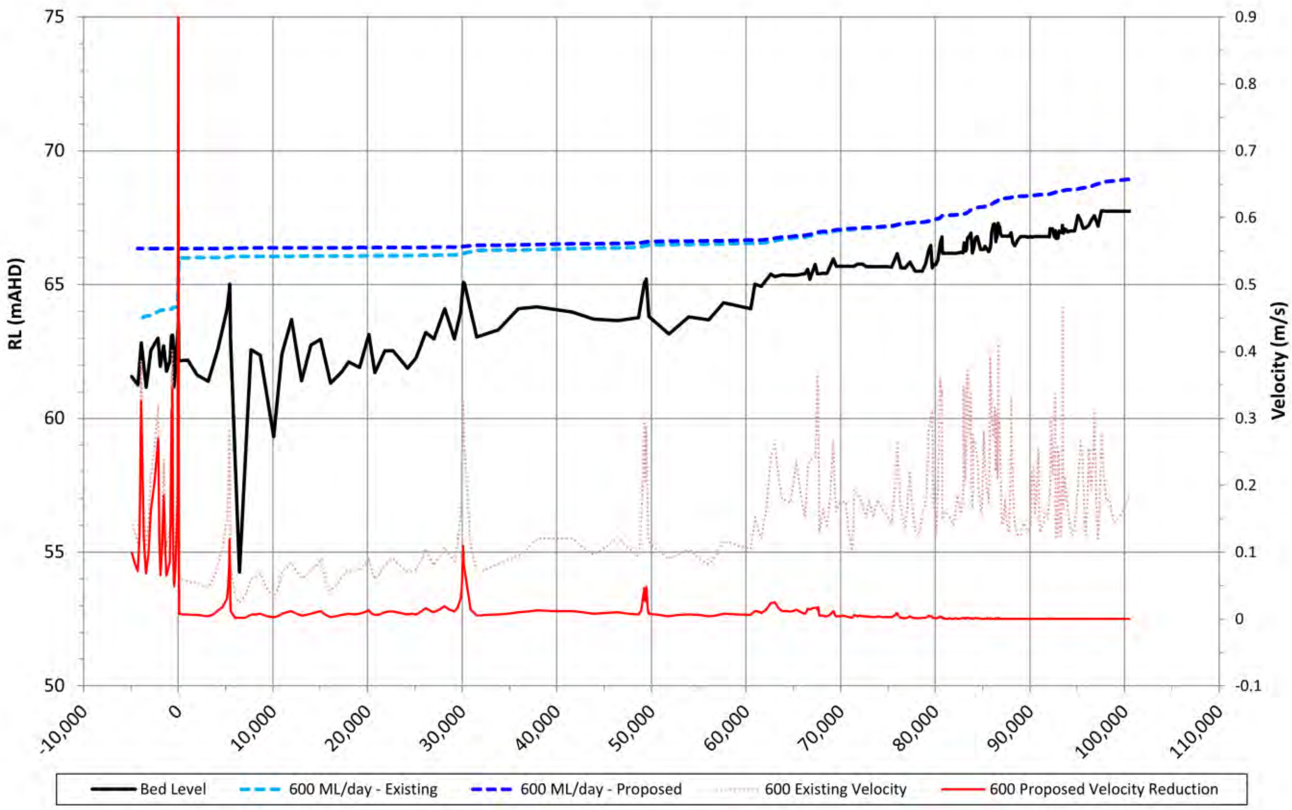


Figure 7-5 Predicted change in water velocities for flows of 600 megalitres per day

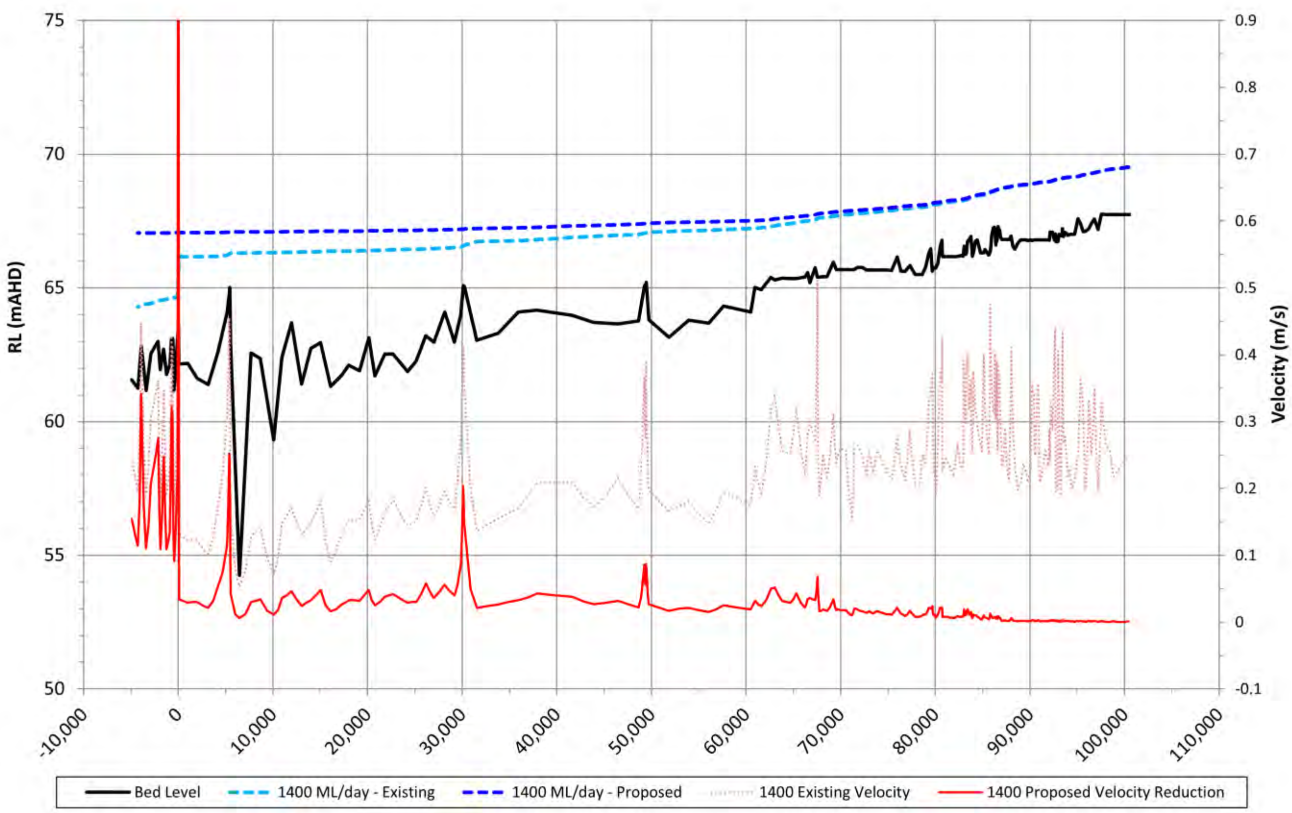


Figure 7-6 Predicted change in water velocities for flows of 1,400 megalitres per day

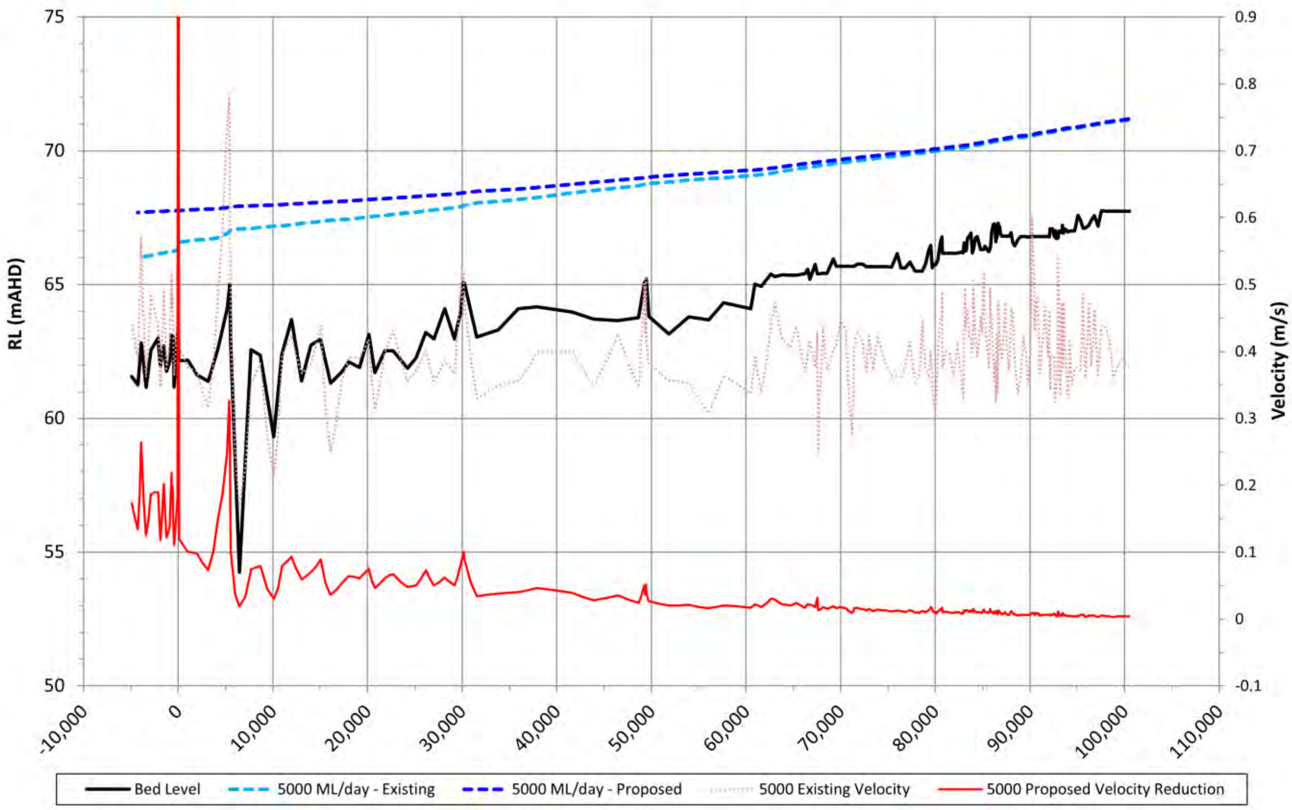


Figure 7-7 Predicted change in water velocities for flows of 5,000 megalitres per day

The predicted reduction in water velocities upstream of the new weir are due to the operation of the weir gates. At high flows the new weir has a more substantial backwater effect than the existing weir, causing flows near the new weir to slow down and the water level to rise. This is seen in **Figure 7-8** and **Figure 7-9,** which show the water level in the weir pool upstream of the existing and new weirs respectively at different flow rates. As shown in these figures, the backwater effect increases as the flow rate increases, with the greatest increase in the water level of the weir pool occurring nearest to the weir.

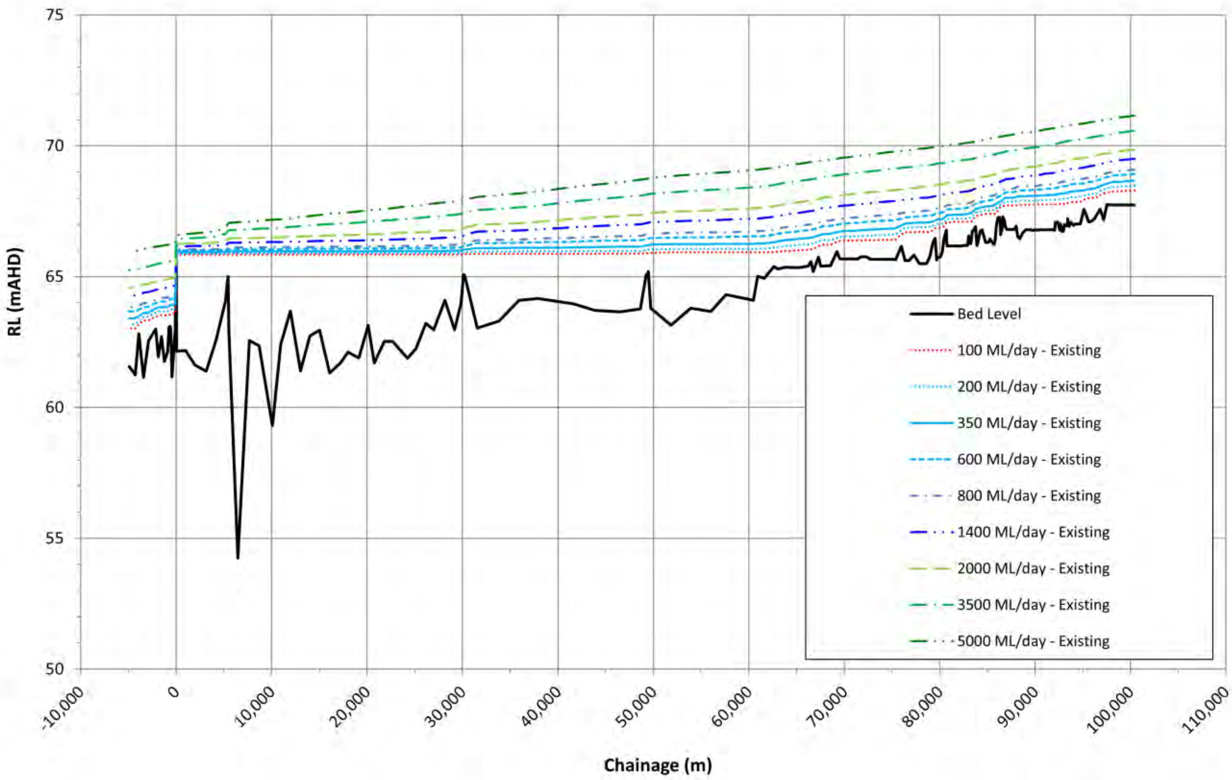


Figure 7-8 Existing water level in the Darling River (Baaka) at different flow rates, from the new weir site to 100-river-kilometres upstream of the existing weir

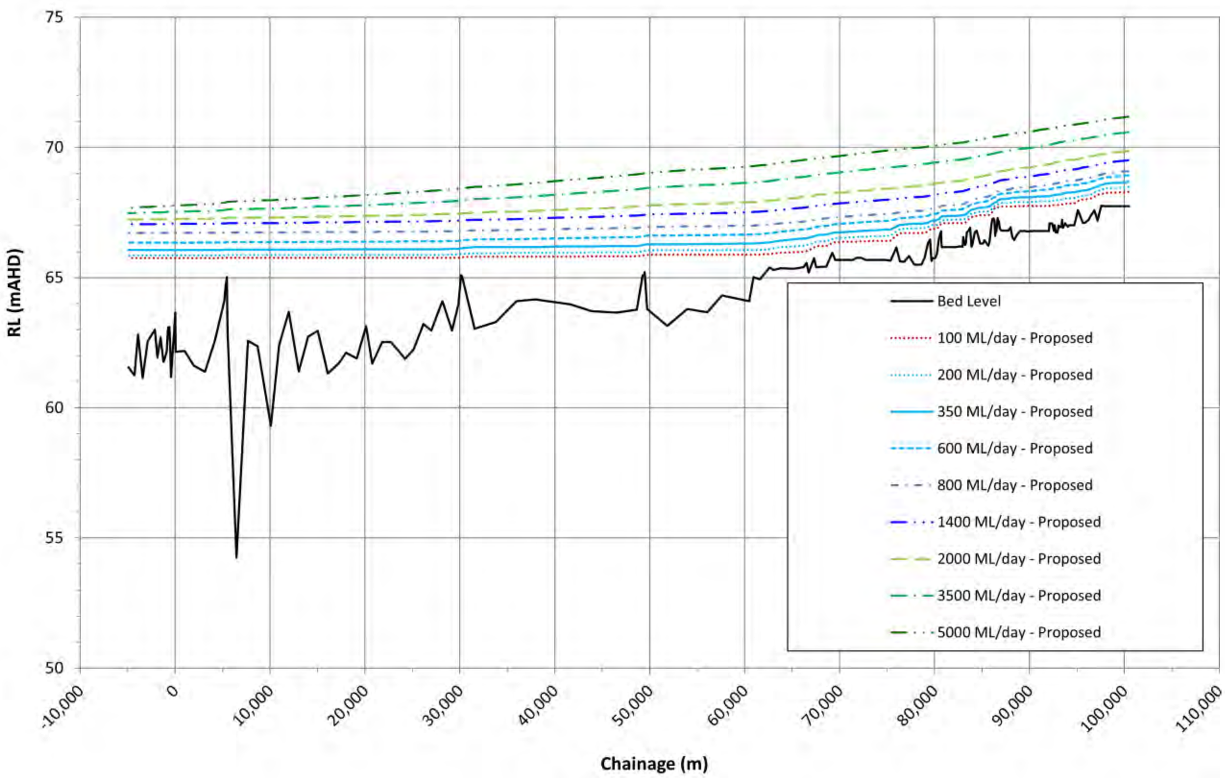


Figure 7-9 Water level in the Darling River (Baaka) at different flow rates when the new weir is in normal operation mode, from the new weir site to 100-river-kilometres upstream of the existing weir

7.6.3 Water users

The proposal would not impact water users in the Tilpa to Wilcannia Management Zone of the Barwon-Darling Unregulated Water Source because it would not change the volume of water flowing in this reach of the river.

As mentioned in **Section 7.5.1**, there is only one water access licence associated with a current water supply works and water use approval in the Wilcannia to Upstream Lake Wetherell Management Zone of the Barwon-Darling Unregulated Water Source. This water user would potentially be impacted by the changes to flows downstream of the new weir described in **Section 7.6.2**.

7.7 Mitigation and management measures

The hydrology impacts of the proposal are directly linked to the design of the new weir and the rules that would govern its operation. These elements of the proposal have been developed to minimise hydrology impacts while providing water security for Wilcannia. This means that there are limited opportunities to improve hydrology outcomes while still maintaining water security. There is potential to minimise hydrology impacts during construction through considered staging, timing and design of the work and there may also be opportunities to refine the triggers for the filling phase during operation of the new weir, and measures that will be implemented to pursue these outcomes are detailed in **Table 7-8**.

Table 7-8 Mitigation and management measures for hydrology impacts

Ref	Impacts	Mitigation and management measures	Timing
HY1	Obstruction of flows during construction	Plan and design the construction work to minimise hydrology impacts including: ▪ Schedule work that requires occupation of part of the riverbed to occur during periods of low flow ▪ Maximise the width of the river channel available for flows to pass instream construction sites.	Pre-construction Construction
HY2	Triggers for the filling phase	In consultation with WaterNSW, investigate opportunities to refine the triggers for the filling phase with the aim of reducing the frequency of filling while ensuring that water security is maintained. The investigations should consider: ▪ Flows in tributaries downstream of Bourke Town Weir, including inflows from the Warrego River and Paroo River ▪ Anticipated flows from upstream of Bourke Weir ▪ Climatic conditions and prevailing weather.	Pre-operation Operation
HY3	Optimisation of the translucency rule	The initial downstream flows resulting from the implementation of the translucency rule will be monitored to identify opportunities to optimise these flows. Based on the findings of this monitoring, the operations plan for the new weir may be revised if opportunities are identified to increase downstream flows by modifying how the translucency rule is implemented. Any proposed revisions to the implementation of the translucency rule will be discussed with key stakeholders prior to the operations plan being updated.	Operation

8. Geomorphology

The proposal has the potential to impact the processes that can lead to changes in the form of the Darling River (Baaka) channel. A geomorphology impact assessment has been carried out to assess the potential for the proposal to affect geomorphological processes in the Darling River (Baaka) and is provided in **Technical Report 1** and summarised in this section.

SEAR no. 2 includes requirements for the assessment of the proposal's potential geomorphology impacts. The requirements of SEAR no. 2 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

8.1 Assessment methodology

The methodology for the geomorphology impact assessment included:

- Undertaking a desktop review of previous geomorphology studies of the Darling River (Baaka) upstream and downstream of Wilcannia
- Reviewing River Styles mapping of the Darling River (Baaka) upstream and downstream of Wilcannia
- Considering the geomorphology risks associated with the proposed location of the new weir
- Assessing the effects of removing the existing weir on geomorphology
- Assessing the potential impacts of the preliminary operating rules for the new weir on geomorphology.

8.2 Risk

Weirs can impact channel geomorphology by trapping sediments from upstream and inadvertently storing them in the weir pool. Without a supply of sediment to replenish areas that have been eroded downstream by increased flow velocities and turbulence below the structure (otherwise known as clearwater erosion), the natural sediment balance is disrupted. Additionally, the manipulation of flows and the associated increased flow velocities below a weir can result in the alteration of natural stream morphology by increasing erosion rates, which can result in the deepening and widening of rivers (Department of Primary Industries, 2006).

8.3 Avoidance and minimisation of impacts

The Department of Primary Industries encourages the removal of redundant structures from waterways, with weir removal providing the greatest benefit to the health of the waterway by re-establishing river connectivity, enabling unrestricted fish passage, restoring flowing water habitat conditions and reinstating natural sediment fluxes (Department of Primary Industries, 2006). The proposal includes removal of the central section of the existing Wilcannia Weir, which would lessen the obstruction created by this structure to sediment fluxes.

The new weir would have dual modes of operation as detailed in **Section 3.5.3**. and this would result in about 18.81 river kilometres of additional weir pool at the upstream end of the existing weir pool being temporarily inundated when the new weir is in drought security operation mode. This section of the river would alternate between flowing water, still-water and, at times, sections of dry riverbed, which would reduce the impact of the new weir on natural sediment fluxes in this reach.

8.4 Existing environment

The geomorphology of the Darling River (Baaka) at Wilcannia is described in a number of previous publications (Thoms et al. 1996; 2004). Thoms et al. (2004) refer to the reach of the Darling River (Baaka) at Wilcannia as forming part of a larger anabranching zone, the river flowing across a broad low angle fan complex or outwash surface with a series of effluent channels and anabranches, such as Twenty Seven Mile Creek and Talyawalka Creek. The main river channel is characteristic of a 'wash load' system with low bed slopes, high sinuosities, low bank-full stream power and highly cohesive bank materials (Thoms et al. 2004). Cross-sectional geometry does vary along the Darling River (Baaka), however, in general the river channel is 'canal' like in form. In-channel benches are present along this section as well as numerous lateritic outcrops which form large natural pools (Thoms et al. 1996).

A visual survey of selected sites along the Darling River (Baaka) at Wilcannia was carried out and this identified signs of bank erosion at all of the sites inspected, as is expected in a meandering channel. Notching/undercutting of banks is more pronounced in the existing weir pool (albeit still relatively minor), compared to the riverbanks upstream and downstream of the weir pool. This is also to be expected in a weir pool with ponding of water against the channel banks. It is not apparent from a review of bathymetric data and site photographs that there is extensive sedimentation within the existing weir pool. Indeed it is noted that the existing weir pool contains a series of pools along its length (refer to **Figure 3-12**). Some sedimentation may occur within these pools, but it is also likely given the fine-grained nature of sediments comprising bed and banks that a large proportion of the sediments are transported as 'wash load' through the extent of the weir pool to the section of river downstream of the existing weir during high flows.

8.4.1 River Styles

The River Styles Framework is a spatial tool used to characterise geomorphology. The framework classifies rivers based on geomorphic qualities that include river type, fragility, sensitivity to disturbance, condition, rarity and recovery potential. River Styles data is available from the NSW River Styles database developed by DPE and Macquarie University. The database includes River Styles data for all third and higher order rivers in NSW.

The River Styles Framework can be used to describe individual rivers, assess their current geomorphic condition and forecast whether a river is degrading or recovering. It also can help in the identification of rare and threatened river forms across NSW.

The characterisation of the Darling River (Baaka) in the NSW River Styles database is based entirely on SPOT5 satellite imagery and does not include field validation. The characterisation of the Darling River (Baaka) at Wilcannia in the NSW River Styles database is characterised as:

- Having a laterally unconfined, continuous channel, meandering fine grained bed
- Being in a laterally unconfined valley setting, with the river channel surrounded by terrace or floodplain
- Having low fragility, which means that it is has little potential to be disturbed or experience change its geomorphic category, although some slight changes in bedform may occur (Outhet et. al., 2004).

8.5 Assessment of impacts

8.5.1 Construction

The construction of the new weir would require the right riverbank alongside the fishway and the left riverbank next to the weir crest to be excavated to construct the new infrastructure. This would create the potential for riverbank erosion and a loss of bank stability. The impacted sections of riverbank would adjoin the dry work sites created on the riverbed for the construction of the fishway and weir crest as shown in **Figure 3-2** and **Figure 3-6** and so would not be subject to erosion by flowing water except in the event of a sufficiently large flood that overtops the cofferdams.

The riverbanks at the new weir site would be reformed and trimmed as part of the construction works so as to tie-in with the undisturbed riverbanks upstream and downstream. Riverbank slopes and erosion protection would be aimed at reducing the risk of bank erosion occurring after completion of construction.

8.5.2 Operation

The operation of the new weir would result in an extension of the existing weir pool both upstream and downstream and these new sections of weir pool are expected to be subject to the same geomorphological impacts as are observed at the existing weir pool. Undercutting/notching of the riverbanks is expected to occur in the new town pool and within the about 18.81 river kilometres of temporary new weir pool upstream of the existing weir pool due to ponding of water against the riverbanks. Similar to the existing weir, this impact is expected to be relatively minor. As mentioned above in **Section 8.3**, the temporary nature of the inundation upstream of the existing weir pool is expected to result in a lesser impact than currently occurs at the upstream extent of the existing weir.

It is likely that sedimentation would occur in the about 18.81 river kilometre section of additional weir pool at the upstream end of the existing weir pool when it is inundated. It is also expected that these sediments may be remobilised and transported further downstream into the existing weir pool. As a large proportion of the sediment is fine grained and forms 'wash load' it is expected that mobilised sediment may still be transferred beyond the extent of the new weir, particularly during larger flood events. This would reduce the potential for sediment starvation downstream of the new weir.

Based on the response of the riverbanks in the existing weir pool to the about 80-years of operation of the existing weir, fluctuations in the level of stored water in the weir pool associated with the operation of the new weir are not expected to impact the stability of the riverbanks. Fluctuations in the level of stored water in the weir pool are not expected to induce changes in pore water pressures that would weaken bank materials and promote bank failure.

Changes to flows downstream of the new weir are expected to have minimal impact on the geomorphology of the river downstream of the new weir.

8.6 Mitigation and management measures

Mitigation and management measures for geomorphological impacts are provided in **Table 8-1.**

Table 8-1 Mitigation and management measures for geomorphological impacts

Ref	Impacts	Mitigation and management measures	Timing
GE1	Riverbank stability	The riverbanks at the new weir site will be reformed and trimmed so as to tie-in as seamlessly as possible with the riverbanks upstream and downstream. Riverbank slopes and erosion protection will aim to reduce the risk of riverbank erosion occurring after completion of construction.	Construction
GE2	Riverbank stability	During the reset phase, lowering of the weir level will be limited to a maximum of 0.2 metres per day to reduce the potential for riverbank erosion within the weir pool.	Operation

9. Groundwater

The proposal has the potential to impact groundwater during construction and operation. A hydrogeological impact assessment of the proposal has been carried out and is provided in **Technical Report 1** and summarised in this section. The assessment was informed by the Groundwater Risk Assessment undertaken by C.M. Jewell & Associates (CMJA) (2021).

SEAR no. 2 includes requirements for the assessment of the proposal's potential groundwater impacts. The requirements of SEAR no. 2 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

9.1 Legislation and policy context

9.1.1 Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020

Groundwater at Wilcannia is subject to the Water Sharing Plan for the Darling Alluvial Groundwater Sources 2020 (Darling Alluvial WSP). The Darling Alluvial WSP covers the Warrego, Upper Darling, Paroo and Lower Darling alluvial groundwater sources. The proposal is located within the Upper Darling alluvial groundwater source.

The Daring Alluvial WSP has several objectives; the objectives that are most relevant to the proposal include:

- To protect the condition of the groundwater sources and their groundwater dependent ecosystems
- To maintain the spiritual, social, customary and economic values and uses of groundwater by Aboriginal people
- To provide access to groundwater to support groundwater-dependent social and cultural values.

In accordance with sections 20 and 21 of the WM Act, the Darling Alluvial WSP applies a range of strategies to achieve these objectives including:

- Providing groundwater for basic landholder rights, town water supply, and for licensed domestic and stock purposes
- Managing extractions under access licences and basic landholder rights within the limits to the availability of water
- Managing the construction and use of water supply works to minimise impacts on high priority groundwater dependent ecosystems, groundwater quality, groundwater-dependent culturally significant areas, basic landholder rights and town water supply.

For each of the groundwater sources, the Darling Alluvial WSP estimates the volume of water that is required each year for domestic and stock rights and identifies long-term average annual extraction limits.

9.2 Assessment methodology

A desktop assessment of the potential hydrogeological impacts of the proposal has been carried out. The methodology for assessing the potential hydrogeological impacts of the proposal included:

- Collating and reviewing existing hydrogeological documentation and information on the proposed study area
- Determining the possible impacts of construction and operation of the proposal on the region's groundwater sources and adjacent water users (specifically the emergency town water supply bores)
- Identifying possible impact to groundwater dependent ecosystems from the project (positive or negative)
- Identifying any potential salinisation impacts of the proposal to the groundwater system.

9.3 Risk

The key risk to groundwater due to the proposal is the potential for salinisation where there is new or increased inundation of the river channel. Water stored in the weir pool has the potential for increased salinity during periods of low or no flow and this can affect the local groundwater resource where there is interaction between the river (weir pool) and groundwater system.

9.4 Avoidance and minimisation of impacts

Potential impacts to groundwater have been minimised by designing the new weir to have dual modes of operation so that an increase in the full supply level (and as a consequence a deeper and extended weir pool) would be temporary. Storage behaviour modelling of the operation of the new weir (refer to **Section 7.2.1**) showed that it would be in drought security operation mode for about 30 per cent of the time over the 119-year simulation period. This minimises the potential for groundwater impacts along the about 18.81 river kilometres of extended weir pool upstream of the existing weir pool when the new weir is in drought security operation mode.

9.5 Existing environment

The primary evidence of groundwater occurrence near the new weir site are five deep bores associated with the emergency water supply bores for the town. These bores typically intersected a thick clay horizon between 20 to 30 metres below ground level and extend to 45 metres below ground level near the proposed new weir site. Interbedded sands, clays extended from 45 metres to borehole termination at about 70 metres below ground level. Bore GW040872 intercepted a shallower clay zone between two and 20 metres with dominantly sand to termination depth of 92 metres. GW040872 is located south of Wilcannia near the east of the Menindee Road turnoff to the Barrier Highway.

9.5.1 Aquifers

The Upper Darling alluvium including the Wilcannia proposal area can be conceptualised as comprising of a shallow and deep aquifer system. The shallow system sediments correspond to the Narrabri formation while the deeper qualifier system corresponds to the Gunnedah and Cubbaroo formations (DPIE, 2019a).

The shallow aquifer system occurs to a depth of 25 metres below ground level, the deeper system occurs to depths of 120 metres below ground level, with a pre-Cenozoic paleochannel that runs approximately parallel with the Darling River (DPIE, 2019a).

The upper alluvium aquifer is hydraulically connected to the Darling River (Baaka). Subject to topography and geology, the aquifer system either is recharged by the river or discharges into the river during time of drought or high river flows respectively. Freshwater sandy lenses and groundwater mounding is evident near the river.

The proposed new weir site is within Quaternary alluvial sediments comprising outwash areas, and drainage flats of black and red clayey silt and sand (Frenda et al.,1965). Underlaying alluvial plains both upstream and downstream of Wilcannia are sequences of interbedded channel and overbank deposits laid down by the meandering Darling River (Baaka). Underneath the Quaternary sediments are sandstone and quartzites of Devonian- age Mulga Downs Group (CMJA, 2021).

The Darling River (Baaka) channel is incised into the Quaternary sediments to a depth of 10 to 11 metres below the banks (CMJA, 2021). CMJA (2021) categorised the top of the Devonian sediments as hydrogeological basement with only the quaternary alluvium of interest to the proposal.

The alluvium sands are the target aquifer for extraction bores in the area. Bores GW040891, GW040892, GW040893, GW040897, GW804531 and GW040872 indicate a varied thickness of clay between 30 to 45 metres and have a leaky system behaviour between the upper and lower aquifers. The shallow system is likely to be unconfined to semi-confined depending on the thicknesses and permeability of the overlaying sand and silt aquitard.

In summary:

- There are two aquifers near the river that may be affected by the new weir pool
- The upper aquifer is clearly connected with the river and is likely to respond directly to changes in river level associated with the new weir
- The deeper aquifer responds to regional conditions and whilst it has a muted connection may also respond to the weir pool changes.

9.5.2 Groundwater

Groundwater level

Groundwater level spot measurements are available for monitoring bores GW040874 and GW040892 located near the town borefield at Union Bend and these indicate that the water table typically fluctuates between seven and 10 metres below ground level (61 to 66 metres AHD). This is at a similar level to the Darling River (Baaka) incised riverbed being about 10 metres below the typical floodplain surface elevation. However, the remnant river meanders are at elevations ranging between 65 and 70 metres AHD and below the typical floodplain elevation. The monitoring bores are generally installed in areas of elevated topography including the town's water supply bores, which are installed at an elevation of 76 metres AHD to allow for flooding. Therefore, in areas of indicated low topography ranging between 65 and 70 metres AHD in the old meander loops near the Darling River (Baaka), the groundwater level is likely to be shallower and nearer to two to five metres below ground level instead of seven to 10 metres below ground level.

Regional groundwater levels appear to be similar, based on nearby bore readings, groundwater flow direction is interpreted to be generally north to south, along the river valley.

CMJA (2021) undertook a detailed analysis of the groundwater levels in relation to the Darling River (Baaka) stage height. They showed that there was a good correlation between the river stage height and the water table in the upper aquifer. In four flood events between 2004 and 2017, there was an almost instantaneous response to water table rise indicating groundwater recharge to the shallow alluvium aquifer via the Darling River (Baaka). These finding are the same as those documented in the 2019 Darling Alluvium Water Resource Plan hydrogeological model completed by DPIE (2019a).

CMJA classified the Darling River (Baaka) at Wilcannia as a connected losing stream that gains under low-flow conditions (baseflow).

Groundwater quality

Groundwater electrical conductivity in the alluvium aquifers is variable and ranges from fresh values of 300 microsiemens per centimetre to saline values of 52,000 microsiemens per centimetre (DPIE, 2019a).

As discussed in **Section 9.5.1**, fresh groundwater in the upper alluvium is due to rapid recharge mainly via the channel floor and sides of the Darling River (Baaka) during high river flows and the floodplain during flood events. Saline groundwater in the alluvium is due to evapo-concentration of shallow groundwater during long dry periods and sediment mineral weathering (DPIE, 2019a).

Groundwater users

Wilcannia has two operational town water supply bores (GW040897 and GW084531) and one new unequipped town bore. The bores are used to augment the town's water supply during periods of drought. The bores are located in the south meander of Wilcannia, once the new weir is completed, the new town pool would extend past the bores. It was reported in February 2020 that the Darling River (Baaka) at this point near the bores was dry with only a few visible remnant pools of water. GW040897 is screened in fine sand from 49 to 55 metres in depth while GW804531 is screened in sand between 48 and 53 metres. As described in **Section 9.5.1**, a thick clay horizon exists between 20 to 30 metres in depth and extends to 45 metres above where the two town water supply bores are screened.

Groundwater dependent ecosystems

Groundwater dependent ecosystems along the Darling River (Baaka) at Wilcannica are discussed in **Section 12.5.3**. Potential aquatic and terrestrial groundwater dependent ecosystems near the proposal have been identified on the Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology, 2020) and include:

- *Aquatic groundwater dependent ecosystems* — The Darling River (Baaka) and the encompassing floodplains have been identified as having a high potential for groundwater dependence based on national assessment
- *Terrestrial groundwater dependent ecosystems*— Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains have been identified as having a high potential for groundwater dependence based on regional studies. A large percentage of the proposal area has been classified as low potential for groundwater dependence based on regional studies.

9.6 Impact assessment

9.6.1 Construction

Construction of the proposal would present a minor risk to groundwater due to the potential for spills or leaks of hydrocarbons or other hazardous materials onto the ground to be drawn down into groundwater causing localised contamination of the groundwater resource. As the emergency town water supply bores are not directly connected to the Darling River (Baaka), the risk to the town water supply bores from the construction of the new weir is considered low.

9.6.2 Operation

Impacts to groundwater level

The two groundwater monitoring bores at Union Bend screened in the shallow alluvium aquifer, GW040874 and GW040892, are at elevations of 70.93 and 75.32 metres AHD respectively. Groundwater levels at these bores were 9.6 and 10.35 metres below ground level respectively in February 2020. When the new weir is in normal operation mode, the groundwater level at GW040874 and GW040892 may reach 5.22 metres and 9.61 metres below ground level respectively.

Groundwater elevation upstream of the existing weir is not expected to change measurably because the full supply level of the new weir during normal operation would be the same as the full supply level of the existing weir.

Salinisation

CMJA noted that a water quality risk assessment had been carried out in 2012 to assess hazards relating to the construction of the new weir noting that there was an existing risk of high salinity water in the weir pool due to drought and prolonged periods of no or low flow of the Darling River (Baaka) (CMJA, 2021).

Shallow groundwater (less than three metres below ground level) has the potential to become saline through evapo-concentration over time. Groundwater mounding in the about 4.92-river kilometre new town pool between the new and existing weirs is likely to occur up to 100 metres away from the banks of this section of the Darling River (Baaka). Long-term groundwater salinisation in low-lying areas next to the new town pool would be similar to that which already occurs upstream of the existing weir in low-lying areas.

Impacts to the emergency town water supply bores

The new town pool is expected to contribute to aquifer recharge of the shallow alluvium aquifer; however, it is unlikely to contribute to the deeper alluvium aquifer due to the 20-metre-thick clay aquitard. The emergency town water supply bores screen the deep alluvium, although the overlaying clay aquitard is likely to leak, it will limit the direct connection to the Darling River (Baaka). Currently the salinity of groundwater pumped from the town water supply boreholes, while acceptable, is higher than that of good quality river water. Any increased salinisation in the upper aquifer is unlikely to impact the deeper aquifer quality.

Impacts to groundwater dependent ecosystems

Equilibrium groundwater levels near the new town pool are expected to rise to within five metres of the ground surface during operation of the proposal and this would be supportive of groundwater dependent ecosystems in these areas. An exception is low-lying areas near the new town pool that are less than three metres below ground level which would experience salinisation similar to that which is already occurring upstream of the existing weir. Any salinisation impact to groundwater dependent ecosystems in low-lying areas near the new town pool would be similar to that which is already occurring upstream of the existing weir.

9.7 Mitigation and management measures

Mitigation and management measures for groundwater impacts are provided in **Table 9-1.**

Table 9-1 Mitigation and management measures for groundwater impacts

Ref	Impacts	Mitigation and management measures	Timing
GW1	Contamination of groundwater during construction	Emergency spill measures will be developed to avoid and manage accidental spillages of fuels, chemicals and fluids to minimise human health impacts and contamination of groundwater.	Construction
GW2	Increase in the water table near the new town pool	Groundwater level data from monitoring bores GW040874 and GW040892 will be analysed 12 months and five years following the start of operation of the new weir and compared to data collected prior to the start of construction to verify whether the groundwater level increases are in line with predictions. If the monitoring finds that groundwater levels are higher than predicted further investigations will be carried out to understand the causes of this change and the need for any additional measures. To assist in monitoring impacts to groundwater: ▪ A combined real-time water level and electrical conductivity logger will be installed in monitoring bore GW040892 ▪ The existing real-time water level logger in monitoring bore GW040874 will be upgrades to also measure conductivity ▪ Records will be maintained of pumping times and rates from all of the emergency town water supply bores.	Operation

10. Surface water quality

The potential surface water quality impacts of the proposal are assessed in **Technical Report 1** and summarised in this section.

SEAR no. 2 includes requirements for the assessment of the proposal's potential surface water quality impacts. The requirements of SEAR no. 2 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

10.1 Legislative and policy context

10.1.1 National Water Quality Management Strategy

The National Water Quality Management Strategy is an Australian Government initiative in partnership with state and territory governments to protect the nation's water resources by maintaining and improving water quality, while supporting dependent aquatic and terrestrial ecosystems, agricultural and urban communities, and industry.

Channels for delivery of the National Water Quality Management Strategy include policy, process and guidelines. There are currently nine guidelines prepared as part of the National Water Quality Management Strategy. Of these guidelines, the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council (ANZECC) is the most relevant to the proposal.

10.1.2 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The current *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG (2018) Water Quality Guidelines), also referred to as the 'revised Water Quality Guidelines', were released in 2018 as an online resource. They provide high-level guidance on the management context, ecological descriptions, biological indicator selection, regional default guideline values for physical and chemical stressors and other advice for three of Australia's 12 inland water drainage divisions. For ecoregions where regional physical and chemical stressor default guideline values are not yet provided and local jurisdictions have not yet derived finer scale (e.g. catchment, basin or physiographic level) guideline values, the regional default guideline values provided in the superseded Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australia and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000) (ANZG (2000) Water Quality Guidelines) apply.

The ANZG (2018) Water Quality Guidelines do not contain default guideline values relevant to the proposal. The water quality targets relevant to the proposal are set out in the Murray-Darling Basin Plan, the Murray-Darling Basin Agreement and the ANZG (2000) Water Quality Guidelines.

10.1.3 NSW Water Quality and River Flow Objectives

The *NSW Water Quality and River Flow Objectives* (Department of Environment, Climate Change and Water (Department of Environment, Climate Change and Water), 2006) are the agreed environmental values and long-term goals for NSW's surface waters. The objectives set out the community's values and uses (i.e. healthy aquatic ecosystems, water suitable for recreation and drinking water) for watercourses (e.g. rivers, creeks, estuaries and lakes) and contain a range of water quality indicators to assess whether the current condition of a watercourse supports these values and uses. The objectives are consistent with the agreed national framework for assessing water quality set out in the ANZG (2000) Water Quality Guidelines.

Water quality and river flow objectives have been developed for each catchment in the State; the proposal is located within the Barwon Darling and Far Western Catchment (Department of Environment, Climate Change and Water, 2006). Different water quality and river flow objectives have been set for areas within this catchment based on land use and the nature of its watercourses and their flows. The Darling River from Mungindi to the top of Lake Wetherell, which includes Wilcannia, is categorised as a ‘controlled river with reduced flow’, for which there are 10 water quality objectives and no river flow objectives.

10.1.4 Basin Salinity Management 2030

Basin Salinity Management 2030 (Murray-Darling Basin Ministerial Council, 2015) provides a 15-year strategy for the coordination of efforts by state governments to manage salinity in the Murray-Darling Basin during the period 2015-2030. It builds upon the reductions in salinity achieved under the *Basin Salinity Management Strategy 2001–2015*.

Basin Salinity Management 2030 comprises eight key elements. The core element is the continuation and refinement of the accountability framework that has been at the heart of Basin salinity management since 1988. The accountability framework commits the partner governments to maintain agreed salinity levels and ensure that their actions that increase river salinity are offset by investing in actions to reduce salinity. The framework includes the Basin Salinity Target to maintain modelled average daily salinity at the town of Morgan in South Australia at less than 800 EC for at least 95 percent of the time over a benchmark period from May 1975 to April 2000 that encompassed the expected long-term range of climate variability.

Another of the key elements in *Basin Salinity Management 2030* is salinity accountability for environmental water management. Environmental watering provides long-term salinity dilution benefits, but it can also mobilise salt from floodplains into the river system. *Basin Salinity Management 2030* requires the positive and negative salinity impacts associated with environmental water management to be accountable actions.

10.1.5 Barwon-Darling Watercourse Water Resource Plan – Water Quality Management Plan

The *Water Quality Management Plan for the Barwon-Darling Watercourse Water Resource Plan* (DPIE, 2019b) identifies relevant water quality objectives for the Barwon-Darling (Baaka) watercourse and the water quality targets required to achieve these objectives.

The plan notes that water quality attributes in the Barwon-Darling (Baaka) are strongly correlated to flow. High flow from rainfall and runoff results in higher turbidity, nutrients and possibly pesticides and pathogens. There is also a general trend towards increasing turbidity and nutrient concentration with distance down the catchment as cumulative impacts increase. Poor water quality also occurs when the Barwon-Darling (Baaka) dries to a series of standing pools, which generally have poor water quality with high nutrients, suspended solids and salinity. Water arriving from upstream catchments can flush this poor quality water from these pools, possibly affecting the usability further downstream and impacting on the riverine environment. The plan notes the following risks to water quality when the river commences to flow after a period of no flow:

- As poor quality water is flushed downstream, it may be unusable for some activities
- Water with low or zero dissolved oxygen often sits on the bottom of stagnant pools. The flushing of this water can cause fish kills in pools and downstream
- Some elements are released at harmful concentrations from river sediments under zero oxygen conditions. These could have toxic effects on plants and soil if used for irrigation
- Denser saline water can flow along or sit on the bottom of pools, leaving the fresher water sitting on top
- The water in stagnant pools can have high nutrient concentrations, triggering potentially toxic blue-green algal blooms downstream.

10.1.6 Australian Drinking Water Guidelines

The *Australian Drinking Water Guidelines* (ADWG) are prepared by the National Health and Medical Research Council and Natural Resource Management Ministerial Council (2011) for the Australian Government and are:

> *“…intended to provide a framework for good management of drinking water supplies that, if implemented, will assure safety at point of use. The ADWG have been developed after consideration of the best available*

> *scientific evidence. They are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved and how it can be assured. They are concerned both with safety from a health point of view and with aesthetic quality."*

The ADWG are not mandatory standards, however, they provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. They are intended for use by the Australian community and all agencies with responsibilities associated with the supply of drinking water, including catchment and water resource managers, drinking water suppliers, water regulators and health authorities.

The Central Darling Shire Council is responsible for providing potable water for drinking purposes. Water is treated at the Wilcannia Water Treatment Plant to a standard that compiles with the *Australian Drinking Water Guidelines*.

10.1.7 Guidelines for Managing Risks in Recreational Water

The *Guidelines for Managing Risks in Recreational Water* (National Health and Medical Research Council, 2008) aim to protect the health of humans from threats posed by the recreational use of coastal, estuarine and fresh waters.

The guidelines provide recommended values for indicators that may pose a risk to human health. These indicators are relevant for the Darling River (Baaka) which has "maintain the quality of surface water for recreational use" as a water quality objective in the *Water Quality Management Plan for the Barwon-Darling Watercourse Water Resource Plan* (DPIE, 2019b). Potential threats to the recreational use of the watercourse may arise as a result of the construction and operation of the proposal.

10.2 Assessment methodology

The methodology for the assessment of surface water quality included:

- Undertaking a desktop review and analysis to understand the existing environment and identify the potential surface water quality risks of the proposal
- Site visits and water quality monitoring to support and enhance the findings of the desktop analysis and refine the understanding of potential surface water quality risks
- Classifying sensitive receiving environments and identifying environmental values relevant to the proposal
- Assessing the potential construction and operational impacts relating to water quality
- A qualitative assessment of potential cumulative water quality impacts by identifying major projects with a construction program that is likely to overlap with construction of the proposal and/or is within the same water catchment
- Identifying appropriate measures to mitigate and manage the potential impacts to surface water quality resulting from construction and operation of the proposal.

A study area for this surface water quality assessment was defined to include the area either directly or indirectly affected by the proposal. The study area includes the construction footprint, the extent of the new weir pool and an about 50-metre reach of the river immediately downstream of the new weir where discharging water has the potential to cause scouring and increased erosion.

10.3 Risk

The proposal presents a risk to surface water quality because it would involve construction work within the Darling River (Baaka). Cofferdams would be used to create dry work sites for the construction of the fishway and later for construction of the weir embankment and crest. In the first phase of construction, a cofferdam would isolate about half the width of the river to enable construction of the fishway, with river flows past the work site in the other half of the river. Once the fishway is complete, the second phase of construction would use cofferdams to create a dry work site for construction of the weir embankment and crest, with river flows directed down the fishway.

Establishing and maintaining these dry work sites within the river would require dewatering of any seepage that enters the work area. This water would need to be appropriately managed to prevent sediment-laden water entering the river.

Other risks to surface water quality during construction of the new weir would include sediment-laden run-off entering the river from the construction compounds, stockpile areas and laydown areas on either side of the river, accidental leaks or spills of hydrocarbons that flow into the river.

The partial removal and decommissioning of the existing weir also presents a risk to surface water quality because it too would involve construction work within the Darling River (Baaka). The operation of an excavator and trucks within the riverbed would disturb sediment that would affect the colour, turbidity and suspended solids.

Risks to surface water quality during the operation of the proposal include mobilisation of sediment due to erosion of reformed, stabilised and revegetated riverbanks at the new and existing weir sites, and scouring of the riverbed downstream of the new weir site. Additionally, locating the weir further downstream introduces additional sources of faecal and other pollution such as stormwater from the Wilcannia township and sewer overflows including during storm events.

Similar to the existing weir, under certain climatic and hydrological conditions there would be a risk to the quality of water stored behind the new weir due to thermal stratification, variable dissolved oxygen, increased nutrients and sediment and algal blooms.

10.4 Avoidance and minimisation of impacts

Protecting surface water quality is a key consideration in the design of the proposal. Construction at the new weir site would be staged and restricted to about half the width of the river at any one time so as to enables flows past the work site. Water quality protection ponds would be used to treat water extracted from within the cofferdams.

At the existing weir site, demolition work would be timed to occur during a period of low flow in the river and a cofferdam and silt curtains would be placed around the work site to prevent sediment plumes travelling beyond the work area.

To minimise scouring during operation of the proposal, the area downstream of the new weir would be protected through the provision of rockfill.

As discussed in **Section 2.2.2**, Water Infrastructure NSW proposes to install diesel-powered back-up pumps at pumping stations numbers 1 and 2 to minimise the risk of sewer overflows entering the weir pool due to power or mechanical failures. Pumping station number 1 is located on the corner of Hood Street and Field Street in Wilcannia. Pumping station number 2 is located on Martin Street, midblock between Hood Street and Woore Street in Wilcannia. The back-up pumps would provide continuity of pumping in the event of power or mechanical failures at these sewage pumping stations so that untreated wastewater is not discharged into the new weir pool. These works do not form part of the proposal.

10.5 Existing environment

The Barwon-Darling is largely an unprotected catchment. This means that unlike most metropolitan water storages which are surrounded by 'Special Areas' typically containing undisturbed bushland to protect drinking water quality, water entering the Wilcannia weir pool can be subject to several water quality risks.

As noted in **Section 10.1.5**, the *Water Quality Management Plan for the Barwon Darling Watercourse Water Resource Plan* (DPIE, 2019b) identifies relevant surface water quality objectives for the Barwon-Darling watercourse and the water quality targets required to achieve these objectives. The plan uses the NSW Water Quality Index to communicate water quality data in a simple and consistent way. The NSW Water Quality Index is a single score between one and 100 based on water quality data from 2010 to 2015 collected by the NSW State water quality assessment and monitoring program against appropriate water quality targets. Scores are presented in four categories: poor (one to 59), fair (60 to 79), good (80 to 94) and excellent (95 to 100). The NSW Water Quality Index scores for the Barwon-Darling water resource plan area are presented in the plan and range from good to poor. The scores decline along the Darling River (Baaka): the score at Mungindi is 90 and it then progressively declines to scores of 33 at Bourke and Louth and decreases further to a score of 26 at Wilcannia.

In general, surface water quality degradation within the Barwon-Darling catchment is the result of a combination of factors including alteration of the river system's natural flow regime, changes to catchment conditions and land-use activities. Surface water quality issues caused by changes to the natural flow regime of the river system are attributable to both high and low flows:

- *High flow* — High flow from rainfall and runoff results in increased sediment loads, which cause higher turbidity levels and higher concentrations of nutrients, pathogens and possibly also pesticides. The Darling River (Baaka) at Wilcannia, generally recorded the highest turbidity, cumulative increase in sediment distance downstream (DPIE, 2019a).
- *Low flow* — Low flow occurs not only due to the climatic conditions and low annual rainfall, but also as a result of headwater dams and water extraction, which has seen over one third of the average annual flow being diverted (Department of Primary Industries, 2018). This can result in the Darling River (Baaka) drying up to a series of standing pools, particularly over extended periods of no tributary inflows. The water quality of these standing pools is generally poor with elevated nutrients, sediments and salinity. This poor quality water can cause downstream impacts when upstream flows recommence and flush standing water downstream.

The *Water Quality Management Plan for the Barwon Darling Watercourse Water Resource Plan* (DPIE, 2019b) identifies the likely causes of water quality degradation in the Barwon-Darling catchment and provides commentary on their relevance at key locations along the river system including at Wilcannia. The plan identifies the following as water quality issues for the Darling River (Baaka) at Wilcannia:

- *Salinity* — Land management practices, water flow or water management practices and reduction in stream flow are all causes of elevated salinity levels. The plan notes that at Wilcannia, the landscape is naturally saline. The Darling River (Baaka) at Wilcannia tends to pool and evaporative concentration induces higher salinity in pools. During first flush events the stream salinity increases markedly.
- *Turbidity* — Across the catchment the conversion of land to cropping and irrigation and the degradation of the banks of waterways as a result of grazing practices, feral pigs and stock trampling result in sediment entering waterways. The alluvial soils found on the floodplain have a high clay content which mean sediment is likely to remain suspended in the water column during both high and low flows, causing high levels of turbidity. The invasive noxious fish Carp (Cyprinus carpio) is present throughout most of the Barwon-Darling river system and it may exacerbate turbidity by its bioturbation of benthic sedimentation during feeding.
- *Electrical conductivity* — Electrical conductivity is generally lower at Wilcannia Weir than upstream areas of the Darling River (Baaka), however, increased conductivity can occur following first flush events, particularly if there are isolated pools where high levels of evaporation have caused concentration of salt.
- *Nutrients* — The highest concentrations of total nitrogen and total phosphorus in the Darling River (Baaka) are recorded at Wilcannia Weir (DPIE, 2019a). Given soils in the area contain low nutrient concentrations, keys sources are likely to be organic matter, animal waste, fertilisers and wastewater and industrial discharge. Concentrations at Wilcannia Weir are higher than upstream areas due to the cumulative impacts of increased nutrients upstream reaching this area.

- *Algal blooms* — Algal blooms are known to occur at times in the Darling River (Baaka), generally occurring when there is little flow, stratification in the water body, sufficient sunlight and nutrient availability.
- *Dissolved oxygen* — Periods of low (and high) dissolved oxygen occur at Wilcannia Weir particularly when flow is low. There are two main causes of oxygen depletion, being; consumption of organic matter by micro-organisms which depletes oxygen faster that it can be replenished and excessive plant growth due to eutrophication causing both high and low oxygen concentrations outside acceptable ranges. Water with low or zero dissolved oxygen often sits on the bottom of stagnant pools. The flushing of these pools can cause fish kills downstream.
- *pH* — pH concentrations are highest at Wilcannia Weir when compared to upstream in the Darling River (Baaka). High pH is attributed to eutrophic conditions caused by excessive pant growth.

10.5.1 Existing water quality

The *Water Quality Management Plan for the Barwon Darling Watercourse Water Resource Plan* (DPIE, 2019b) contains water quality targets for water dependent ecosystems that reflect those contained in the Basin Plan. There are different water quality target values for the various zones of the river system covered by the plan. The relevant target values for the proposal are those for the Darling valley lower and middle zones. Electrical conductivity targets are not identified for each water quality zone. Instead, 'end of valley' target are used. For the proposal, the relevant electrical conductivity target value is that for the Barwon-Darling valley.

Water quality monitoring of the Darling River (Baaka) at Wilcannia undertaken by WaterNSW over the past five years has been used to establish the range across which water quality is likely to currently vary . WaterNSW monitoring was undertaken at the existing weir, with the exception of November 2020 when a sample was also collected at the proposed new weir site. Median data from the past five years is presented in **Table 10-1** together with the percentage of the samples taken during this period that comply with the water quality target values. It should be noted that this is a conservative simplification of how the plan measures compliance with the water quality target values, which is based on annual medians.

The *Water Quality Management Plan for the Barwon Darling Watercourse Resource Plan* (DPIE, 2019b) also contains water quality targets for recreational water based on the *Guidelines for Managing Risks in Recreational Waters* (National Health and Medical Research Council, 2008). Cyanobacteria and algal targets are contained in the plan and are applicable to all the water quality zones covered by the plan. **Table 10-1** contains median cyanobacteria and algal data collected at Wilcannia over the last five years and shows the percentage of the samples taken during this period that comply with the recreational water target values.

Table 10-1 Existing water quality and compliance with WQO; Darling River at Wilcannia Weir (source: WaterNSW)

Indicator	Median (count)	% compliance	WQ target
Water dependent ecosystems			
Electrical conductivity (microSiemens per centimetre)	973 (29)	N/A	389 (median)
Total nitrogen (milligrams per litre)	1.25 (30)	13%	0.5
Total phosphorous (milligrams per litre)	0.1 (29)	17%	0.05
Turbidity (NTU)	39.2 (35)	69%	50
Dissolved oxygen (saturation, %)	94.2% (30)	53%	85-110%
pH	8.59 (35)	20%	6.5-8.0
Recreational water			
Cyanobacterial biovolume (cubic millimetres per litre)	0.4 (59)	80%	<10
Toxic cyanobacterial biovolume (cubic millimetres per litre)	0.035 (59)	76%	<4

Indicator	Median (count)	% compliance	WQ target
Potentially toxic cyanobacteria (cells per millilitre)	402 (49)	78%	<50,000

The Darling River (Baaka) at Wilcannia Weir generally has poor water quality with respect to the protection of aquatic ecosystems, due to the nominated targets frequently being exceeded. Median conductivity target of 389 microsiemens per centimetre (μS/cm) was not met at the existing weir, with median concentrations over the past five years more than double this. Nutrient concentrations are also elevated at the weir and rarely complied with the target concentrations. Turbidity and dissolved oxygen concentrations met the respective targets for more than 50 percent of the time of the past five year. Dissolved oxygen non-compliance was a result of both concentrations that were too high and too low. The low concentrations were generally observed in the warmer months when the water temperature is higher and streamflow is typically lower. High dissolved oxygen concentrations were observed both in winter and summer. During cooler weather, the cold water can hold more dissolved oxygen resulting in higher concentrations. During warmer weather, the higher concentrations are likely the result of photosynthesis from increased algal activity. pH levels were often too high to meet the nominated target upper limit of 8.5 for protection of aquatic ecosystems. The lower limit of 6.5 was always achieved.

The Basin targets for the recreational water quality objective is that that potentially toxic cyanobacteria counts and biovolume should be less than 50,000 cells per millilitre and less than four cubic millimetres per litre respectively. Additionally, total cyanobacterial biovolume should be less than 10 cubic millimetres per litre. Data collected in the weir pool over the past five years, indicates that whilst there are occasions of high algal numbers, the proportion of toxic cyanobacteria is small and mostly compliant with the *Guidelines for Managing Risks in Recreational Water* (National Health and Medical Research Council, 2008).

The quality of raw drinking water should meet the ADWG targets which provide both health and aesthetic guideline limits when treated. Raw water quality data collected by City Water Technology between July 2015 and May 2019 from the current draw off location in proximity of the existing Wilcannia Weir has been compared to the AWDG (2011) to identify if there are any key indicators that could be problematic for treatment of raw water (City Water Technology, 2020). Results are provided in **Table 10-2**.

Current monitoring and knowledge of the presence of pathogen issues such as bacteria and microorganisms in the Barwon Darling catchment is limited (DPIE, 2020e). It is expected that with ongoing inputs of human and animal waste and access of stock and animals to rivers and streams that pathogens would be present in waterways. Higher numbers of pathogens would be expected following rainfall and runoff flushing contaminants into the rivers. During dry weather/low flows, high counts may be present in areas of point source pollution (DPIE, 2020c). A single sample was collected at the existing weir (N1042) and the proposed new weir (N1333) in November 2020 by WaterNSW and analysed for faecal coliforms. Faecal coliform numbers were higher at the existing weir (700 cfu/100mL) compared to about two cfu/100mL at the proposed new weir. At the time of sampling, no rainfall had fallen in the previous seven days.

Median raw drinking water was generally below the ADWG limits with the exception of turbidity, colour and total manganese. High turbidity can be problematic with respect to suitability for drinking water as levels could impact on the efficiency of the disinfection process, particularly with removal of pathogens and can affect the aesthetics of the treated water. Colour, which is generally related to organic content if too high at the point of disinfection can result in higher concentrations of disinfection by-products. Manganese concentrations were below the recommended ADWG Health limit, median concentrations of 0.29 milligrams per litre exceeded the aesthetic guideline limit. Manganese at these concentrations can cause an undesirable taste to water and can stain plumbing fixtures and laundry.

Table 10-2 Summary statistics of surface water quality data (City Water Technology, 2020)

Indicator	Median (count)	ADWG limit	
		Health	Aesthetic
Temperature (^{o}C)	22.4 (44)	-	-
pH	7.6 (51)		6.5-8
Total alkalinity (mg/L)	89 (24)	<200	
Turbidity (NTU)	82.8 (50)	<1	<5
Colour (HU)	101(17)		<15
Total iron (%)	0.25 (41)		<0.3
Total manganese (mg/L)	0.29 (26)	<0.5	<0.1
Electrical conductivity (μS/cm)	513 (48)	-	-

10.5.2 Existing water quality monitoring

WaterNSW currently operates two water quality monitoring stations in the Darling River (Baaka) in the Wilcannia region:

- Gauging station 425008 (Wilcannia Main Channel) — This is WaterNSW's primary water quality monitoring site at Wilcannia. It currently provides continuous measurement of water flows, water levels, electrical conductivity and water temperature. Once the new weir commences operation, this gauging station would be within the new town pool and, therefore, would no longer be used to measure flows. It would continue to measure water level, electrical conductivity and water temperature. Water sampling are collected at the gauging station monthly and analysed at a laboratory for a comprehensive range of parameters including several algal and cyanobacteria parameters, faecal coliforms, alkalinity, conductivity, dissolved oxygen, pH, suspended solids, temperature, total hardness, turbidity, and other analytes. More frequent water sampling occurs on request, typically when there are concerns about algal levels
- Gauging station 425058 (Moorabin) — This gauging station was commissioned by WaterNSW in February 2020 to become its new Wilcannia water quality monitoring site once the new weir starts operation. The gauging station is located downstream of the new weir. It is proposed that water quality monitoring at this site will be for the full range of parameters monitored by WaterNSW elsewhere on the Darling River (Baaka), although it is currently only being used to measure logged parameters i.e. continuous measurement of water flow, water level, electrical conductivity, dissolved oxygen and water temperature.

10.6 Assessment of impacts

10.6.1 Construction

Construction of the proposal presents a risk to degradation of downstream surface water quality if management measures are not implemented, monitored and maintained throughout the construction phase. The main construction activities (and sub-activities) with the potential to cause surface water quality impacts includes but is not limited to:

- Access tracks – upgrade of the existing tracks and provision of new access tracks. It involves movement and use of vehicles across exposed earth, excavation, vegetation clearing and mulching and transport of materials to and from site
- Compounds – construction compounds and lay down areas would be established on both sides of the river. Potential activities occurring at compounds include movement and use of vehicles, stockpiling, vegetation clearing and mulching, concrete batching plants, establishment of water quality controls such as water quality ponds

- Weir construction – involving instream works, including building temporary cofferdams, piling, cutting and later reinstating the riverbanks, concreting as well as vegetation clearing in streambed and banks
- Testing and commissioning of the new weir – following construction of the new weir, there would be a commissioning phase during which there would be testing of the performance of the weir gates, fishway gates, and the systems for remotely controlling the operation of the weir
- Decommissioning of the existing weir – demolition of the existing weir would occur once the new weir is operational. It would be undertaken during low flow and involve establishment of an access road, temporary construction compound, installation of water quality controls such as silt curtains, excavation and stockpiling
- Site restoration – rehabilitation and landscaping of disturbed areas (including construction compounds and access tracks including southern access to the riverbed, etc) to pre-construction conditions where required. Rehabilitation of the riverbank at the existing weir site would include reshaping and stabilisation of the riverbank so that it is commensurate with upstream and downstream reaches.

Potential impacts to water quality associated with the construction activities of the abovementioned proposal elements are discussed below. The Darling River (Baaka) is the only waterway at risk.

Erosion and sedimentation

There is a risk of erosion and sedimentation from various activities associated with construction including: establishment of access tracks and movement of heavy vehicles across exposed earth; stockpiling; vegetation clearing, excavation, dewatering, instream works such as streambed levelling and piling and landscaping/site restoration. Prior to any activity that could potentially result in erosion and sedimentation, appropriate erosion and sediment controls will be implemented to ensure minimal entrainment of sediment or pollutants into the Darling River.

Erosion and sedimentation can result in increased turbidity and poor water clarity, impacting on visual amenity and potentially lead to smothering of benthic organisms and reduced visibility for fish. Sediments may contain high concentrations of nutrients which can lead to algal blooms and subsequently result in reduced light penetration therefore limiting growth of aquatic vegetation. Algal blooms may also result in a reduction of dissolved oxygen in the waterway, which, if reduced to very low levels, aquatic organism could not survive. In addition to nutrients, mobilised sediments maybe contain elevated concentration of metals and other contaminants which can negatively impact on aquatic life.

While the water quality of the Darling River (Baaka) has the potential to be temporarily reduced as a result of sediment-laden runoff and pollutants from erosion and sedimentation, it is unlikely to cause major or long term impacts to the overall condition of the river as erosion and sedimentation will be managed with implementation of silt curtains and water management ponds. Furthermore, additional environmental management measures outlined in **Section 10.7** will be implemented to avoid and/or manage erosion and sedimentation impacts from construction activities.

Release of tannin leachate

While vegetation removal has been minimised where possible by using existing tracks and avoiding trees and other substantial groupings of vegetation, removal of some vegetation would be required during site preparation at the new weir. Cleared vegetation would be mulched and could result in the release of tannin leachate which can cause dark coloured water to be discharged into downstream waterways altering the instream pH and reducing visibility and light penetration. Tannins can also increase the biochemical oxygen demand in the waterway which can decrease instream dissolved oxygen concentrations which can impact on aquatic ecosystems.

Procedures would be established for the disposal, stockpiling and reuse of cleared vegetation to ensure that this occurs away from areas where runoff could cause tannin leachate into receiving waterways, as outlined in the environmental management and mitigation measures in **Section 10.7**. Therefore, the risk of release of tannin leachate to the Darling River (Baaka) is very low and unlikely to result in a significant impact to surface water quality.

Dewatering

Dewatering of the area within the cofferdam would be required to provide a dry worksite. Dewatering discharge could result in discharge of saline water (due to groundwater intrusion at low flow) or highly turbid water which could impact on visual amenity and aquatic ecosystems. Piling could also result in saline displaced groundwater which would need to be disposed of. To minimise the impact of this, dewatering discharge would be directed into temporary construction sediment basins where available for treatment prior to release. Treatment of the water prior to discharge, together with measures outlined in **Section 10.7** would not result in any significant impact to water quality of the Darling River (Baaka), particularly as these activities would only occur during construction.

Disturbance of saline soils

Saline soils are known to occur within the construction footprint. Saline soils may become exposed, erode or leach high concentrations of salt into runoff and subsequently to the Darling River (Baaka), altering the salinity of the water which can alter instream biodiversity and ecosystem function. Saline soils would be disturbed as a result of earthworks and piling. The risk of this occurring, however, is considered low as water quality controls and management measures will be implemented to ensure that there is minimal runoff from exposed areas and stockpiles, as outlined in **Section 10.7**.

Release of oils and fuels

The release of oils and fuels into the Darling River (Baaka) could occur accidently during construction as a result of vehicle movements, or spills and leaks from construction plant and equipment or during refuelling. This can result in the release of hydrocarbons and heavy metals into the Darling River which could be harmful to aquatic life and could affect river users. Environmental mitigation and management measure SW05 will be implemented to minimise the potential for and impact of spills and leaks (refer to **Section 10.7**),

Release of concrete waste

A mobile concrete and grout batching plant would be required during the construction of the new weir which could mobilise cement dust, concrete slurries and washout water to the downstream Darling River (Baaka). This could increase the pH of the water which could be harmful to aquatic life. Water from the curing of concrete may be high in chromium which can accumulate in the gills of fish affecting the health of aquatic organisms. The Darling River (Baaka) at the new weir is the main area at risk, however the risk of transportation of concrete waste downstream is considered low as the work area will be dry and water quality controls and management measures will be implemented to avoid the release of contaminated water (refer to **Section 10.7**).

Dust and litter

Dust and litter could be generated from a variety of sources during the construction of the proposal including materials transport, stockpiling, concrete works, demolition of existing weir, rock crushing and use of construction sites impacting on the water quality of the Darling River (Baaka). Dust generated from concrete works and rock crushing may contain heavy metals that could be harmful to aquatic life. Mobilisation of litter to the Darling River (Baaka) could introduce gross pollutants, heavy metals and hydrocarbons into the waterway which could be harmful to aquatic life and reduce the visual amenity.

Environmental mitigation and management measures will be implemented to minimise dust and litter during construction of the proposal (refer to **Section 10.7**).

10.6.2 Operation

The potential operational surface water quality impacts of the proposal are associated with:

- Initial filling of the weir pool
- Hydrological changes
- Normal weir pool operations
- Recreation
- Downstream erosion
- Weir/fishway maintenance.

Initial filling of the weir pool/Inundation of previously exposed land

The operation of the new weir would result in the formation of the about 4.92-river kilometre-long new town pool between the new and existing weirs, and, when the weir is in drought security operation mode, also inundate about 18.81 kilometres of the river that is upstream of the existing weir pool to a depth of up to one metre. This has the potential to trigger blackwater events, increase salinity and mobilise nutrients.

Blackwater events occur when large amounts of plant matter partially broken down by bacteria are inundated and the decaying matter is transported into the river resulting in the leaching of high loads of dissolved organic nutrients from the floodplain to the river channel, decreasing water quality. This can result in low levels of dissolved oxygen, which when combined with the toxic components of some organic matter can result in death of aquatic organisms. Chemicals released from organic material can also make water bodies more alkaline or acidic, potentially disrupting normal pH balances and resulting in toxic effects on some aquatic organisms (ANZG, 2018). Additionally, water may require additional treatment prior to being used for drinking water purposes (MDBA, 2020b). Despite the short term negative affect, there are benefits to blackwater events including supply of additional carbon and nutrients to drive overall production in river and wetlands which boosts food supplies and supports breeding cycles (ANZG, 2018).

Increases in the salinity of the Darling River (Baaka) has the potential to occur as a result of inundation due to mobilisation of surface salts, however the impact on this would be dependent on groundwater water salinity and rate of drawdown. Increased mobilisation of nutrients may also occur with inundation which could be assimilated by phytoplankton and result in increased algal blooms.

Therefore it is expected that some reduction in water quality would occur during the first filling periods, particularly with respect to nutrients (total nitrogen and total phosphorous) and subsequently turbidity and dissolved oxygen. This could present an issue at the water treatment plant when drawing water for drinking water purposes, however it is likely that this would be no different to a significant rainfall event in the catchment.

Recreation

The proposed new weir is located two kilometres downstream of the Wilcannia township and this increases the risk of faecal contamination of the weir pool due to pathogens from sewage system overflows/leaks and pathogens from on-site sewage management system discharges/failures contaminating source water (Public Works Advisory, 2020).

Works to reduce or eliminate the risk of sewer overflows entering the stormwater and river are proposed and include stormwater mitigation works by Water Infrastructure NSW to protect raw water quality and a proposed upgrade to the towns sewerage scheme by Central Darling Shire Council (refer to **Section 22.5.1**). These proposed works would greatly reduce the risk of pathogens from sewer overflows, leaks and outages. As such the key risks to the water quality of the new weir with respect to recreational suitability is the same as the existing weir; agricultural land use inputs, but will also be influenced by stormwater and other sources from the Wilcannia township.

Mobilisation of sediment deposited behind the existing weir wall

Sedimentation occurs upstream of weirs because they reduce the velocity of flowing water, which causes sediment in the flow to settle and deposit on the riverbed. The proposed partial removal of the existing would remove the physical barrier that currently prevents sediment deposited on the riverbed from moving downstream. Following the partial removal of the existing weir it is likely that some of the sediment deposited behind the existing weir would remobilise and be transported downstream. This would be most likely to occur during high flow events.

The mobilisation of sediment from behind the existing weir would create a risk of poor water quality, particularly within the new town pool located immediately downstream of the existing weir. Remobilised sediment could also be transported downstream of the new weir, although this risk is diminished by the physical barrier created by the new weir.

There is potential for remobilised sediment from behind the existing weir to contain contaminants, however, this risk is considered to be small.

Normal weir pool operations

The commencement of operation of the new weir would result in a weir pool which under different climatic and hydrological conditions can impact on surface water quality by way of stratification, variable dissolved oxygen, increased nutrients and sediment and algal blooms.

As a result of hydrological changes, chemical and thermal differences may be observed at the weir. Thermal stratification occurs when the surface water heats up more rapidly than the deeper water during the day. The surface water becomes less dense and can result in minimal to no mixing with the deeper water, which over time can result in stratification. In addition to clear temperature differences between the surface and deeper water, stratified water bodes also tend to result in different dissolved oxygen levels, where the surface water is continually replenished with oxygen from the atmosphere, but due to lack of mixing and consumption of oxygen from respiring microorganisms the bottom waters become depleted of oxygen (anoxic).

As weir pools are deeper than free flowing sections of the river but have the same volume of water, just at a slower velocity, they are conducive to stratification. However, given weir pools are usually not deep, destratification can occur with climatic changes (Baldwin, 2019). Additionally, due to the low flow velocity, weir pools tend to be deposition zones where the bottom sediments accumulate carbon. This results in a higher sediment oxygen demand in the weir pool compared to free-flowing sections of the river which can contribute to anoxic waters.

Weir pools are also susceptible to algal blooms. The likelihood of algal blooms is dependent on a number of factors including nutrient concentrations, flow/weir height and thermal stratification and therefore more likely to occur during summer/warmer months. Algal blooms can impact on the uses of the weir pool, including its suitability for recreation and visual amenity as algae can cause skin and eye irritations and blooms can result in discolouration and unsightly scums. It can cause taste and odour issues for the drinking water supply and reduce the effectiveness of the treatment process. Just as algal blooms when present impact on water quality, as the blooms subside, the dead and decaying algae can significantly reduce the oxygen levels in the water, causing stress and sometimes death of aquatic animals.

In summary the risks to surface water quality from the operation of the new weir may include:

- Thermal stratification
- Variable dissolved oxygen levels through the water column at the weir itself, that are likely to be lower than the free flowing parts of the Darling River (Baaka)
- Elevated turbidity at the weir itself and a portion of the weir pool immediately upstream of the wall due to sediment build from upstream sources and land use practice

- Elevated nutrient concentrations, particularly following initial fill and rainfall
- Increased occurrence of blue-green algal blooms at the weir itself due to low flow, elevated nutrients and stratification.

Dissolved oxygen, temperature and electrical conductivity would be measured at an existing gauging station at Rock Bar located between the new weir and the existing weir. This would assist in identifying whether passing translucency flows when the new weir is in drought security operation mode prevents or minimises thermal stratification and deterioration in water quality.

Downstream erosion

There is potential for localised erosion immediately downstream of the new weir which could contribute sediment loading to the Darling River (Baaka) which could deteriorate water quality. Scour protection by way of rockfill would be provided minimising the risk of erosion and increased sediment loads.

10.7 Mitigation and management measures

Mitigation and management measures for surface water quality impacts are provided in **Table 10-3.**

Table 10-3 Mitigation and management measures for surface water quality impacts

Ref	Impacts	Mitigation and management measures	Timing
SW1	General	A construction soil and water management plan will be prepared as a sub-plan of the construction environmental management plan and will outline measures to manage soil and water impacts associated with the construction works. The construction soil and water management plan will include but not be limited to: ▪ Measures to minimise/manage erosion and sediment transport within the construction footprint and offsite including requirements for the preparation of erosion and sediment control plans for all progressive stages of construction ▪ Measures to manage stockpiles including locations, sediment controls and stabilisation ▪ Measures to manage accidental spills including the requirement to maintain materials such as spill kits ▪ Measures to manage potential tannin leachate ▪ Concrete waste management procedures ▪ A surface water quality monitoring program to monitor the performance of management measures.	Pre-construction

Ref	Impacts	Mitigation and management measures	Timing
SW2	Erosion and sedimentation	Erosion and sediment control measures will be implemented at all works sites in accordance with the principles and requirements in *Managing Urban Stormwater – Soils and Construction Volume 1* (Landcom 2004) and Volume 2D (NSW Department of Environment, Climate Change and Water 2008), commonly referred to as the “Blue Book”. Additionally, any water collected from work sites will be treated before being discharged to avoid contaminants from entering the Darling River (Baaka). Erosion and sediment control measures will be identified in the construction soil and water management plan and will likely consist of cofferdams, diversion drains, sediment fencing, coir logs, catch drains, perimeter bunds, silt curtains and sediment basins. Progressive site-specific erosion and sediment control plans will be prepared for work sites. These plans will include: ▪ Detailed consideration of staging and management in accordance with the Blue Book ▪ Identification of site conditions for construction activities that could potentially result in erosion and associated sediment runoff ▪ Identification of stockpile and storage locations and provide erosion and sediment controls around these ▪ Methods to minimise potential adverse impacts of construction activities on the water quality within surrounding waterways and floodplains ▪ Proposed types and locations of control measures such as sediment fencing, silt curtains and covering stockpiles ▪ Progressive stabilisation and revegetation of exposed areas following disturbance as soon as is practicable. A suitably qualified erosion and sediment control specialist will be engaged where deemed appropriate to provide advice regarding erosion and sediment control including review of erosion and sediment control plans.	Pre-construction Construction
SW3	Working in watercourses	The construction surface water management plan will include details of the design, construction method and sequencing and management of cofferdams used to control flows past dry in-stream work sites. The plan will detail: ▪ How flows past in-stream work sites will be maintained at all times ▪ The flow rates at which inundation of work sites would occur ▪ How flow rates will be monitored ▪ Procedures to secure in-stream work sites and prevent water pollution when high flows occur.	Pre-construction Construction

Ref	Impacts	Mitigation and management measures	Timing
SW4	Dewatering	Any water collected from work sites will be treated before being discharged to avoid contaminants from entering the Darling River (Baaka). A dewatering management plan will be prepared as part of the construction soil and water management plan and it will outline: ▪ The method for dewatering the cofferdams as well as discharges from sediment basins/water quality ponds ▪ Opportunities for using captured water on site, such as for dust suppression ▪ The method for monitoring discharge from temporary construction sediment basins and actions required for treatment or disposal if water quality does not meet Darling River (Baaka) water quality targets ▪ Supervision requirements ▪ Staff responsibilities and training ▪ Discharge to surface water will be carried out in accordance with the POEO Act or the requirements of any environment protection licence issued under the POEO Act for the proposal.	Pre-construction Construction
SW5	Spills and leakages	The construction surface water management plan will outline site-specific control measures and required procedures to ensure containment of accidental spills and reduce the risk of the release of potentially harmful chemicals from spills entering the Darling River (Baaka). This will include: ▪ All fuels, chemicals and liquids will be stored on level ground at least 50 metres away from waterways (including existing stormwater drainage system, if present) and will be stored in a sealed bunded area within ancillary facilities ▪ An emergency spill kit will be provided at all ancillary facilities and construction work areas at all times. An emergency spill response procedure will be prepared to minimise the impact of accidental spillages of fuels, chemicals and fluids during construction. Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out when working near the Darling River (Baaka).	Pre-construction Construction

Ref	Impacts	Mitigation and management measures	Timing
SW6	Impact of stockpiles	Stockpiles will be managed to minimise the potential for mobilisation and transport of dust, sediment and leachate in runoff. This will include: ▪ Minimising the number of stockpiles, area used for stockpiles and time that they are left exposed ▪ Locating stockpiles away from drainage lines, waterways and area where they may be susceptible to wind erosion ▪ Stabilising stockpiles, establishing appropriate sediment controls and suppressing dust as required.	Construction
SW7	Water quality	The location and details of all water quality controls (including but not limited to temporary sediment basins) will be further considered during the detailed design phase. Diversion drains and erosion and sediment control measures will include but not limited to: ▪ Temporary drainage to construction sediment basins ▪ Inclusion of silt curtains around the work site. Control measures will be in place prior to commencement of any work.	Detailed design Construction
SW8	Concrete work	To avoid ingress of concrete waste material into the Darling River (Baaka), the construction environmental management plan will outline procedures to capture, contain and appropriately dispose of any concrete waste. These procedures and the level of management required will be informed by concrete analysis which will be carried out before construction.	Detailed design Construction
SW9	Construction discharges	Prior to releasing construction water collected in sediment basins, water should be repurposed on site wherever possible. For instance, for dust suppression activities. Water that cannot be repurposed on site should be treated if necessary, prior to discharge. Water quality monitoring should occur to confirm the suitability for any proposed reuse of water on site or prior to it being discharged downstream.	Detailed design Construction

Ref	Impacts	Mitigation and management measures	Timing
SW10	Water quality monitoring – construction	A construction surface water monitoring program will be developed in accordance with the ANZG (2018) and included in the construction surface water management plan to establish baseline conditions, to observe any changes in surface water quality that may be attributable to construction of the proposal and inform appropriate management responses. Monitoring during pre-construction and construction will occur at various locations along the Darling River (Baaka). Monitoring sites will be located upstream and downstream of the key construction activities and will include sampling for key indicators of concern. The surface water quality monitoring program will be developed in consultation with WaterNSW and will aim to integrate with WaterNSW's existing water quality monitoring program at gauging stations 425008 (Wilcannia Main Channel) and 425058 (Moorabin). 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.	Pre-construction Construction
SW11	Water quality monitoring – commissioning	Operational surface water monitoring will occur following completion of construction until work sites have been rehabilitated to an acceptable condition and water quality issues associated with initial inundation of the new town pool have subsided.	Commissioning

11. Flooding

The potential flooding impacts of the proposal are assessed in **Technical Report 1** and summarised in this section.

SEAR no. 3 includes requirements for the assessment of the proposal's potential flooding impacts. The requirements of SEAR no. 3 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

11.1 Legislative and policy context

11.1.1 Water Management Act 2000 and Water Act 1912

Historically, the management of rural floodplains relied upon the preparation of localised floodplain management plans under Part 8 of the *Water Act 1912*. Localised floodplain management plans prepared under Part 8 of the *Water Act 1912* are superseded upon the commencement of a floodplain management plan under the *Water Management Act 2000*. No floodplain management plan was prepared for the Darling River (Baaka) at Wilcannia under Part 8 of the *Water Act 1912*.

Floodplain management plans are prepared in accordance with section 50 of the *Water Management Act 2000*. Floodplain management plans provide the framework for coordinating the development of flood works on a whole-of-valley basis. As part of the transition of water management from the requirements of the *Water Act 1912* to the requirements of the *Water Management Act 2000*, floodplain management plans have been prepared for five valleys in northern NSW: the Gwydir, Namoi (Upper and Lower), Barwon-Darling, Macquarie and Border Rivers valleys.

A floodplain management plan has not been prepared for the Darling River (Baaka) at Wilcannia. However, the floodplain management plant prepared for the Barwon-Darling Valley contains information that is useful to understanding the nature of flooding in the Barwon-Darling Valley and is therefore discussed below.

11.1.2 Floodplain Management Plan for the Barwon-Darling Valley Floodplain 2017

The *Floodplain Management Plan for the Barwon-Darling Valley Floodplain 2017* was prepared in accordance with section 50 of the *Water Management Act 2000*. The upstream limit of the floodplain is at Mungindi on the Barwon River, at the NSW-Queensland border and the downstream limit is about 20 kilometres downstream of Louth on the Darling River (Baaka). Wilcannia is about 220 kilometres downstream of Louth and the plan is therefore not directly applicable to the proposal.

An objective of the plan is to facilitate the orderly passage of floodwaters through the Barwon-Darling Valley Floodplain. The plan contains several strategies to achieve its objectives including establishing management zones for coordinating flood work development, identifying the existing and natural flooding regimes in the area, and delineating a floodway network that has adequate hydraulic capacity and continuity to effectively convey floodwaters.

11.1.3 Floodplain Development Manual

The *Floodplain Development Manual: The Management of Flood Liable Land* (Department of Planning, Infrastructure and Natural Resources, 2005) incorporates the NSW Government's Flood Prone Land Policy, the primary objectives of which are to reduce the impact of flooding and flood liability on owners and occupiers of flood prone property and to reduce public and private losses resulting from floods, whilst also recognising the benefits of use, occupation and development of flood prone land.

The *Floodplain Development Manual* forms the NSW Government's primary technical guidance for the development of sustainable strategies to support human occupation and use of the floodplain, and promotes strategic consideration of key issues including safety to people, management of potential damage to property and infrastructure and management of cumulative impacts of development. Importantly, the manual promotes the concept that proposed developments be treated on their merit rather than through the imposition of rigid and prescriptive criteria.

Flood and floodplain risk management studies carried out by local councils as part of the NSW Government's Floodplain Management Program are carried out in accordance with the merits based approach promoted by the *Floodplain Development Manual*. A similar merits based approach has been adopted in the assessment of the impacts that the project would have on existing flood behaviour and also in the development of a range of potential measures which would be aimed at mitigating its impact on the existing environment. In accordance with the manual, the hydraulic and hazard categorisation of the floodplain was also considered when assessing the impact of the project on existing flood behaviour, as well as the impact of flooding to the project and its users.

11.1.4 Considering flooding in land use planning

In July 2021 the NSW Government issued Planning Circular PS 21-006 *Considering flooding in land use planning: guidance and statutory requirements* which provided advice on a package of changes regarding how land use planning considers flooding and flood-related constraints including an overview of its new guideline *Considering Flooding in Land Use Planning (2021)*.

The guideline supports the principles of the *Floodplain Development Manual* and provides advice to councils on land use planning on flood-prone land. It provides councils with greater flexibility in defining the areas to which flood-related development controls apply, with consideration of defined flood events, freeboards, low-probability/high consequence flooding and emergency management considerations.

The manual states that a defined flood event of one per cent annual exceedance probability (1% AEP), or a historic flood of similar scale, plus a freeboard should generally be used as the minimum level for setting residential flood planning levels. Choosing different defined flood events and freeboards requires justification based on a merit assessment that is consistent with the floodplain risk management process and principles of the *Floodplain Development Manual*.

Special flood considerations apply to sensitive and hazardous development in areas between the flood planning area and the probable maximum flood and to land that may cause a particular risk to life and other safety considerations that require additional controls. These controls relate to the management of risk to life and the risk of hazardous industry/hazardous storage establishments to the community and the environment in the event of a flood.

11.2 Assessment methodology

A desktop upstream flooding impact assessment of the proposal has been carried out. The overarching methodology for assessing the potential flooding impacts of the proposal is to compare any potential flooding impacts of the proposal to the existing situation i.e. the continued operation of the existing weir.

Key inputs to this assessment have been provided by Public Works Advisory and include:

- Weir pool extent mapping
- Drown-out assessment
- An afflux assessment.

The main steps in the assessment methodology were to:

- Review the weir pool extent mapping prepared by Public Works Advisory to confirm that the weir pool would be contained within the river channel and that related upstream changes in inundation extents are minimal

- Review the findings of the hydraulic analysis undertaken to estimate the indicative weir drown-out flow and assess the underlying potential for upstream impacts at higher flows. Review was also undertaken of the estimated Darling River (Baaka) flow at which the increase in upstream water level (afflux) that may be caused by the new weir would diminish to less than 50 millimetres, which was aimed at assessing the underlying potential for upstream flood impacts by confirming whether afflux would reduce to an assumed minimal amount at an in-channel flow level below the top of the low (left) riverbank.

11.3 Risk

The purpose of a weir is to create an increase in upstream river levels to enable flow diversion or, in the case of Wilcannia, to provide an instream raw water supply storage source for extractive use. Weirs have the potential to cause hydrologic and hydraulic impacts both upstream and downstream. Flooding related impacts are typically associated with potential changes in conditions upstream of the weir. Potential upstream impacts include:

- Changes in the extent and depth of upstream inundation
- Changes in upstream flood levels and flood frequency
- Changes in the frequency and duration of upstream inundation
- Changes in flood flow distributions
- Increased riverbank overtopping and breakouts
- Reductions in the stability of the riverbanks and bed due to operation of the weir, particularly I this results in upstream weir pool/river levels that fall at faster rates than historical conditions
- Inundation of private property and property access roads
- Reduction in upstream flow velocities due to increased depths with potential impacts on flowing water habitats
- Potential issues for extraction pumping infrastructure, particularly if sited between riverbanks
- Potential issues related to performance of stormwater drainage and floodplain levee systems.

The potential upstream flooding impacts of the proposal have been considered as have the relative vulnerability of the community living within the weir pool floodplain area.

11.4 Avoidance and minimisation of impacts

The key factor influencing the potential for a weir to cause upstream flooding is the weir height and the area of the river channel cross-section that is obstructed. The higher the crest level of a weir, the more likely it is to cause the potential impacts identified in **Section 11.3**.

Public Works Advisory, on behalf of Water Infrastructure NSW, has investigated different crest levels for the proposed new weir. These investigations are documented in the business case and business case addendum. The investigations considered the relationships between weir crest height and the water supply secure yield provided by the additional weir pool storage capacity and the likelihood of upstream and/or downstream impacts. Of the three heights considered (existing, +0.5 metres and +1.0 metres), only the one-metre raising provided an adequate secure yield hence was the only viable weir height investigated.

11.5 Existing environment

11.5.1 Natural flooding regime

The *Floodplain Management Plan for the Barwon-Darling Valley Floodplain 2017* includes a description of the natural flooding regime in the Barwon-Darling Valley and is relevant to flooding at Wilcannia. Natural flooding in the Barwon-Darling River (Baaka) originates from a number of contributory rivers/streams from Queensland and NSW catchments. The main contributing catchment systems to flooding in the Barwon-Darling included:

- Southern and central Queensland via the Culgoa, Birrie, Bokhara and Warrego Rivers
- Macintyre and Dumaresq Rivers along the border between Queensland and NSW
- North-western and central river valleys of NSW including the Gwydir, Namoi, Castlereagh, Macquarie and Bogan Rivers
- A combination of any or all of the above sources.

In its natural state, the Barwon-Darling River (Baaka) was characterised by highly variable and unpredictable patterns of high and low flows. Floods most frequently occurred during summer and winter months.

Since official records began, there have been a number of major flood events recorded in the Barwon-Darling Valley prior to the construction of major regulating structures on contributing systems that commenced in the 1960s. Between 1864 and 1960 six major flood events have been recorded at Bourke that occurred in 1864, 1890, 1921, 1950, 1955 and 1956. The largest flood recorded at Bourke occurred in 1864 with river gauge heights recorded at 14.52 metres and Annual Exceedance Probability (AEP) of 0.54% (or 1 in 185 AEP). The second highest flood recorded at Bourke occurred in 1890 with river height recorded at 14.40 metres and with AEP of 0.7% (or 1 in 143 AEP).

Natural flooding in the Barwon-Darling Valley was generally characterised by higher flows with more defined seasonal flood peaks. Flooding could last for weeks to months but in some instances was shorter in duration than floods post-1960s. The natural flood extent was more widespread in many parts of the Barwon-Darling Valley Floodplain, due to greater flood volumes, low channel gradients and absence of water regulating structures and other structures that influenced flood behaviour (e.g. railway lines).

11.5.2 Existing flooding regime

The *Floodplain Management Plan for the Barwon-Darling Valley Floodplain 2017* also includes a description of the existing flooding regime in the Barwon-Darling Valley and is relevant to flooding at Wilcannia. The plan notes that although the Barwon-Darling River (Baaka) is largely unregulated, the existing flooding regime is characterised by changes since the construction of headwater storages that commenced in the 1960s on tributaries in both NSW and Queensland. This coincided with river regulation (mainly the construction of weirs and regulators that allow water to be managed for irrigation delivery), land use and vegetation changes, and floodwork development. These changes have affected the nature, frequency, extent and duration of flooding in the Barwon-Darling Valley Floodplain by:

- Altering the seasonal low flow regime
- Reducing the frequency and extent of minor and moderate floods
- Reducing water quality.

The plan describes low flow conditions as generally dominating the Barwon-Darling Valley with major periodic floods interrupting these dry periods. Flood duration can range from a few hours to months. Changes to the duration of flooding compared to the natural flooding regime include both reductions and increases in the duration of flooding.

11.6 Assessment of impacts

11.6.1 Weir pool extents

Mapping of the new weir pool extents in normal operation mode at the normal full supply level is provided in **Appendix B** and it shows that:

- The weir pool inundation extents are well confined within the banks of the main river channel with no breakouts and insignificant extents of water backing up into tributaries and/or drainage watercourses
- Upstream of the existing weir the inundation extents are essentially the same as those for the existing weir, assuming the existing crest breach on the right abutment is remediated (refer to **Section 2.1.2** and **Photo** 2-1)
- The greatest change in river conditions would occur within the new town pool. Conditions along this about 4.92 river kilometre section of the river would change from existing natural flowing (lotic) conditions o weir pool (lentic) for most of the time with consequent effects including permanent inundation of the riverbed and riverbanks up to 65.71 metres AHD, reduced river flow velocities and increased water depths. These impacted conditions within the new town pool would generally continue for flows up until afflux becomes negligible (assumed to be less than 50 millimetres) at a flow above weir drown-out
- The upstream extent of the weir pool would remain the same at about 61.79 river kilometres upstream of the existing weir, or about 66.71 river kilometres upstream of the proposed new weir.

Mapping of the weir pool extent when the new weir is at the drought full supply level of 66.71 metres AHD is also provided in **Appendix B** and it shows that:

- There would be no substantial increases in lateral weir pool extents and no weir pool breakout of the main river channel. This indicates that there is no topographical impediment to the proposed one metre increase in the design full supply level when the weir is in the drought security operation mode
- Increases in the lateral extent of the weir pool are greatest where the riverbanks are flatter and where there are in-channel riverbank and bed features, such as bank benches above 65.71 metres AHD (and below 66.71 metres AHD)
- There would only be minor intrusion of the weir pool into tributaries and/or drainage watercourses. The greatest intrusion would occur into Kallyanka Creek, where the weir pool would backup about 100 metres. The weir pool would also backup into Paroo River by about 100 metres. Elsewhere, the weir pool would backup tributaries and/or drainage watercourses by less than 30 metres, and typically less than 10 to 15metres
- Based on the mapping there would be no out-of-channel impacts to private property.

11.6.2 Weir drown-out and afflux

General

To assess the potential impact of the new weir, the extent of any upstream water level increase caused by the new weir is compared to what the upstream water level would be if a new weir were not to be built and the existing weir were to remain in place. Consideration is also given to what the water level would be in the river if there were no weir for the purpose of understanding the relationship between weirs and upstream river water levels.

The water levels upstream of the proposed new weir would depend on the design of the weir structure, the operating mode, the position of the weir and fishway gates, operational settings and the river flow conditions:

- *Low flow* — When there are near cease-to-flow river conditions (i.e. less than one megalitre per day, as per **Table 7-1**) the new weir is likely to be in drought security operation mode and upstream water levels in the new town pool and existing weir pool would be up to one metre above the current full supply level. There would also be up to about 18.81 river kilometres of additional weir pool upstream of the existing weir pool.

If cease-to-flow conditions persist, the water level in the weir pool (and also the upstream extent of the weir pool) would reduce due to water extraction for town water use, evaporation and infiltration

- *High flow* — When flows return to the river, the reset phase would be triggered and the new weir would transition from drought security operation mode to normal operation mode and the full supply level would return to being the same as the existing weir pool. As river flows increase, the water level upstream of the new weir would increase if inflows to the weir pool exceed the design capacity of the fishway at the weir, which is 1,000 megalitres per day. Once inflows to the weir pool exceed 1,000 megalitres per day, water would start to flow over the top of the weir crest. If flows continue to increase, the difference between existing upstream river levels compared to those for the new weir would diminish as the weir becomes first submerged and then drowned-out
- *Weir drown-out* — Weir drown-out occurs when river flow is sufficiently high to cause the weir structure to cease being the main hydraulic influence on upstream river water levels. This occurs when passing flow produces a high water level immediately downstream of the weir that results in the weir structure becoming completely submerged and the difference in water levels from downstream to upstream becoming typically 0.15 metres or less

The difference between existing and proposed upstream river levels at a particular location is referred to as the afflux. A typical design requirement is to ensure that the afflux has diminished to an amount deemed to be insignificant at some point, such as before significant upstream infrastructure, property access or environmentally sensitive areas are affected, and particularly before riverbank overtopping and breakout occur.

The likelihood of potentially significant upstream impacts increases with waterway area obstruction and weir height. The proposed new weir would obstruct the natural river waterway area relative to a top of the low (left) bank level of 72.11 metres AHD by 25 per cent at the normal full supply level 65.71 metres AHD, and by 35 per cent at the drought full supply level (66.71mAHD), this shows the incremental obstruction to existing river channel of 10 per cent. It is important to note that the proposed new weir with fully opened weir gates and a high flow fishway would have a lesser flow obstruction than the initially assessed wholly fixed crest weir. Accordingly, the weir drown-out and afflux assessments described below are expected to be conservative.

Weir drown-out

A weir drown-out assessment is provided in Section 9.4.2 of **Technical Report 1** and it shows that weir drown-out would occur when flows in the river exceed about 12,070 megalitres per day, which has a time duration exceedance frequency of 17 per cent, or about 1 in 6 years. The depth of water above the weir crest when drown-out occurs would be about 0.95 metres, which is about four metres below the height of the low (left) bank at the new weir site. The substantial difference between the level of the river at which weir drown-out would occur and the top of the low (left) riverbank at the new weir site indicates that the proposal is unlikely to produce any apparent upstream flooding impacts out of the main river channel. Additionally, the afflux values at weir drown-out would diminish moving away from the weir site in the upstream direction due to backwater effects.

At the weir drown-out flow, upstream water levels would be about 0.16 to 0.20 metres higher than existing depending on the height of the proposed weir. These afflux values would diminish due to backwater effects moving away from the new weir site in the upstream direction. Furthermore, for larger flood events such as the 1% AEP and the probable maximum flood the new weir would not produce any incremental impact in terms of affluxes compared to the existing weir.

Changes to upstream flood water levels (afflux)

An afflux assessment is provided in Section 9.4.2 of **Technical Report 1**. The assessment calculated the flow rate at which afflux would reduce to 50 millimetres, which is a level at which the potential for the new weir to cause upstream impacts is considered insignificant.

The assessment found that afflux would reduce to 50 millimetre at a flow rate of 16,200 megalitres per day past the weir obstruction. This flow rate corresponds to a headwater level of 68.96 metres AHD, which is 2.31 metres above the assessed one-metre raised fixed crest level of 66.65 metres AHD that was assessed. This level is 3.15 metres below the top of low (left) riverbank level of 72.11 metres AHD.

11.7 Mitigation and management measures

Mitigation and management measures for flooding impacts are provided in **Table 11-1.**

Table 11-1 Mitigation and management measures for flooding impacts

Ref	Impacts	Mitigation and management measures	Timing
F1	Localised flooding due to construction activities	The design of temporary flow diversion works within the river will take into consideration and make clear reference to available hydrological data and clearly identify the assumptions and criteria adopted.	Construction
F2	Localised flooding due to construction activities	The design and crest level of the proposed cofferdams will take into consideration and make clear reference to available hydrological data and clearly identify the assumptions and criteria adopted.	Construction
F3	Flood impacts to temporary and permanent works	The construction contractor will develop a monitoring and flood preparedness response plan that will: ▪ Detail procedures for monitoring catchment rainfall, river system flows (including tributaries), river water levels, flow conditions at the construction sites ▪ Identify subsequent response actions that will be taken to ensure the protection of personnel, equipment, materials, the existing weir structure (including as modified), the new weir works, the river channel and environment, and any other aspects/items ▪ Establish contingencies such as, for example, provisions for the removal or pre-flooding (filling) of cofferdams if a response action flow trigger is reached and designated temporary cleared storage locations to standby equipment and materials.	Construction
F4	Flood impacts to temporary and permanent works	River gauges in the Darling River (Baaka) nos. 425008 (Wilcannia Main Channel) and 425058 (Moorabin) will be monitored to gain an understanding of prevailing flows at the new and existing weir sites. Upstream gauges on both the main river and tributaries will also be monitored for upstream flow conditions in advance of flows arriving in Wilcannia. Monitoring will be used to identify current and predicted flow conditions in the river at Wilcannia and to provide notification of likely significant flow events that may impact the progress of the works or trigger implementation of appropriate response actions.	Construction
F5	Flood impacts to temporary and permanent works	Rainfall within the catchment will be monitored to identify significant events to provide early warning of the potential for increased river flows.	Construction

Ref	Impacts	Mitigation and management measures	Timing
F6	Flood impacts to temporary and permanent works	The construction contractor will establish suitable temporary provisions for monitoring the level of any weir pool and how these levels correlate to flows past the construction sites.	Construction
F7	Flood impacts to temporary and permanent works	Response actions are to include the timing and duration of all key activities expressed in relation to river flows, weir pool levels, and/or other relevant measures.	Construction
F8	Flood impacts to temporary and permanent works	Response actions may involve, but not be limited to, the withdrawal and later return of personnel, equipment, materials, temporary works and other items from the river and/or adjacent construction sites.	Construction
F9	Flood impacts to temporary and permanent works	Provisions will also be made for out-of-hours implementation of response actions.	Construction

12. Terrestrial biodiversity

The potential terrestrial biodiversity impacts of the proposal are assessed in **Technical Report 2** and summarised in this section.

SEAR no. 4 provides requirements for the assessment of the proposal's biodiversity impacts. The requirements of SEAR no. 4 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

12.1 Legislative and policy context

12.1.1 Biodiversity Conservation Act 2016

The purpose of the *Biodiversity Conservation Act 2016* (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 NSW Biodiversity Offsets Scheme is established under Part 6 of the BC Act to provide a mechanism to offset the impact of actions on biodiversity values including the impacts of the clearing of native vegetation and the loss of habitat. Section 6.2 of the BC Act identifies permitted offsets and includes the establishment of biodiversity stewardship sites on land to generate tradeable biodiversity credits (and thereby enable them to be acquired by developers or other persons who have an obligation to retire biodiversity credits under the scheme), and the payment into a Biodiversity Conservation Fund of an amount equivalent to the cost of acquiring those credits determined in accordance with an offsets payment calculator. The Biodiversity Conservation Fund is managed by a Biodiversity Conservation Trust that has an obligation to later secure biodiversity offsets from the money paid into the Fund.

Section 6.7 of the BC Act establishes a Biodiversity Assessment Method for the assessment of impacts on threatened species and threatened ecological communities and their habitats, and the impact on biodiversity values. The Biodiversity Assessment Method provides a basis for determining the number of biodiversity credits required for a proposal.

Part 7.9 of the BC Act requires that an application to carry out State significant infrastructure under Division 5.2 of the EP&A Act must be accompanied by a biodiversity development assessment report. SEAR no. 4 confirms the need to prepare a biodiversity development assessment report for the proposal in the form specified in section 5.16 of the BC Act, clause 6.8 of the Biodiversity Conservation Regulation 2017 and the Biodiversity Assessment Method. A biodiversity development assessment report has been prepared for the proposal in accordance with these requirements and is provided in **Technical Report 2**.

12.1.2 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection and management of nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined under the Act as matters of national environmental significance (MNES). MNES identified in the EPBC Act include threatened species and communities and migratory species protected under international agreements.

As noted in **Section 4.3.3**, the proposal is a controlled action, with the controlling provision being listed threatened species and communities, including the Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (Coolibah – Black Box Woodlands) endangered ecological community, Grey Falcon (*Falco hypoleucos*, listed as vulnerable), *Atriplex infrequens* (vulnerable) and Menindee Nightshade (*Solanum karsense*, vulnerable).

12.2 Assessment methodology

A study area was defined for the terrestrial biodiversity assessment that included the area subject to direct impacts during construction of the proposal plus a 50-metre buffer as well as areas upstream and downstream of the new weir that would be subject to indirect impacts during operation of the proposal. The study area is shown in **Figure 12-1**.

The existing ecology of the study area was initially identified through database searches and a literature review that included the NSW BioNet Vegetation Classification database, the Department of Agriculture, Water, and the Environment's Protected Matters Search Tool and Directory of Important Wetlands, the Bureau of Meteorology's Groundwater Dependent Ecosystems Atlas and mapping of vegetation types and soils.

A field survey of the study area was carried out from 17 November to 27 November 2020 and included a plot-based full floristic vegetation survey, vegetation integrity assessment and targeted threatened species surveys.

12.3 Risk

The proposal includes clearing of native vegetation and therefore poses a risk of directly impacting threatened ecological communities and plant species, reducing habitat for fauna species including threatened fauna species, and fragmenting native vegetation.

12.4 Avoidance and minimisation of impacts

Impacts to terrestrial biodiversity have been avoided and minimised during the preparation of a preliminary concept design for the proposal by locating temporary construction compounds and laydown areas away from areas of good quality or dense native vegetation and using existing tracks to provide access to these areas from the road network, where feasible. The proposed staging of the construction works would also reduce the footprint compared to carrying out all of the works concurrently.

The community river place has been designed to avoid the removal of native vegetation.

12.5 Existing environment

12.5.1 Plant community types

Three plant community types were identified in the plot-based floristic vegetation survey of the construction and operational footprints of the proposal and these are identified in **Table 12-1** along with vegetation zones that reflect condition classes based on the vegetation integrity assessment. The distribution of each of these plant community types and vegetation zones as well as the plant community types that surround the construction and operational footprints of the proposal are shown in **Figure 12-1.**

Table 12-1 Plant community types and vegetation zones within the construction and operational footprints of the proposal

Vegetation zone	Plant community type		Vegetation formation	Vegetation class	Status	Broad condition class	Area (hectares)	
	ID No.	Name					By condition class	Total
1	36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	Forested Wetlands	Inland Riverine Forests	Not a threatened ecological community	Good	0.95	2.57
2						Low	1.62	
3	39	Coolabah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands	Endangered under the BC Act Endangered under the EPBC Act (moderate condition class only)	Moderate	1.94	2.94
4						Low	0.94	
5						Poor	0.05	
6	158	Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands	Not a threatened ecological community	Moderate	1.94	4.64
7						Poor	0.71	
8						Good	1.99	
							Total	**10.14**

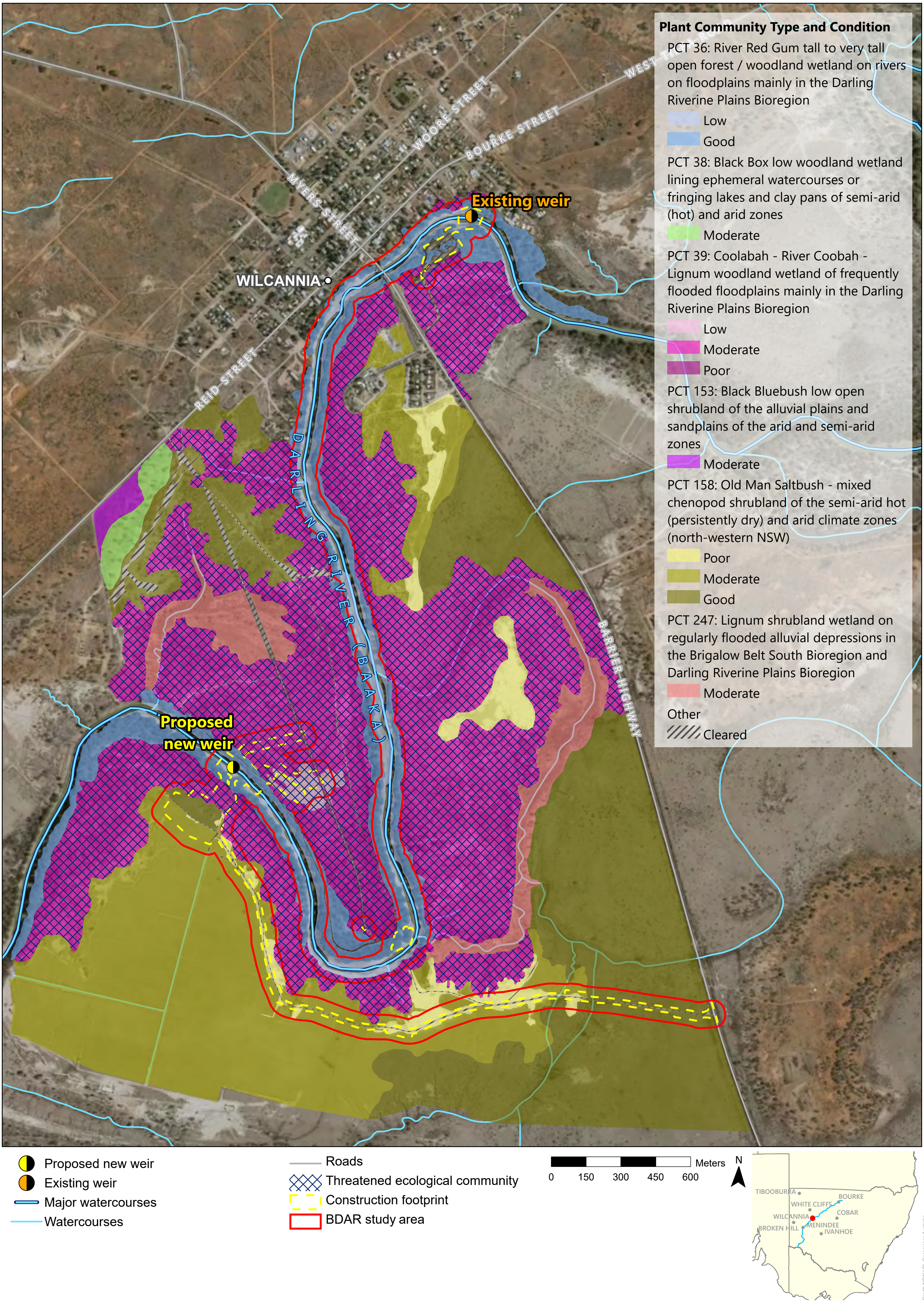


Figure 12-1: Plant community types, vegetation zones and threatened ecological communities

12.5.2 Threatened ecological communities

Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions

The BioNet Vegetation Classification database lists Coolabah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion (plant community type 39) as being a part of the listed endangered ecological community named Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions.

The *Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions – endangered ecological community listing* (NSW Scientific Committee, 2012) describes the endangered ecological community as being found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees. The structure of the community may vary from tall riparian woodlands to very open 'savanna like' grassy woodlands with a sparse midstorey of shrubs and saplings. Coolibah (*Eucalyptus coolabah*) is typically the dominant or subdominant tree species and it may occur with or without River Cooba (*Acacia stenophylla*), Cooba (*Acacia salicina*), Belah (*Casuarina cristata*), Eurah (*Eremophila bignoniiflora*), Black Box (*Eucalyptus largiflorens*), River Red Gum (*Eucalyptus camaldulensis*) and Bimble Box (*Eucalyptus populnea* subsp. *bimbil*).

Coolabah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion (plant community type 39) was identified in moderate, low and poor conditions (vegetation zones 3, 4 and 5 respectively) within the construction and operational footprints. Vegetation in all three conditions classes meets the definition of the BC Act listed endangered ecological community Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions. The occurrence of plant community type 39 at the new weir site meets the description of this threatened ecological community as it is generally dominated by Coolibah (*Eucalyptus coolabah*) with some of the listed accompanying species and it is located on grey, alluvial clays of the Darling River (Baaka) floodplain. There are no condition thresholds described in the threatened ecological community listing advice (NSW Scientific Committee, 2012), therefore all vegetation zones (condition classes) within the construction and operational footprints are included in the threatened ecological community listing.

Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions

Coolabah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion (plant community type 39) that was identified in moderate condition (vegetation zone 3) also meets the definition of the EPBC Act listed endangered ecological community Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions. This vegetation contains all structural layers with a canopy of medium to large Coolibah (*Eucalyptus coolabah*) and the occasional River Red Gum (*Eucalyptus camaldulensis*) and Black Box (*Eucalyptus largiflorens*) (10-15 metres) and a generally good midstorey and ground cover of native species. There appears to have been some disturbance throughout much of this vegetation in the past, particularly where it borders old agricultural areas. Branch lopping is common, and large open areas lacking canopy are common. It is difficult to determine where treeless areas are natural and where they are a result of disturbance.

12.5.3 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities was identified using the Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology, 2020) and the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* (Kuginis et al., 2012).

Three types of groundwater dependent ecosystems are generally recognised:

- Aquatic ecosystems that rely on the surface discharge of groundwater – including surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – including forests and riparian vegetation
- Subterranean ecosystems – including caves and aquifer ecosystems.

There are potential aquatic and terrestrial groundwater dependent ecosystems in the vicinity of the proposal:

- **Aquatic groundwater dependent ecosystems:** The Darling River (Baaka) and the encompassing floodplains have a high potential for groundwater dependence
- **Terrestrial groundwater dependent ecosystems**: Floodplain plant community types surrounding the Darling River (Baaka) have known and high potential for groundwater dependence based on regional studies, this includes downstream of the proposed new weir. The Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology, 2020) identifies most of the site of the proposal and surrounding floodplain areas of the Darling River (Baaka) as containing moderate to high potential groundwater dependent terrestrial vegetation.

Using the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* (Kuginis et al., 2012), it is unlikely that the plant community types listed in **Table 12-1** have a total reliance on groundwater. However, being located within the floodplain, these plant community types are likely to be proportional facultative groundwater dependent ecosystems, meaning that they depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) for a proportion of their water requirements in some locations but not in others, particularly where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. PCT 38 and PCT 153, being located on the edges of the alluvial soils, are likely to be opportunistic facultative, using groundwater when available. These facultative groundwater dependent ecosystems may use groundwater during periods of low flow or drought.

12.5.4 Threatened species

Threatened plant surveys

Targeted field surveys were undertaken for the following five threatened plant species based on an analysis of geographic and habitat constraints for a longer list of candidate species:

- Saltbush (Atriplex *infrequens*)
- Bindweed (Convolvulus tedmoorei)
- Phyllanthus maderaspatensis
- Menindee Nightshade (*Solanum karsense*)
- Slender Darling Pea (*Swainsona murrayana*).

No threatened plant species were found during the field surveys. As the surveys were conducted in November, which is outside the survey season for Bindweed (*Convolvulus tedmoorei*) and Slender Darling Pea (*Swainsona murrayana*), the Biodiversity Assessment Method requires that the presence of these two species be assumed or otherwise demonstrated that the habitats are degraded to the point that the species is unlikely to be present.

Bindweed (*Convolvulus tedmoorei*)

Bindweed (*Convolvulus tedmoorei*) is only known from a few locations in NSW: two areas on the Murrumbidgee and Darling River (Baaka) floodplains in central-western NSW (from Toganmain Station, Darlington Point, and from a locality eight kilometres north-west of Louth); and two other records from east of Broken Hill on the road to Wilcannia, and from the Menindee Road, Scarsdale. Wilcannia sits roughly between the records around Broken Hill and the records from Louth. It is unknown what survey effort has been undertaken across the region to identify further occurrences of this species. Little data exists to describe the conditions and habitat at these locations, however the Bindweed (*Convolvulus tedmoorei*) BioNet profile states that the species may require periodic flooding of its habitat to maintain the wet conditions suitable for seed set and germination.

As a persistent and perennial species, and given the optimal rainfall conditions experienced for four months prior to the survey, there is a high likelihood that the species would have been detected if present, despite not flowering at the time. The targeted transect survey and spacing of observers was targeted at detection of this species. It is likely Bindweed (*Convolvulus tedmoorei*) would have been in seed during the November survey.

Given the small impact area and walked survey effort, there is a reasonable expectation that the species would have been detected if present. The species is considered unlikely to occur. About 1.3 hectares of the potential habitat identified occurs along the road edge of the southern access road and is in low condition.

Slender Darling Pea (*Swainsona murrayana*)

The survey period occurred in November and was outside the main flowering period and the prescribed survey month of September for Slender Darling Pea (*Swainsona murrayana*). Surveys undertaken in November 2020 identified two other Swainsona species: *Swainsona greyana* and *Swainsona swainsonioides*.

Slender Darling Pea (*Swainsona murrayana*) dieback after flowering in September, however it is possible that plant remains would have still been identifiable during the November 2020 survey considering the high rainfall in the months preceding the survey. *Swainsona greyana* was flowering and very common along the Darling River (Baaka) in plant community type 36. It is a large species (up to 1.5 metres high) and easily distinguishable from Slender Darling Pea (*Swainsona murrayana*). *Swainsona swainsonioides* was identified flowering in good/moderate and poor condition vegetation zones of plant community type 158. Apart from the presence of flowers, *Swainsona swainsonioides* differs from Slender Darling Pea (*Swainsona murrayana*) primarily by having basifixed rather than medifixed hairs, an incomplete circular keel, wider leaflets, sparsely hairy rather than densely hairy stems and a hairless, rather than hairy calyx.

The Threatened Biodiversity Data Collection identifies associated habitat for Slender Darling Pea (*Swainsona murrayana*) as plant community types 38, 158, and 247. Of these habitats about 4.6 hectares of plant community type 158 would be impacted on the left (southern) riverbank at the new weir site. The other two plant community types are not directly impacted. This species has been considered unlikely to occur.

Threatened animal surveys

Targeted threatened species surveys were undertaken for animals with potential habitat in the vicinity of the proposal. Surveys included diurnal (daytime) and nocturnal (nighttime) effort using a stratified sampling approach that aimed to sample the range of habitats present. Opportunistic observations of threatened species were also recorded during survey activities.

Targeted surveys were conducted for 11 bird species including Australian Bustard (*Ardeotis australis*), Bush Stone-curlew (*Burhinus grallarius*), Red-tailed Black-Cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*), Squatter Pigeon (southern species) (*Geophaps scripta scripta*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Black-breasted Buzzard (*Hamirostra melanosternon*), Little Eagle (*Hieraaetus morphnoides*), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Square-tailed Kite (*Lophoictinia isura*), Barking Owl (*Ninox connivens*), and Masked Owl (*Tyto novaehollandiae*) and one mammal species, the Koala (*Phascolarctos cinereus*). No threatened fauna species were identified within the construction footprint during the targeted surveys.

The Red-tailed Black-Cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*) was the only targeted threatened species identified during the surveys in the vicinity of the proposal (but outside of the construction footprint). It was observed in large family groups of up to 20 individuals at three locations along the Darling River (Baaka):

- At Union Bend, on the inside bend of the river, about one river kilometre upstream of the new weir
- About 15 river kilometres upstream of the new weir
- At the end of the new weir pool extent i.e. about 85.52 river kilometres upstream of the new weir.

A small group of Red-tailed Black-Cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*) was also observed feeding in Old Man Saltbush (plant community type 158) near the southern access track to the new weir. The birds in this location appeared to be feeding on the fruits of the native chenopod shrub (*Dissocarpus paradoxus*).

No evidence of breeding was observed in any of these locations (i.e. birds in hollows, courtship behaviour or the sound of chicks in a hollow). Suitable breeding hollows are highly abundant all along the Darling River (Baaka), with a high prevalence of large hollow-bearing trees. Considering the presence of family groups, it is possible that this species breeds around these observed locations. No Red-tailed Black-Cockatoos were observed within the construction and operational footprint of the proposal.

Non-targeted species identified opportunistically during the surveys included Brown Treecreepers, Dusky Woodswallow (*Artamus cyanopterus*) and Spotter Harrier (*Circus assimilis*). Brown Treecreepers were commonly observed in riparian vegetation around the Darling River (Baaka), however they do not qualify for inclusion under the eastern subspecies listing as the western boundary of the range of *Climacteris picumnus victoriae* runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell.

12.6 Assessment of impacts

12.6.1 Construction impacts

12.6.1.1 Removal of native vegetation, threatened ecological communities and habitat for threatened species

The proposal would directly impact 10.14 hectares of native vegetation as detailed in **Table 12-2**. This area of direct impact includes native vegetation present in the river channel between the new and existing weirs that would be inundated by the new town pool. Areas of the river channel subject to temporary inundation when the new weir is in drought security operation mode and the full supply level is above the normal full supply level are not included.

The River Red Gum tall to very tall open forest/woodland (plant community type 36) (vegetation zone 1) occupies the length of the riparian section between the new and existing weirs on both sides of the river. A low condition treeless variant of this community (vegetation zone 2) was also mapped extending down the slopes to the riverbed in some places (evident by the presence of the same mid-storey and ground stratum species). To calculate the direct loss of vegetation associated with the new town pool, a 1.5 metre buffer was placed on the vegetation on the land side of this mapped riparian community, to represent the likely level horizontal inundation and loss of vegetation. These areas equate to 1.49 hectares and were accounted for in the direct loss of vegetation for the purposes of calculating the offset.

The future vegetation integrity of all directly impacted areas of native vegetation has been assumed to be zero.

The estimated area of vegetation and habitat directly impacted during construction and operation therefore equates to 10.14 hectares including the 1.49 hectares in the river channel between the new and existing weirs that would be inundated by the new town pool. While the exact area of vegetation removal that would occur for the community river place is not able to be quantified, and may be less than 0.7 hectares, for the purpose of calculating a biodiversity offset, the entire area of the community river place has been used to quantify the impact. Similarly, the future vegetation integrity score for the area of vegetation at the community river place has been set to zero to allow for the car park and likely change in vegetation integrity at the site.

Table 12-2 Summary of direct impacts to vegetation within the construction and operational footprints of the proposal

Vegetation zone	Plant community type		Broad condition class	Area of direct impact (hectares)	Vegetation integrity	
	ID no.	Name			Current score	Future score
1	36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	Good	0.95	75.4	0
2			Low	1.62	21.2	0
3	39	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Moderate	1.94	57.8	0
4			Low	0.94	15	0
5			Poor	0.05	0.9	0
6	158	Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)	Moderate	1.94	63.4	0
7			Poor	0.71	3.5	0
8			Good	1.99	92.4	0
			TOTAL	**10.14**		

12.6.1.2 Impact to threatened species and habitat

The proposal would not result in any direct impact to threatened species or their habitat that are 'credit species' for the purposes of the Biodiversity Offset Scheme. The impacts to native vegetation identified in **Table 12-2** constitute impacts to 'ecosystem-credit species habitat' under the Biodiversity Offset Scheme. Impacts to ecosystem credit species habitat are detailed in **Table 12-3**.

Table 12-3 Summary of direct impacts to ecosystem-credit species habitat

Species	Common name	EPBC Act	BC Act	Habitat	Impact area (ha)
Birds					
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	Observed. Woodland (PCT 36, PCT 39), excluding low and disturbed condition	2.90
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies) (foraging)	-	V	Observed. Woodland (PCT 36, PCT 39) and chenopod shrublands (PCT 158), excluding low and very poor condition	4.44
Certhionyx variegatus	Pied Honeyeater	-	V	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition	2.90

Species	Common name	EPBC Act	BC Act	Habitat	Impact area (ha)
Circus assimilis	Spotted Harrier	-	V	Observed. All vegetation zones.	10.14
Daphoenositta chrysoptera	Varied Sittella	-	V	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Epthianura albifrons	White-fronted Chat	-	V	Assumed present. Chenopod shrublands (PCT 158).	4.64
Falco hypoleucos	Grey Falcon	-	V	Assumed present. All vegetation zones.	10.14
Falco subniger	Black Falcon	-	V	Assumed present. All vegetation zones.	10.14
Grantiella picta	Painted Honeyeater	-	V	Assumed not present due to absence of habitat constraints (density of mistletoe).	-
Grus rubicunda	Brolga	-	V	Assumed present. All vegetation zones.	10.14
Hamirostra melanosternon	Black-breasted Buzzard (foraging)	-	V	Assumed present. All vegetation zones.	10.14
Hieraaetus morphnoides	Little Eagle (foraging)	-	V	Assumed present. All vegetation zones.	10.14
Lophochroa leadbeateri	Major Mitchell's Cockatoo (foraging)	-	V	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Lophoictinia isura	Square-tailed Kite (foraging)	-	V	Assumed present. Woodland (PCT 36, PCT 39).	5.51
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	V	Assumed present. All vegetation zones are within 1km of waterbody.	10.14
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Ninox connivens	Barking Owl (foraging)	-	V	Assumed present. Woodland (PCT 36, PCT 39).	5.51
Tyto novaehollandiae	Masked Owl (foraging)	-	V	Assumed present. Woodland (PCT 36, PCT 39).	5.51
Phaps histrionica	Flock Bronzewing	-	E	Assumed present. Chenopod shrublands (PCT 158).	4.64
Stagonopleura guttata	Diamond Firetail	-	V	Woodland (PCT 36, PCT 39).	5.51

Species	Common name	EPBC Act	BC Act	Habitat	Impact area (ha)
Stictonetta naevosa	Freckled Duck	-	V	Assumed present. Woodland (PCT 36).	2.57
Rostratula australis	Painted Snipe	E	E	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Pyrrholaemus brunneus	Redthroat		V	Associated with PCT 158, however assumed not present due to only low and poor condition area present, that are too degraded for the species.	0
Limosa limosa	Black-tailed Godwit	-	V	No mapped important areas, but may occasionally use good condition PCT39.	1.94
Botaurus poiciloptilus	Australasian Bittern	E	E	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Mammals					
Antechinomys laniger	Kultarr	-	E	Assumed present. Cracking clay (PCT 39, PCT 158).	7.58
Chalinolobus picatus	Little Pied Bat	-	V	Assumed present. All vegetation zones.	10.14
Phascolarctos *cinereus*	Koala (foraging)	V	V	Assumed present. Woodland (PCT 36, PCT 39), excluding low and disturbed condition.	2.90
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	Assumed present. All vegetation zones.	10.14
Sminthopsis macroura	Stripe-faced Dunnart	-	V	Assumed present. All vegetation zones.	10.14
Rattus villosissmus	Long-haired Rat	-	V	Assumed present. Chenopod shrublands (PCT 158).	4.64
Leggadina forresti	Forrest's Mouse	-	V	Assumed present. Chenopod shrublands (PCT 158).	4.64
Reptiles					
Pseudonaja modesta	Ringed Brown Snake	-	E	Assumed present. Woodland (PCT39) and Chenopod shrubland (PCT158).	7.58

Key: E = endangered, V = vulnerable, PCT = Plant community type

12.6.1.3 Fauna injury and mortality

Fauna injury or death has the greatest potential to occur during the construction phase when excavation and vegetation clearing would take place. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal (tree-living) mammals and microbat species), may find it difficult to rapidly move away from the clearing activities when disturbed. In addition to this, entrapment of fauna in any excavated trenches or pits may potentially occur if the trenches or pits are deep and steep sided. Fauna may also become trapped in or may choose to shelter in construction vehicles, infrastructure, machinery and equipment and/or during relocation of stored construction materials that is stored in the development site overnight. Fauna that may take shelter inside construction vehicles, infrastructure, machinery, and equipment and/or during relocation of stored construction materials machinery, may result in injury or death if not thoroughly checked prior to construction activities and equipment use. Direct impacts to fauna can be minimised and avoided through the implementation of the mitigation measures detailed in **Table 12-5**.

12.6.2 Indirect impacts

Section 1.2 of the *Biodiversity Assessment Method Operational Manual Stage 2* (DPIE, 2019c) defines indirect impacts as development related activities not associated with clearing for the development footprint. Section 8.2 of the *Biodiversity Assessment Method* (DPIE, 2020c) lists potential indirect impacts that may result from construction and/or operation of a new development. The potential indirect impacts that are applicable to this proposal are discussed in the following sections. Though indirect impacts cannot be quantified, the potential for indirect impacts can be minimised through the application of stringent mitigation measures and monitoring the performance of these. Such measures would be documented in the construction environmental management plan.

The types of potential indirect impacts on native vegetation and threatened species (and their habitat) beyond the vegetation clearing boundary of the proposal are summarised in **Table 12-4**.

Table 12-4 Summary of potential indirect impacts on native vegetation and habitat for threatened species beyond the vegetation clearing boundary

Indirect impact	Impacted entities	Extent	Duration	Consequence
Edge effects and potential displacement of fauna	Native vegetation associated with 3 PCTs and habitat for threatened species adjoining the site including hollow trees	The extent of the indirect disturbance buffer adjacent to the project is uncertain and subject to monitoring and assessment	Long-term	Negative changes to the structure and function of the adjoining vegetation
Increased sedimentation into stream habitat affecting water quality	Aquatic habitat	Weir pool and downstream from weir	Long-term	Temporary loss of habitat for threatened birds and mammals
Loss of foraging habitat for threatened and migratory waterbirds	Wetland habitat in stream channel	Weir pool	Long-term	Loss of potential habitat for threatened and listed migratory bird species

Indirect impact	Impacted entities	Extent	Duration	Consequence
Transport of weed and pathogens	Native vegetation associated with three plant community types and habitat for threatened species adjoining the site	The extent of the indirect disturbance buffer adjacent to the project is uncertain and subject to monitoring and assessment	Potential long-term during construction and operation	Negative changes to the structure and function of the adjoining vegetation
Noise and vibration	Threatened fauna	Localised near the new and existing weir construction sites and assess roads	Short-term during construction	Disturbance to breeding activity
Dust pollution	Native vegetation and threatened species	Localised near the new and existing weir construction sites and access roads	Short-term during construction	Negative changes to the structure and function of the adjoining vegetation
Contaminant pollution	Aquatic habitats	Darling River (Baaka) (weir pool, and downstream habitat)	Potential long-term	Decline on habitat condition for aquatic species

Edge effects and potential displacement of fauna

Edge effects refer to the changed abiotic conditions when new edges are created through previously intact vegetation. These indirect impacts can occur in vegetation and habitat retained next to clearing required for the proposal. Edge effects can result in negative changes to the structure and function of retained vegetation from changed abiotic factors such as increased light intensity and duration, increased exposure to wind and weed invasion in edge habitats.

The proposal is located in a mixture of vegetation types ranging from closed canopy riparian vegetation with a very open mid-storey to open floodplain woodland and disturbed (and previously cropped) saltbush shrublands. Clearing works within riparian vegetation would only be undertaken to facilitate placement of machinery and would not result in total removal of vegetation. Construction lay down areas would be placed in areas already lacking canopy and the access roads are utilising existing tracks to be upgraded, and vegetation is already edge affected. Therefore, the conditions following the clearing of native vegetation for the development are unlikely to dramatically change the abiotic conditions such that retained vegetation next to the proposal would be substantially modified. Indirect impacts to retained adjacent vegetation and habitats can be minimised and avoided through the implementation of the mitigation and management measures detailed in **Table 12-5**.

Large, mature hollow-bearing trees are widespread across the study area and all along the Darling River (Baaka). These represent important microhabitat features and provide potential breeding sites for threatened bird species that have a high likelihood of occurring. This includes Major Mitchell’s Cockatoo (*Lophochroa leadbeateri*), Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*). There were no confirmed breeding sites for these species reported during the survey, however the proposal may remove trees and hollows that provide potential nest sites.

The Square-tailed Kite (*Lophoictinia isura*), Black-breasted Buzzard (*Hamirostra melanosternon*), Little Eagle (*Hieraaetus morphnoides*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*) were not found during the surveys although are considered to potentially occur. Three moderately-sized stick nests were located in trees in the construction and operational footprints, although there were no confirmed nest sites for these threatened diurnal raptors reported during the survey.

Increased sedimentation into stream habitat affecting water quality

During construction there is potential for sediment from disturbed ground at the work sites to enter the Darling River (Baaka) particularly in the event of heavy rainfall. This indirect impact has potential to cause degradation of habitat in the river, that is potentially used by threatened fauna species, including birds and mammals. The extent and duration of the impact is unknown but may occur for large distances downstream. Over the long-term operational phase of the proposal, the recovery of ground layer vegetation at the construction site would be expected to prevent further movement of sediment.

Mitigation and management measures to prevent sediment entering the river will be implemented as part of the construction environmental management plan and soil and water management plant, as detailed in **Table 12-5**.

Loss of foraging habitat for threatened and migratory waterbirds

Wetlands of the Darling River (Baaka) system provide significant water bird habitat in the Murray-Darling Basin, as they dry and flood, supporting tens of thousands of birds (Kingsford et al. 2002). No instream wetlands were identified from the field surveys, likely due to the river being dry for an extended period of time and the largely incised nature of the river at this location. The vegetation that would be flooded within the proposed new town pool consists of poor condition riparian woodland which provides a low habitat value for wetland bird species.

The direct impact caused by permanent inundation is predicted to occur to the shallow mudflats that currently exist between the existing weir and the proposed new weir. These mudflats may provide suitable foraging habitat for a range of wading species, and the Black-fronted Dotterel, Black-winged Stilt and Australian Ibis were recorded just south of the existing weir during the field surveys. These are relatively common species and the current condition of the habitats is unlikely to be suitable for threatened and migratory water bird species such as the Black-tailed Godwit (*Limosa limosa*), Australasian Bittern (*Botaurus poiciloptilus*), Freckled Duck (*Stictonetta naevosa*), Blue-billed Duck (*Oxyura australis*), Curlew Sandpiper (*Calidris ferruginea*) and Australian Painted Snipe (*Rostratula australis*). These species require high condition wetland habitat with thick cover of macrophyte vegetation for foraging and refuge and are less likely to occur within the proposed new weir pool. As a result of the project, these existing mudflats will be permanently inundated, removing potential low value foraging habitat for wading species. However, the mudflat habitat is currently only temporary due to modified flow regimes.

The permanent inundation may encourage the growth of instream vegetation and increase habitat quality for water bird species such as the Freckled Duck (*Stictonetta naevosa*) and Blue-billed Duck (*Oxyura australis*). Therefore mitigation is not proposed.

Transport of weeds and pathogens

The activities associated with clearing vegetation and increased human presence during construction and operation have potential to introduce weeds into adjacent vegetation outside the construction and operational footprints as well as increase the risk of introducing plant and animal diseases carried on machinery. Of the 30 identified weed species, three species are considered high threat weeds including Wards Weed (*Carrichtera annua*), African Boxthorn (*Lycium ferocissimum*) and Arabian Grass (*Schismus barbatus*).

Plant and animal disease pathogens can be carried on machinery to construction sites and indirectly impact on native vegetation and habitat for threatened species, this includes the following listed key threatened processes:

- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Introduction and establishment of Exotic Rust Fungi on plants of the family Myrtaceae
- Infection of naïve plants by *Phytophora cinnamomi.*

Weed control mitigation measures will be included as part of the construction environmental management plan and the management and mitigation measures proposed in **Table 12-5** will be implemented to control high threat weeds prior to clearing and provide for ongoing monitoring of weed invasion in adjoining habitat during construction.

Noise and vibration

Anthropogenic noise can alter the behaviour of animals or interfere with their normal functioning (Bowles, 1997). During construction of the proposal there would likely be increased noise and vibration levels in the disturbance site and immediate surrounds due to vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. Noise impacts during operation are expected to be minimal and associated within increased human presence at the recreational facilities. During construction of the proposal the key sources of noise would include:

- Construction traffic – noise along accesses roads during daytime activities only. Additional traffic movements from construction activities are not expected to result in unacceptable changes in traffic noise levels
- Construction vibration – due to earthmoving and handling of rock. These types of activities would be temporary and occur periodically.

Construction activities would likely result in a small increase in ambient noise levels as well as potentially loud noises and vibration for short periods associated with earthworks. The noise and vibration from activities associated with the proposal would potentially disturb resident fauna and may disrupt foraging, reproductive, or movement behaviours, however, impacts from noise are likely to be temporarily localised to the construction areas and not spread far. These emissions are not considered likely to have a significant, long-term, impact on wildlife populations outside the area of direct impact. Within the area of impact (including habitats immediately adjacent to the development site), some sensitive species (e.g. woodland birds) may avoid the noise and some more tolerant species, including small mammals, would habituate over the longer-term.

Mitigation and management measures to minimise noise and minimise potential impacts on wildlife are provided in **Table 12-5**.

Dust pollution

Elevated levels of dust may be deposited onto the foliage of vegetation next to the construction footprint. 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. Consequently, changes in the structure and composition of plant communities and consequently habitat use by fauna may occur.

Some level of dust is likely to be generated throughout construction of the proposal due to the clearing of vegetation and increased movements of trucks and vehicles along dirt access road. Potential dust pollution would be the greatest during earthworks, vegetation clearing, vehicle movements for construction activities and adverse weather conditions (i.e. high wind). Any deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the rain periods) and is therefore not considered likely to be a major impact. Dust mitigation and management measures will be implemented to minimise dust pollution impacts, as detailed in **Table 12-5**.

Contaminant pollution

During the construction phase localised release of contaminants (i.e. hydraulic fluids, oils, drilling fluids, etc.) into the surrounding environment (including the Darling River (Baaka)) may accidentally occur. The most likely result of contaminant discharge would be the localised contamination of soil, the waterway, and potential direct physical trauma to flora and fauna that come into contact with contaminants. Accidental release of contaminants is considered low risk, and if it did occur would likely to be localised and able to be contained. Control measures will include ensuring that accidental spills are immediately reported and remediated, as detailed in **Table 12-5**.

12.6.3 Prescribed biodiversity impacts

Section 6 of the *Biodiversity Assessment Method* (DPIE, 2020c) requires the identification of potential prescribed biodiversity impacts on threatened species associated with the proposal that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. The potential prescribed biodiversity impacts of the proposal include:

- *Habitat connectivity* — The proposal includes clearing of about 200 metres of native vegetation within the Darling River (Baaka) riparian corridor. This clearing would slightly reduce the connectivity of the riparian woodland by the removal of trees. There is also likely to be temporary disturbance during construction, which may deter threatened species from the construction footprint. However, there is unlikely to be any threatened arboreal animal species that occur within or around the construction footprint, as evidenced by an absence of tree scratches and scats at the base of trees during surveys. Therefore, the threatened animal species that may be affected by the slight decrease in connectivity are all highly mobile bird species. The Red-tailed Black Cockatoo, Brown Treecreeper and Dusky Woodswallow were all observed along the Darling River (Baaka) during surveys. These species may experience a temporary disruption during construction of the proposal, however this is not expected to result in significant impacts to the movement of these species throughout their range. The functional connectivity of the riparian woodland would remain after the completion of the development. There is not expected to be any significant impacts to the ability of threatened species to move across their range.

  The final stage of the construction phase would involve revegetation around the weir site to restore any areas disturbed during construction. Revegetation would focus on restoring any impacts from lost connectivity along the riparian area, focusing on gaps in the canopy through tree planting.

- *Water bodies, water quality and hydrological processes* — Hydrological changes caused by the proposal were considered in the assessment of potential terrestrial biodiversity impacts including inundation of about 4.92-river kilometres of river channel between the new and existing weirs (the new town pool), temporary inundation of about 18.81 river kilometres of the river channel upstream of the existing weir pool extent when the weir is in drought security operation mode, and changes to downstream flows due to the altered operating regime and greater storage capacity of the new weir compared to the existing weir.

  Eucalyptus camaldulensis (River Red Gum) dominates the upper banks of the Darling River (Baaka) around the study area, forming open forests or woodlands. The *Eucalyptus camaldulensis* trees in this section of the river are old and very large (up to two metres diameter at breast height), located mainly on top of the banks, however there are some lower positioned trees (around two or three in the new town pool) where the bank slope is not too steep. Changes in river flow could lead to a decline in *Eucalyptus camaldulensis* health and changes in the understorey composition in the riparian zone. Permanent inundation of lower positioned trees along the proposed new weir pool may lead to dieback of a few trees (Dalton, 1990). As the proposed new weir would raise the weir pool by a maximum of one metre from the current full supply level, prolonged flooding to the River Red Gum habitat is not expected to occur as a result of the proposal. However, some individual *Eucalyptus camaldulensis* trees, located on the lower extent of the embankments, may dieback if flooded for prolonged periods of time.

  Direct impacts and offsets have been calculated for the potential loss of this native vegetation by an increased storage level for the new town pool and equates to a conservative estimate of two hectares.

  Field surveys of the about 18.81 river kilometres of the Darling River (Baaka) upstream of the existing weir pool extent did not identify any shallow wetland or instream vegetation communities that would be inundated, and as such no direct impact has been calculated for the temporary inundation of this section of the river when the new weir is in drought security operation mode. There were no important habitats identified at this location that would be lost as a result of inundation.

  The operating regime for the new weir is expected to restore some of the natural seasonal variability to the entire weir pool that would have occurred prior to river-regulation, in river levels, water velocities and the associated wetting and drying of littoral areas along the main river channel. Weir pools have the potential to protect and rehabilitate biodiversity and ecosystem functions in the littoral and riparian zone of waterways and adjacent wetlands throughout the reach. Weir pools are predicted to improve the productivity of these areas, increase the extent and health of water dependent vegetation and promote increased populations of fish, increased water bird foraging and connectivity to other significant sites (Brown P. Gehrig, 2018).

River Red Gum communities downstream of the proposed new weir along the channel, benches and billabongs of the Darling River (Baaka) could be reasonably expected to experience reduced frequency of flow and potentially lower-levels of flooding. This would have the potential to reduce floodplain vegetation health and inputs of carbon into the river (Thoms et al., 2000). This reduction in flow may affect larger areas of the Darling River (Baaka) further downstream and result in less water for threatened species that rely on aquatic habitats, such as the Black-tailed Godwit, Australasian Bittern, Freckled Duck, Blue-billed Duck, Curlew Sandpiper and Australian Painted Snipe. Modelling of the expected river flow regime downstream of the new weir and assessment against baseline flow conditions (from the past 118 years), indicates that impact of the new weir would result in more frequent cease-to-flow events downstream, but these events would also be of shorter duration. Several sites within the river channel were visited and investigated downstream of the proposed new weir during the targeted field surveys, the furthest being about 28 kilometres downstream. The results of the downstream investigation showed that the instream vegetation and habitat immediately downstream of the new weir are of very similar condition to those habitats identified in the proposed new town pool, and that about 20 kilometres and 28 kilometres downstream, the river is degraded from farming. No instream pools or wetlands that would be considered important aquatic habitat features and provide suitable habitat for wading and water bird species, (including listed migratory birds) were observed.

- *Impacts to groundwater dependent ecosystems* — Floodplain vegetation such as the River Red Gum community (plant community type 36) is dependent on flooding to recharge groundwater levels, and reduced flood events could lead to lower water table levels and higher groundwater salinity in nearby vegetation communities. The groundwater assessment of the proposal (refer to **Section 9** and **Technical Report 1**) has identified that groundwater mounding in the new town pool is likely to occur up to 100 metres out from the banks of both sides of the Darling River (Baaka). Shallow groundwater in this area (>3 metres below ground level) has the potential to become saline through evapo-concentration over time. The impact of this increased salinity on the condition of the plant community types surrounding the weir pool is difficult to predict and uncertain.

  The impact of the changed flow regimes on the condition of the surrounding groundwater dependent ecosystems downstream of the weir is also difficult to predict and uncertain. Section 8.5 of the *Biodiversity Assessment Method* (DPIE, 2020c) suggests that an adaptive management plan can be used to address impacts that are infrequent or difficult to measure. Further details around monitoring of the groundwater dependent ecosystems and adaptive management are described in **Table 12-5**.

- *Vehicle strike* — The risk of fauna injury and mortality during the construction and operation of the proposal through vehicle strike is considered low. Vehicle strike is an impact that reduces local population numbers and is a common occurrence in Australia. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike, particularly those common species (e.g. birds) that are tolerant of disturbance and remain in work sites during construction. The risk of an increase in the frequency of vehicle strike due to the proposal is relatively low and would generally be limited to vehicle movements to and from the new weir construction site. There would also be an increase in construction traffic during the decommissioning of the existing weir. Construction activities would only occur during the day, therefore there is no risk of collision at night from construction vehicles.

  During operation of the proposal, there would be an increase in traffic from the general public entering and leaving the community river place. Considering there is currently very little traffic using the proposed access roads into the new weir location, the proportional increase could be substantial. However, the actual amount of traffic that is expected to use the new access to the recreational facility is likely to be low and limited to low speed limits during the day only.

  Importantly, there is already vehicle traffic in the area and the proposal would not introduce a new impact. Vehicle strike associated with the proposal is unlikely to affect any threatened species of animals or animals that are part of a threatened ecological community.

Increased vehicle movements during construction of the proposal have the potential to result in fauna mortality from vehicle strikes. These potential impacts can be avoided and managed and will be addressed in the construction management plan, as detailed in **Table 12-5**.

12.7 Mitigation and management measures

Mitigation and management measures for terrestrial biodiversity impacts are provided in **Table 12-5.**

As explained in the *Biodiversity Assessment Method Operational Manual Stage* 2 (DPIE, 2019c), some impacts are difficult to predict or assess prior to commencement of the proposal. The management of uncertain impacts requires the development of an adaptive management plan with the aim of adjusting actions based on results of monitoring to achieve a specified outcome.

The operation of the proposal is predicted to result in equilibrium groundwater levels rising within five metres of the surface either side of the new town pool. Identified low-lying areas near the Darling River (Baaka) where groundwater levels are less than three metres below ground level would potentially experience salinisation. While the levels of salinisation would be similar to what has been experienced upstream of the existing weir the impact on the integrity of the plant community types surrounding the new town pool and downstream low-lying areas are uncertain. A comprehensive monitoring program will be developed to assess any change in vegetation integrity for the plant community types that have been identified as groundwater dependent ecosystems as detailed in mitigation measure BIO14 (refer to **Table 12-5**).

Table 12-5 Mitigation and management measures for terrestrial biodiversity

Ref	Impacts	Mitigation and management measures	Timing
BIO1	Clearing boundary	Prior to construction, the limits of the work zone, areas for parking and turning of vehicles, and plant equipment will be accurately and clearly marked out by a qualified surveyor. These areas would be located so that vegetation disturbance is minimised as much as possible, and the dripline of trees avoided.	▪ Pre-construction ▪ Pre-clearing
BIO2	Native vegetation	Construction machinery, equipment, materials, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree driplines.	▪ Pre-construction ▪ Pre-clearing
BIO3	Training	Construction personnel will be informed of the environmentally sensitive aspects of the proposal area, including plans for impacted and adjoining areas of vegetation to be removed and mitigation measures for impacts to biodiversity.	▪ Pre-construction ▪ Pre-clearing
BIO4	Minimise clearing area and impacts	Where possible, clearing of native vegetation will be avoided. Clearing of vegetation will be staged, allowing for dispersal of potentially occurring fauna species. Habitat items such as hollow logs and coarse woody debris will be retained where possible, potentially by relocating these items to vegetation beyond the construction footprint.	▪ Pre-construction ▪ Pre-clearing
BIO5	Additional surveys	Supplementary surveys will be carried out for species credit matters to further validate presence/absence within the appropriate survey seasons required under the Biodiversity Assessment Method for Bindweed (*Convolvulus tedmoorei*), Slender Darling Pea (*Swainsona murrayana*) and Little Eagle (*Hieraaetus morphnoides*) nesting habitat.	▪ Pre-construction

Ref	Impacts	Mitigation and management measures	Timing
BIO6	Pre-clearing inspection	In the weeks before clearing begins an ecologist will be engaged to: ▪ Identify any fauna that may have the potential to be disturbed, injured or killed as a result of clearing activities (e.g. nesting birds, large stick nests occupied by threatened diurnal raptors) ▪ Map location of any hollow-bearing trees and physically mark these habitat features to be protected during construction or considered during the clearing work (e.g. flagging tape) ▪ If there are hollows within the clearing boundary, conduct stag watching during the day and night to determine if these are being used by fauna, in particular forest owls or Major Mitchell's Cockatoo ▪ Check construction vehicles and any areas which have been excavated for fauna during pre-start activities.	▪ Pre-clearing
BIO7	Staged habitat removal	A staged habitat removal process is required for removal of habitat (hollow-bearing trees, habitat trees, and bushrock). Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally. The process will include: ▪ If possible, avoid clearing during breeding seasons for hollow-dependent fauna ▪ Contact vets and wildlife carers before construction activities commence ▪ Ensure a licensed wildlife carer and/or ecologist is present during vegetation clearing/habitat removal ▪ Adopt a two staged habitat removal strategy, for example clearing non-habitat trees first (i.e. shrubs, regrowth, ground cover) followed by habitat trees. Allow at least 24 hours for fauna to vacate habitat before removing habitat trees ▪ Fell habitat trees carefully using equipment that allows habitat trees to be lowered to the ground with minimal impact (e.g. claw extension). Do not fell trees towards exclusion zones ▪ Ensure a wildlife carer and/or ecologist inspects trees before and after felling. Capture and relocate non-injured fauna that are found in any felled trees to pre-determined habitat identified for fauna release to be undertaken by a licensed ecologist or wildlife carer.	▪ Construction
BIO8	Vegetation management plan	A vegetation management plan will be prepared as a sub plan of the construction environmental management plan and would detail the management of native trees, shrubs and other vegetation (including hollow-bearing trees) within the construction footprint. Key requirements in this plan will be included in the induction pack for all contractors.	▪ Pre-construction ▪ Construction

Ref	Impacts	Mitigation and management measures	Timing
BIO9	Fauna within excavations	Excavated areas such as pits/trenches will be inspected daily prior to commencing work to check for trapped fauna. Any trapped fauna must be removed by trained fauna handling personnel. Alternatively, fauna ramps (logs or wooden planks) are to be installed to provide an escape for trapped fauna. If any pits/trenches remain open overnight, they will be securely covered, where reasonable and feasible.	▪ Construction
BIO10	Fauna within work sites	Pre-start-up checks will be undertaken for possible fauna sheltering in excavated areas, construction machinery, equipment, construction vehicles and infrastructure and/or during relocation of stored construction materials. Fauna must be removed by trained fauna handling personnel prior to commencing any construction activities.	▪ Construction
BIO11	Site rehabilitation	▪ Revegetation of the riverbanks will be undertaken as soon as possible. A rehabilitation plan will be prepared as a sub plan of the construction environmental management plan. The rehabilitation plan will guide the long-term rehabilitation of applicable parts of the proposal. Such areas would include areas disturbed during construction that are not required to be maintained or cleared for the operation of the proposal. ▪ The rehabilitation plan will focus on prevention of soil erosion and re-establishing local endemic plant species ▪ Restoration of riparian vegetation (i.e. weed control) will be implemented to protect and improve threatened aquatic species habitat.	▪ Pre-construction ▪ Construction ▪ Post-construction
BIO12	Weed and pathogen management	▪ Weed management will be undertaken in areas affected by construction prior to any clearing works in accordance with the *Biosecurity Act 2015* to ensure they are not spread to the surrounding environment; including during transport disposal off-site to a licensed waste disposal facility ▪ Priority weeds will be identified, mapped, and removed before clearing for construction, and their location recorded for use in an ongoing weed monitoring program ▪ During construction, all personnel, vehicles, and machinery driving to and from site will follow a protocol to prevent the spread or introduction of plant diseases, particularly *Phytophthora cinnamomi*, namely vehicles and machinery will be clean, including the tyres, footwear of personnel, and any equipment ▪ All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules that are likely to regenerate will be treated on site or bagged, removed from site and disposed of at a licensed waste disposal facility ▪ Wash down stations will be constructed at suitable locations to wash down vehicles and employee shoes to stop the spread of weeds, pathogens (including amphibian chytrid fungus, *Phytophthora cinnamomi* and exotic rust fungi) and the introduction of new species.	▪ Pre-construction ▪ Construction

<table>
<tr><th>Ref</th><th>Impacts</th><th>Mitigation and management measures</th><th>Timing</th></tr>
<tr><td>BIO13</td><td>Fauna strike</td><td>Vehicle movements within the construction footprint will be limited to a 20 kilometres per hour speed limit to reduce the risk of vehicle strike to fauna
Drivers must stay vigilant for fauna during machinery operation and vehicle movements.</td><td>Construction
Operation</td></tr>
<tr><td>BIO14</td><td>Groundwater dependent ecosystems</td><td>A vegetation monitoring program will be developed in consultation with WaterNSW to monitor for changes in the vegetation integrity of groundwater dependent ecosystems as well as groundwater regime (e.g., declines in water level and increases in salinity). This will focus on plant community types immediately adjacent to the new town weir and additional floodplain plant community type sites immediately downstream of the new weir.
The monitoring program will consider:
the level of detail (number of replicates, number of sites, distance from weir and distance downstream, survey timing, precision of measurement of variables) required to detect a level of change that indicates an impact
vegetation integrity data and associated groundwater data to detect if change is associated with groundwater and no other factors
data will be analysed soon after collection to facilitate prompt adaptive management actions and the mitigation of unforeseen impacts
site-specific trigger values (performance criteria) for corrective action. These could be based on vegetation integrity values
Any negative effect on plant community type vegetation integrity will be considered in the form of an adaptive management plan that considers mitigation options for maintaining the health of affected plant community types, or additional offsets where applicable.</td><td>Pre-construction
Construction
Operation</td></tr>
</table>

12.8 Offsetting of impacts

The biodiversity impacts of the proposal require offsetting in accordance with Section 9.2 of the *Biodiversity Assessment Method* (DPIE, 2020c). The size of the required offsets has been calculated based on the loss of vegetation integrity caused by the proposal. A total of 262 ecosystem credits are required to offset the proposal's biodiversity impacts. The calculation of this offset is detailed in **Table 12-6**. No species credits are required.

Table 12-6 Direct impacts to PCTs which require an offset

Vegetation zone	Plant community type		Broad condition class	Threatened ecological community		Direct impact area (hectares)	Vegetation integrity score			Credits
	ID	Name		BC Act	EPBC Act		Current	Future	Change	
1	36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	Good	No	No	0.9	75.4	0	-75.4	31
2			Low	No	No	1.52	21.2	0	-21.2	15
			Subtotal							*46*
3	39	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Moderate	Yes	Yes	1.94	57.8	0	-57.8	56
4			Low	Yes	No	0.93	15	0	-15	7
			Subtotal							*63*
6	158	Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)	Moderate	No	No	1.5	63.4	0	-63.4	61
8			Good	No	No	1.6	92.4	0	-92.4	92
									Subtotal	*153*
									Total	**262**

The options available to satisfy the biodiversity offset liability of the proposal would entail either one of or a combination of the following options:

- Payment directly to the Biodiversity Conservation Fund, managed by the Biodiversity Conservation Trust
- Purchasing credits from the open market
- Establishing a biodiversity stewardship site.

The feasibility of developing a biodiversity stewardship site on suitable land adjoining the proposal was investigated, however an agreement with the landholder could not be reached. Credit registers maintained by the Department of Planning and Environment in accordance with clause 6.3 of the Biodiversity Conservation Regulation 2017 were searched on 14 October 2021 but no suitable credits were available.

The biodiversity offset strategy to meet the proposal's credit obligation would be to firstly source any available like-for-like credits from the Biodiversity Offsets Scheme public registers. The balance of any credits owing that cannot be sourced from the public registers would be met by paying directly into the Biodiversity Conservation Fund. Paying into the fund is quick but is the most expensive option.

13. Aquatic biodiversity

The potential aquatic biodiversity impacts of the proposal are assessed in **Technical Report 3** and summarised in this section.

SEAR no. 4 provides requirements for the assessment of the proposal's biodiversity impacts. The requirements of SEAR no. 4 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

13.1 Legislative and policy context

13.1.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The proposal was declared a controlled action on 11 August 2020 (EPBC reference 2020/8713) for the reason that the proposed action is likely to have a significant impact on listed threatened species and communities protected by the EPBC Act.

Two threatened species listed under the EPBC Act are expected to occur in the vicinity of the proposal and are likely to be impacted:

- Silver Perch (*Bidyanus bidyanus*) – listed as critically endangered
- Murray Cod (*Maccullochella peelii*) – listed as vulnerable.

The significance of impacts is determined in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (Department of the Environment, 2013). Assessments of significance for the Silver Perch and Murray Cod are provided in Appendix B of **Technical Report 3** and summarised in **Section 13.6.5**.

13.1.2 Fisheries Management Act 1994

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The FM Act is administered by Fisheries NSW, which is part of the Department of Regional NSW.

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'
- requiring the provision of fishways in the construction of weirs' (as per section 218 of the FM Act)
- consideration and assessment of threatened species impacts in the development assessment process.

These mechanisms are discussed further below.

Threatened species

Part 7A, Division 12 of the FM Act relates to the environmental assessment of a development under Part 5 of the EP&A Act. Of relevance to this assessment, the following threatened aquatic species, populations and ecological communities which are listed under Schedule 4, 4A and 5 of the FM Act are predicted to occur in the Darling River (Baaka) at Wilcannia:

- Darling River Snail (*Notopala sublineata*) – Critically Endangered
- Silver Perch (*Bidyanus bidyanus*) – Vulnerable
- Western population of Olive Perchlet (*Ambassis agassizii*) – Endangered population

- Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (Darling River Endangered Ecological Community) – Endangered ecological community.

The likely impacts of the proposal on these listed species, populations and ecological communities is assessed in accordance with the 'seven-part test' outlined in sections 221ZV and 221ZX of the FM Act in Appendix B of **Technical Report 3** and summarised in **Section 13.6.5**.

Impacts to critical habitat

While the Darling River (Baaka) at Wilcannia is known to support threatened aquatic species, no areas have been declared to be 'critical habitat' in accordance with Part 7A, Division 3 of the FM Act.

Permits

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 new weir and demolition of the existing weir 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. In addition, construction and operation of the proposal would result in the 'temporary or permanent blockage of fish passage within watercourses' as defined under section 219 of the FM Act.

Provision of a fishway

A public authority that proposes to construct, alter or modify a weir on a waterway is subject to the provisions of section 218(5) of the FM Act, which requires that the Minister for Agriculture be notified of the proposal and allows for the Minister for Agriculture to request that the works include a suitable fishway or fish by-pass. The proposal includes a fishway, and Water Infrastructure NSW has consulted with NSW Fisheries as part of its preparation of a preliminary concept design for the proposal.

This assessment is based on a preliminary concept design of the proposed fishway. The fishway would be subject to further design development in the detailed design phase of the proposal. Water Infrastructure NSW would engage with NSW Fisheries during the further development of the fishway design and seek their agreement on the suitability of the final fishway design.

Key threatening processes

Schedule 6 of the FM Act outlines the key threatening processes related to aquatic species and ecological communities. Of the key threatening processes listed, the proposal is expected to involve the following:

- Installation and operation of instream structure and other mechanisms that alter natural flow regimes of rivers and streams
- Degradation of native riparian vegetation along NSW watercourses
- Removal of large woody debris from NSW rivers and streams.

However, as noted in **Section 4.3.2**, by force of section 5.23 of the EP&A Act, the requirement to receive permits for these activities (listed under sections 201, 205 or 219 of the FM Act) do not apply.

Despite the exemption, the proposal aims to maintain fish passage throughout construction and operation of the new weir through design of an appropriate instream construction methodology and construction of a fishway for use during the second stage of construction of the new weir and during its operation.

13.1.3 Policy and Guidelines for Fish Habitat Conservation and Management

The *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013) is the guideline applicable to all planning and development proposals and various activities that affect freshwater ecosystems in NSW. The aim of the guidelines is to maintain and enhance fish habitat for the benefit of native fish species, including threatened species, in freshwater environments. The guidelines are taken into account when NSW Fisheries assess proposals for developments and other activities that affect fish habitats.

NSW Fisheries is responsible for the application of the *Policy and Guidelines for Fish Habitat Conservation and Management* on key fish habitat, ensuring mitigation and compensation measures are in place to redress any adverse environmental impacts to aquatic systems. The guideline states that to ensure no net loss of aquatic habitats, proponents should avoid impacts to key fish habitat. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works.

The Darling River (Baaka) is 'Type 1 – Highly Sensitive Key Fish Habitat'. The impact of the proposal on key fish habitat are described in **Section 13.6.6**. Impacts to key fish habitat would be offset (refer to **Section 13.7.1**).

13.1.4 Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings

Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003) provides practical guidelines for the planning, design, construction and maintenance of watercourse crossings aimed at minimising impacts of fish passage and aquatic ecology in general. The proposed new weir has been designed in accordance with the requirements of this guideline. The assessment of impacts to aquatic habitat has also taken into account the requirements of these guidelines.

13.1.5 Aquatic Ecology in Environmental Impact Assessment – EIA Guideline

The *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Department of Planning, 2003) provides a framework for the identification, prediction and assessment of aquatic ecology impacts and suggest approaches to the management of impacts that have been predicted or observed through monitoring. This guideline was taken into consideration during the preparation of **Technical Report 3**.

13.1.6 NSW Biodiversity Offsets Policy for Major Projects

The *NSW Biodiversity Offsets Policy for Major Projects* (Office of Environment and Heritage, 2014) clarifies and standardises biodiversity impact assessment and offsetting for major project approvals in NSW. Under the policy, the default position is that impacts must be offset in a like-for-like manner. This means that aquatic habitat that is impacted must be offset with the same aquatic habitat. Where like-for-like is not available (provided reasonable steps have been taken to locate an appropriate measure at that level), variation rules can be applied to allow for aquatic habitat to be offset in similar or more threatened habitat within the same catchment.

Unlike terrestrial biodiversity offsets, aquatic habitat offsets are not undertaken through biodiversity stewardship agreements, as a method for quantifying aquatic biodiversity using tradable credits is yet to be developed. Aquatic offsets instead use mechanisms outlined in the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013).

The Biodiversity Offset Policy states that "to meet aquatic biodiversity offset requirements, the NSW Fisheries policy and guidelines (Department of Primary Industries, 2013) will classify the habitat types being offset. It will then apply a ratio and dollar value to determine the total dollar value of the offset required to be implemented by the proponent via on-ground protection or rehabilitation works, or placed into the aquatic biodiversity offset fund. The proponent will have the opportunity to reduce this cost through direct negotiation with NSW Fisheries, subject to meeting the minimum overall offset ratio requirements".

The area of aquatic habitat required to be offset for the proposal has been identified and considered in accordance with the relevant guidelines. This is further discussed in **Section 13.7.1**.

13.1.7 NSW Weirs Policy

The *NSW Weirs Policy* (NSW Government, 1997) provides a framework for the review of weirs across NSW, and establishes the goals and principles for the ongoing approval and management of weirs. The goal of the *NSW Weirs Policy* is to halt and, where possible, reduce and remediate the environmental impacts of weirs. The *NSW Weirs Policy* has three components, the first relates to the approval to build a new weir or expand an existing weir, the second is a review of all existing weirs (Weir Review Program) and the third addresses the provision of fishways. Of relevance to this assessment, the first and third components of the policy have been taken into consideration. The fishway for the proposal has been designed with consideration of factors outlined in the *NSW Weirs Policy*. This is further discussed in Section 8 of **Technical Report 3**.

13.2 Assessment methodology

The methodology for assessing the potential aquatic ecology impacts of the proposal included:

- Desktop assessment — The desktop assessment involved a review of public database searches, literature and previous reports relevant to the proposal, as well as the proposal design. The database search included the Protected Matters Search Tool (Department of Agriculture, Water and the Environment, 2021), Bionet – The Atlas of NSW Wildlife Threatened Species Profile Database (EESG, 2021), the Atlas of Living Australia (ALA, 2021) and key fish habitat mapping and threatened species distribution maps (DPIE, 2021)
- Field survey — A visual aquatic habitat assessment of the Darling River (Baaka) upstream and downstream of Wilcannia was undertaken in November 2020. The purpose of the field assessment was primarily to characterise the aquatic environment of the Darling River (Baaka) in the reach that would be impacted by the proposal. This involved a visual aquatic habitat assessment at 25 accessible sites along the length of this reach
- Storage behaviour modelling — The downstream flow-spell analysis discussed in **Section 7.2.2** was reviewed to analyse the frequency and duration of discharges from the new weir compared to those from the existing weir. The storage behaviour modelling was also used to analyse the frequency, duration and level of inundation upstream of the new weir compared to inundation caused by the existing weir
- Hydrodynamic modelling – The hydrodynamic modelling discussed in **Section 7.2.3** was analysed to assess the impact of the proposal on water velocities during the native fish breeding season at the upstream end of the existing weir pool and the reach of the river upstream of the existing weir pool, which are characterised by higher quality fish habitat
- Risk assessment — A risk assessment approach based on the likelihood of an impact occurring and the consequence of that impact was used to determine the magnitude of risks to aquatic values. Likelihood and consequence criteria were adapted from the *Threatened Species Status Assessment Manual* (Threatened Species Scientific Community, 2015) as a way for establishing whether the proposal could have an adverse effect on the population, habitat or life history needs of a threatened species.

13.3 Risk

The proposal poses a range or risks to aquatic ecology during both construction and operation including:

- Construction works within waterways can cause direct and indirect harm to aquatic species by:
  - Construction equipment or machinery coming into direct contact with aquatic species causing injury or death
  - Removal of instream vegetation that aquatic species depend on them for food supply, shelter, spawning and recruitment processes

  - Removal of riparian vegetation and riverbank excavation, which can indirectly impact aquatic species as it can affect water quality if runoff is able to mobilise exposed soils into the waterway or may reduce channel stability which could result in increased bank erosion and subsequent sediment deposition downstream of the works
  - Creating a barrier to fish passage by stopping the movement of fish species upstream or downstream
- Construction sites near waterways have the potential to impact water quality due to mobilisation of sediments and other contaminants via wind, stormwater runoff or construction discharges/dewatering. Mobilisation of sediments and poor water quality have the potential to directly harm native species that are unable to tolerate changes to water quality or can favour the proliferation of pest species that may be able to tolerate poorer water quality (i.e. Common Carp). In particular, concrete works can result in concrete dust, concrete slurries or washout water entering downstream waters and as these concrete by-products are alkaline, with a pH of about 12, they have the potential to alter the pH of downstream watercourses which can be harmful to aquatic life that are sensitive to changes in water quality. Additionally, concrete washout water contains high levels of chromium that can accumulate in the gills and intestines of fish.

13.4 Avoidance and minimisation of impacts

The existing Wilcannia Weir prevents fish passage except during high flows (above 5,000 megalitres per day) when the weir is drowned out such that downstream water levels are close to upstream water levels. The new weir is designed to provide fish passage when flow is greater than 60 megalitres per day. The 119-year simulation of the operation of the new and existing weirs that was used to assess the hydrology impacts of the proposal (refer to **Section 7.2.1**) was also used to predict the improvement in fish passage that the new weir would provide. It showed that the inclusion of a fishway would substantially increases the number of consecutive days that fish passage is possible from a mean of 46 consecutive days at the existing weir to 162 consecutive days at the new weir. The number of days that fish passage is available during the spawning season (September to December) would on average nearly double from 37.5 days at the existing weir to 66 days at the new weir. The increase in fish passage at the new weir compared to the existing weir is illustrated in **Figure 13-1**.

Increased fish passage would provide species with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which would in turn boost biodiversity, long-term population resilience and contribute to food webs.

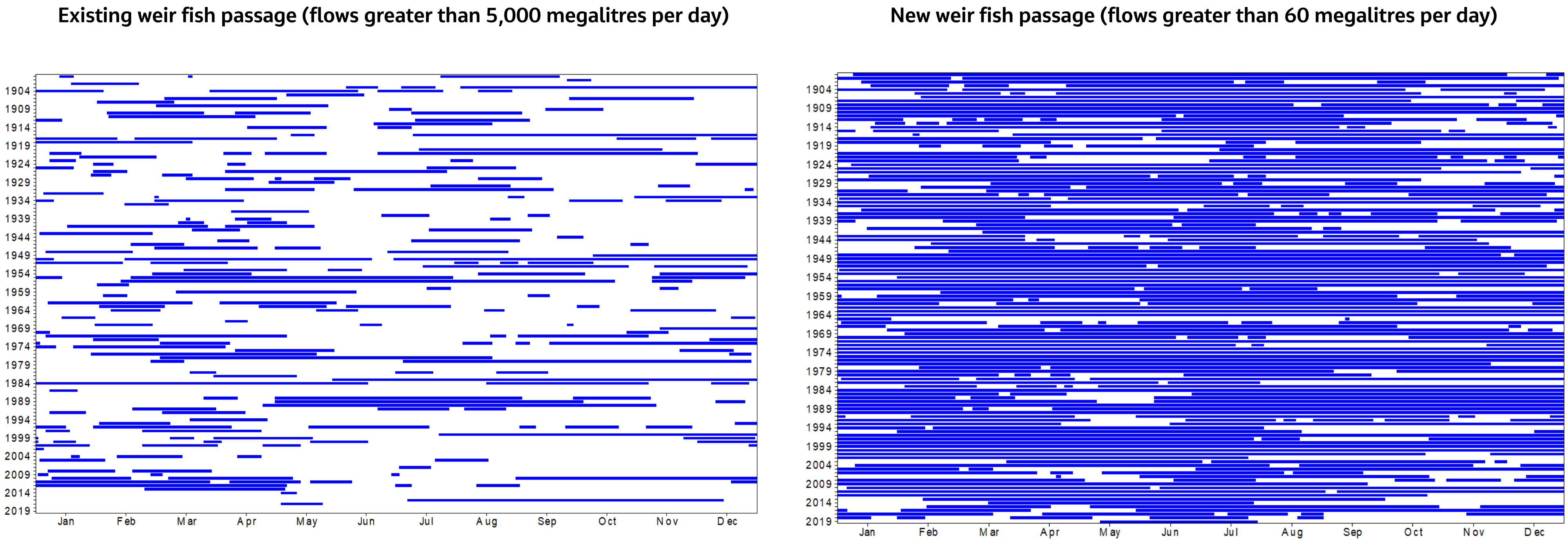


Figure 13-1 Distribution of times when fish passage is available (blue lines) for the existing weir (left) and new weir (right) over the 119-year simulation period, 1900 to 2019

13.5 Existing environment

The semi-arid, lowland region of the Darling River (Baaka) is characterised as meandering, slow-flowing and turbid, often surrounded by extensive floodplains containing billabongs, swamps and River Red Gum (*Eucalyptus camaldulensis*) riparian zone and forests (Lintermans, 2007). The freshwater environment of the main Darling River (Baaka) channel comprises an extensive range of physical aquatic environments including deep pools, shallow runs/riffles, benches and sand/gravel beds (Department of Primary Industries, 2015). Other aquatic habitat features within the channel include aquatic and riparian vegetation, overhanging banks, fallen trees, snags and woody debris which have fallen instream and now form important niche habitats that provide protection from predatory birds and other fish, feeding and breeding locations, as well as shade and refuge from flows (Lintermans, 2007).

There are 15 weirs along the main channel of the Barwon-Darling River (Baaka) upstream of Menindee Lakes, including Wilcannia Weir, as shown in **Figure 13-2**. These weirs create weir pools that submerge aquatic habitat features (woody debris and aquatic vegetation), reduce flows and increase the occurrence of cease-to-flow events downstream of each weir. The non-flowing (lentic) water pooled behind weirs can cause reduced water quality, potential increased occurrence of algal blooms, as well as impacts to breeding and spawning conditions of several native species that require flowing conditions. Existing weirs also present barriers to fish movement along the river, particularly during low flow periods (weirs are drowned at higher/flood flows). Conversely, weir pools may provide refuge habitat for a range of biota during extended cease-to-flow periods.

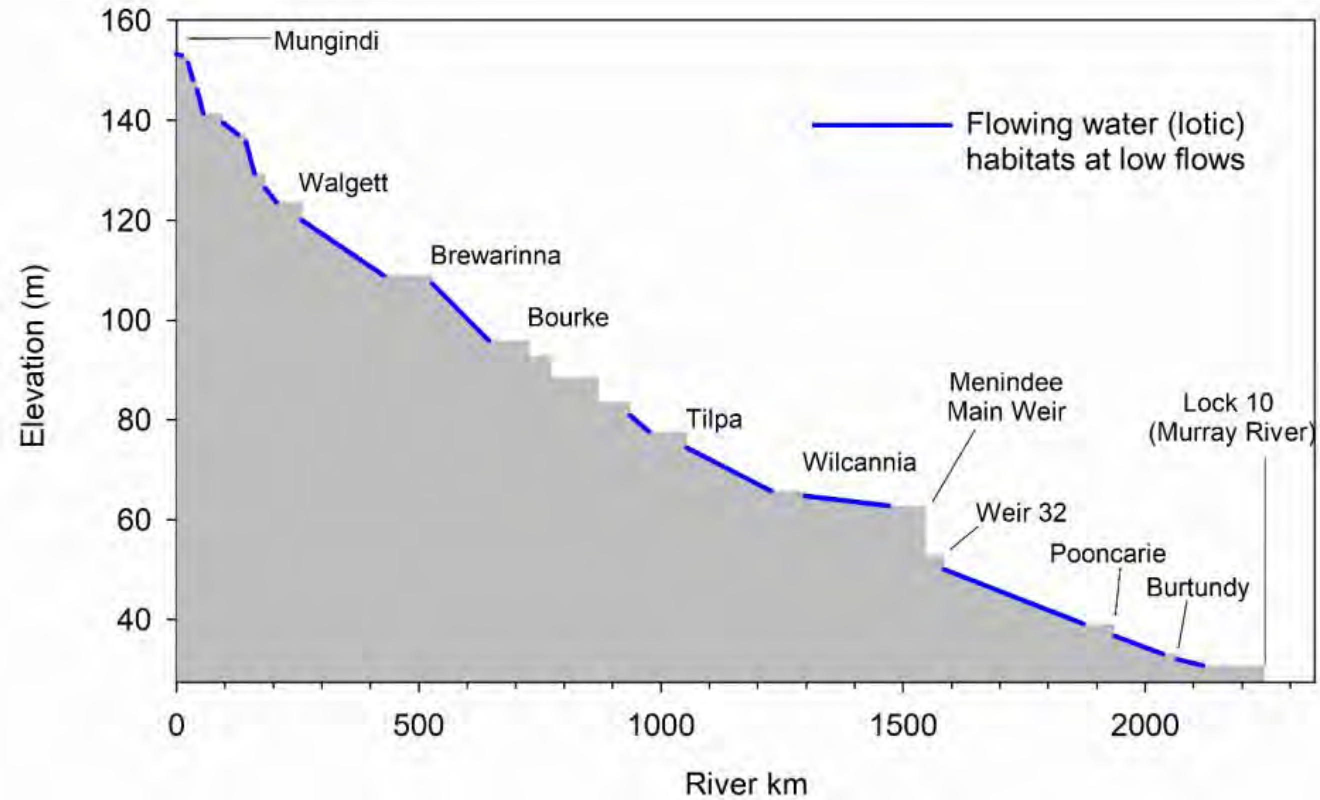


Figure 13-2 Profile of the Barwon-Darling River showing flowing reaches between existing weir pools

Source: Mallen-Cooper and Zampatti (2020)

The Darling River (Baaka) is 'Type 1 – Highly Sensitive Key Fish Habitat' (DPIE, 2021). It supports a diverse assemblage of native and introduced aquatic species. Nineteen fish species are known to inhabit the system, including 15 native species and four alien species (Department of Primary Industries, 2015). Three native species that are listed as threatened under both the EPBC Act and FM Act are predicted to occur at Wilcannia: Murray Cod (*Maccullochella peelii*), Silver Perch (*Bidyanus bidyanus*) and the western population of the Olive Perchlet (*Ambassis agassizii*). The Darling River Snail (*Notopala sublineata*), which is listed as a critically endangered aquatic species under the FM Act, is also predicted within the system (although no live specimens have been recently recorded in the Darling River (Baaka)), as is the River Mussel (Mallen-Cooper and Zampatti, 2020). Turtle species that have been recorded upstream and downstream of Wilcannia include the Eastern Long-necked Turtle (*Chelodina longicollis*), Broad-shelled Turtle (*Chelodina expansa*) and Murray River Turtle (*Emydura macquarii*).

Four alien species are known to occur in the Darling River (Baaka) and include Common Carp (*Cyrinus carpio*), Eastern Gambusia (*Gambusia holbrooki*), Redfin Perch (*Perca fluviatilis*) and Goldfish (*Carassius auratus*). Carp is the most common alien fish in the catchment and there are several mapped 'carp hot spots' immediately upstream and downstream of Wilcannia (Department of Primary Industries, 2015).

An assessment of fish community status of the Barwon-Darling valley by NSW Fisheries in 2015 suggested that the fish community between Tilpa and Menindee Lakes was in moderate health and fish condition status is mapped as fair to good in the main channel and good in anabranches and inflowing unregulated creek and rivers, with minimal reaches below poor condition and some parts in good to very good condition (Department of Primary Industries, 2015).

The proposal lies wholly within the endangered ecological community known as 'the natural drainage system of the lowland catchment of the Darling River' (Darling River Endangered Ecological Community), which is protected under the FM Act. The Darling River Endangered Ecological Community encompasses a large area of inland NSW including the Barwon-Darling River (Baaka) (refer to **Figure 13-3**). This aquatic endangered ecological community comprises all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River (Baaka) within NSW.

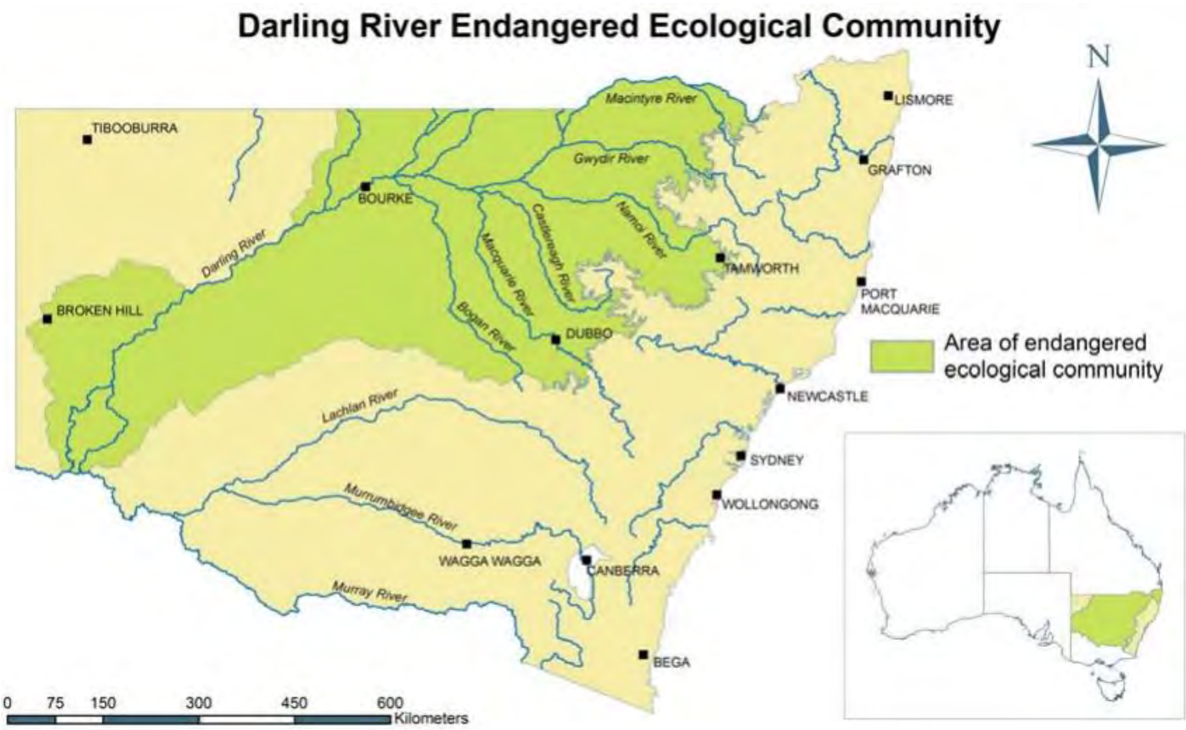


Figure 13-3 Area of the Darling River Endangered Ecological Community

Source: Department of Primary Industries (2007)

13.6 Assessment of impacts

13.6.1 Construction impacts

The construction of the proposal would have the following impacts that would potentially either directly or indirectly effect aquatic ecology:

- Instream works — Instream works are required for the construction of the new weir and partial removal and decommissioning of the existing weir. This would include plant and equipment being used to build temporary cofferdams at the new and existing weir sites to create dry work sites on the riverbed for construction of the fishway, fixed crest weir, weir gate bay and embankments and partial removal of the existing weir. Aquatic species would be at risk of being directly struck by construction plant during these works. Instream works would also block or reduce fish passage due to the use of cofferdams
- Removal of instream vegetation — The construction of the new weir would require clearing of instream vegetation and displacement of aquatic habitat features where work sites are proposed on the riverbed. This would include removing large woody debris and rocks. This would reduce the habitat available to aquatic species for food supply, shelter, spawning and recruitment processes
- Removal of riparian vegetation and riverbank excavation — Riparian vegetation would be removed and the riverbanks excavated on both sides of the Darling River (Baaka) at the new weir site (refer to **Figure 3-2** and **Figure 3-3**). The partial removal of the existing weir would also require clearing of a small amount of riparian vegetation to allow construction plant and equipment to access the river. These works would expose soils on the embankments, which could erode into the river which would reduce water quality and potentially smother aquatic vegetation. The works could also reduce the stability of the riverbanks
- Construction sites near the river — Construction sites are proposed alongside the Darling River (Baaka) and would be used for stockpiling materials and spoil, storage and treatment of wastewater, construction offices and amenity blocks and laydown of plant, equipment and materials. There is potential for sediments and other contaminants to be mobilised from these work sites and travel into the river via wind, stormwater runoff or construction discharges/dewatering. As noted above, sediment that enters the river would reduce

water quality and potentially smother aquatic vegetation, while contaminants would also affect water quality and could be toxic to some species. As noted in **Section 13.3**, mobilisation of sediments and poor water quality have the potential to directly harm native species that are unable to tolerate changes to water quality or can favour the proliferation of pest species that may be able to tolerate poorer water quality (i.e. Common Carp)

- Concrete works —Concrete works are proposed alongside the river and these could result in concrete dust, concrete slurries or washout water entering downstream waters. As noted in **Section 13.3**, wastes from concrete works pose a risk to water quality and the health of fish.

The construction impacts to aquatic ecology described above are typical for projects that involve works in and around waterways and would be managed by implementing the surface water quality mitigation and management measures identified in **Table 10-3** and the specific aquatic ecology mitigation and management measures identified in Table 13-1.

13.6.2 Operational impacts –inundation upstream of the new weir

During the operational phase of the proposal, potential risks to the aquatic community of the Darling River (Baaka) are associated with changes to the extent, depth, frequency and duration of upstream inundation due to the position of the new weir and its operating at times at levels above the full supply level of the existing weir, as well as changes to flows downstream of the new weir.

Changes to upstream inundation would occur due to:

- The new weir being about 4.92 river kilometres downstream of the existing weir, resulting in this section of the river becoming permanently inundated to create the new town pool
- The weir pool being one meter deeper and extending about 18.81 river kilometres upstream of the existing weir pool extent when the new weir is in drought security operation mode and operating at the drought full supply level of 66.71 metres AHD. This temporary upstream extension of the weir pool represents about 10 per cent of the flowing water habitat between the existing weir pool extent and the next upstream weir, Tilpa Weir, located about 180 kilometres upstream of the existing weir pool extent.

These changes to upstream inundation would result in the following key impacts to the aquatic ecosystems:

- The new town pool would permanently change from a flowing (lotic) to still-water (lentic) environment.
- When the new weir is in drought security operation mode, the change in the environment at the upstream extent of the extended weir pool would depend on whether there are inflows to the weir pool:
  - When there are inflows to the weir pool, the incremental increase in the weir pool would be still-water instead of flowing
  - Where there are no inflows to the weir pool, the incremental increase in the weir pool would be still-water instead of being dry.

The permanently change in the hydraulic characteristics of the river at the new town pool from a flowing environment to a still water environment has the potential to impact the abundance and diversity of species reliant on flowing conditions as it can disrupt life-cycles of species and degrade habitat conditions (Sheldon, 2017). The native Freshwater Fish Community Status in this section of channel has been classified as fair. However, the habitat conditions are overall poor and it is unlikely that the reach represents critical spawning or refuge habitat for threatened species, although some live River Mussels were observed during site inspections.

At the upstream end of the extended weir pool, while there would not be a permanent change from flowing to non-flowing hydraulic habitat, there would be a number of potential effects associated with inundation during drought security operation mode. The increase in the area of inundation may provide additional refuge habitat for fish during non-flowing periods. This could benefit some native species but may also benefit pest species (such as Common Carp). However, the relative effect compared to current conditions is likely to be small because even under current condition there is a large length of inundated river reach that provides similar habitat for native and non-native fish.

With regard to benthic species, River Mussels have been recorded in the reach of the river upstream of the existing weir pool. River Mussels prefer flowing channel environments (Ponder, et al, 2020; Department of Primary Industries, 2018) so the conversion of flowing to non-flowing habitat represents a threat to River Mussels as they are sedentary, filter-feeders (Ponder, et al, 2020), meaning they rely on flow for their food source and are also considered to be "oxyconformers", meaning they rely on flow for their food source and to maintain a stable environmental supply of oxygen (Sheldon and Walker, 1989; Jones, 2007; Ponder et al, 2020). Hence, River Mussels tend to be recorded in permanent lotic (flowing) habitat rather than lentic (still) weir pools which may also be subject to low oxygen conditions. Recent surveys have also shown that long duration cease to flow conditions experienced in the Darling River (Baaka) in 2017-2020 resulted in mortality of River Mussels, especially in sections of the river that experienced dry channel bed, including areas upstream of the existing weir pool, and that while not ideal habitat, isolated pools may provide refuge habitat for some individuals during extended cease to flow periods (Sheldon et al. 2020). However, as discussed above, it is expected that the proportion of time this section of the river remains wet but not flowing would be comparable to the length of time that the channel would have otherwise been dry (i.e. there is no substantial shift in conditions from flowing to non-flowing, the shift is from dry to wet but not flowing). The implications for River Mussels of this shift from lotic to lentic, or dry to lentic conditions is likely to vary and would depend on the frequency and duration of any change in hydraulic conditions as a result of the temporary extension of the weir pool. Although it is acknowledged that non-flowing habitat is not ideal habitat for River Mussels, Sheldon et al. (2020) suggest that River Mussels are more likely to survive cease-to-flow conditions where refuge pools are present. It is considered possible that River Mussels would be able to survive submerged within the temporarily extended weir pool during drought security operation mode for a period of time equivalent to the existing duration of dry conditions. Upon resumption of inflows the new weir would return to normal operation mode and flowing conditions would return to the reach of the river upstream of the existing weir pool similar to what currently occurs.

13.6.3 Operational impacts – upstream flowing water habitat

Further analysis of the hydrodynamic modelling results (refer to **Section 7.6.2**) was carried out by considering the impact of the new weir on flowing water habitats. Flowing water habitat supports biodiversity and ecosystem integrity in the Darling River (Baaka). The timing, duration and extent of flowing water required for successful spawning differs between aquatic species.

The analysis considered three water velocity criteria based on Mallen-Cooper and Zampatti (2018) to indicate stream health for native fish, freshwater mussels, and snails in the Darling River (Baaka) at Wilcannia:

- 0.3 metres per second – high quality flowing water habitat
- 0.2 metres per second – minimum to maintain flowing water habitat
- 0.1 metres per second – tolerable short-term habitat.

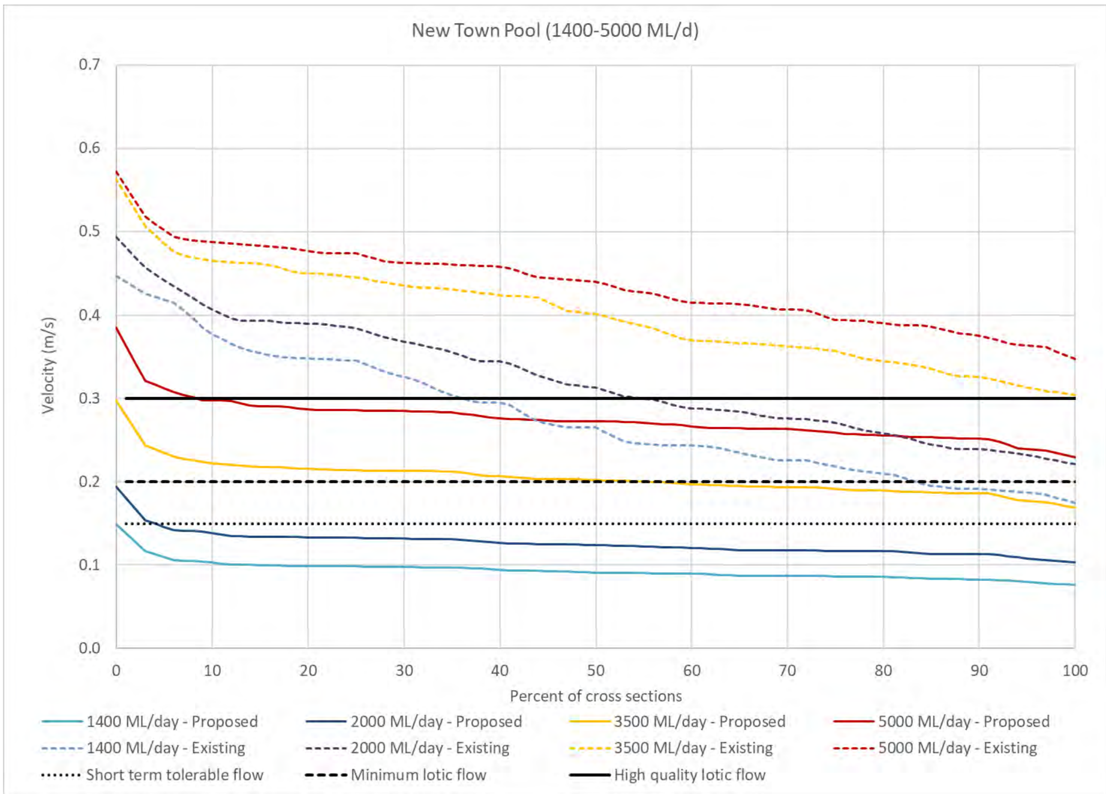
The analysis considered the impact of the new weir on flowing water habitat in five reaches of the river:

- The new town pool, between the new weir (chainage -4920 downstream) and existing weir (chainage 0)
- The existing weir pool (chainage 0 to 61790 upstream)
- Bars 1, 2 and 3 (chainages 5430, 30120 and 49200)
- Between Bar 3 and the existing weir pool extent (chainage 49200 to 61790)
- Upstream of the existing weir pool to the new weir pool extent (chainage 61790 to 80683).

The analysis compared the existing and predicted water velocities to the flowing water habitat criteria for each of the 219 modelled cross sections that were located within the overall river reach being analysed. The results of the analysis are presented in **Figure 13-4** to **Figure 13-8** and are shown as a comparison of the flowing water habitat criteria and the range of water velocities at the cross sections within the reach of the river being analysed.

The analysis shows that:

- New town pool — The proposal would significantly reduce flowing water habitat conditions in the new town pool (refer to **Figure 13-4**). This reach of the river currently provides flowing water habitat / hydraulic complexity at flow rates across the range analysed (200 to 5,000 megalitres per day). Under the proposal, the new town pool would only provide flowing habitat at higher flows; minimum flowing habitat would be present across about 50 per cent of cross sections at a flow of 3,500 megalitres per day and higher. While at a flow of 5,000 megalitres per day and above minimum flowing habitat would be present across all cross sections. At median flows (800 megalitres per day) and lower, velocity would be less than 0.1 m/s, indicating flowing conditions would be replaced with non-flowing conditions are these flow rates representing a loss of Type 1 Key Fish habitat. The new town pool (about 4.92 river kilometres) represents about five per cent of the flowing reach between the existing weir and the upstream extent of Lake Wetherell (about180 river kilometres)
- Existing weir pool — There would be little change in the velocity profiles between existing and proposed conditions for flow rates up to 350 megalitres per day (refer to **Figure 13-5)**. For flows in the range 600 to 3,500 megalitres per day there is a reduction in the number of cross sections that experience high quality flowing conditions, although minimum and high quality lotic conditions would still be present at some locations across the weir pool. At flows of 5,000 megalitres per day most cross-sections would retain high quality flowing habitat
- Bars 1, 2 and 3 — Water velocities at Bars 1, 2 and 3 are an important consideration as they provide flowing habitat during lower flows as well as providing hydraulic complexity or variability. The proposal would result in a reduction in velocity over Bars 1, 2 and 3, especially at intermediate flows (in the range 600 to 1,400 megalitres per day). The velocity reduction is small at low flows (less than 350 megalitres per day) and under both current and proposed operation velocity at Bars 2 and 3 would experience flows around the moderate flow threshold (refer to **Figure 13-6**). As flow increases the velocity differential increases with more substantial velocity reductions under proposed conditions compared to current conditions at flows of 600 to 1,400 megalitres per day. At these flows, velocity declines from high quality habitat to the minimum required to maintain lotic habitat at Bars 1 and 2 but remains above moderate velocity habitat at Bar 3. At flows of 2,000 to 5,000 megalitres per day the velocities under proposed conditions are still lower than those under current conditions but the differential decreases and even under proposed conditions velocities remain above the minimum required to maintain lotic habitat at all three bars (refer to **Figure 13-6**). Notably, the velocity differential is less at Bar 3 compared to Bars 1 and 2 – Bar 3 would continue to provide access to flowing habitat for biota within the existing weir pool across a range of flows and Bars 1 and 2 would provide flowing habitat at higher flows (refer to Figure 6 16). Overall, the predicted reduction in water velocities at Bars 1 and 2 and, to a lesser extent, Bar 3 would reduce hydraulic complexity/variability within the weir pool
- Upstream of Bar 3 — The proposal would result in a reduction in high quality flowing water habitat conditions upstream of Bar 3 to the existing weir pool extent for flows less than 5,000 megalitres per day and particularly flows less than 2,000 megalitres per day (refer to **Figure 13-7**). Minimum lotic conditions would be maintained in this reach for all flows of 3,500 megalitres per day and above, and for most of this reach for flows between 1,400 and 3,500 megalitres per day. The proposal would not significantly reduce flowing water habitat conditions upstream of the existing weir pool (refer to **Figure 13-8**). While there would be a small decrease in high quality flowing water habitat conditions at high flow rates, these habitat conditions would still exist at many locations in this reach of the river.



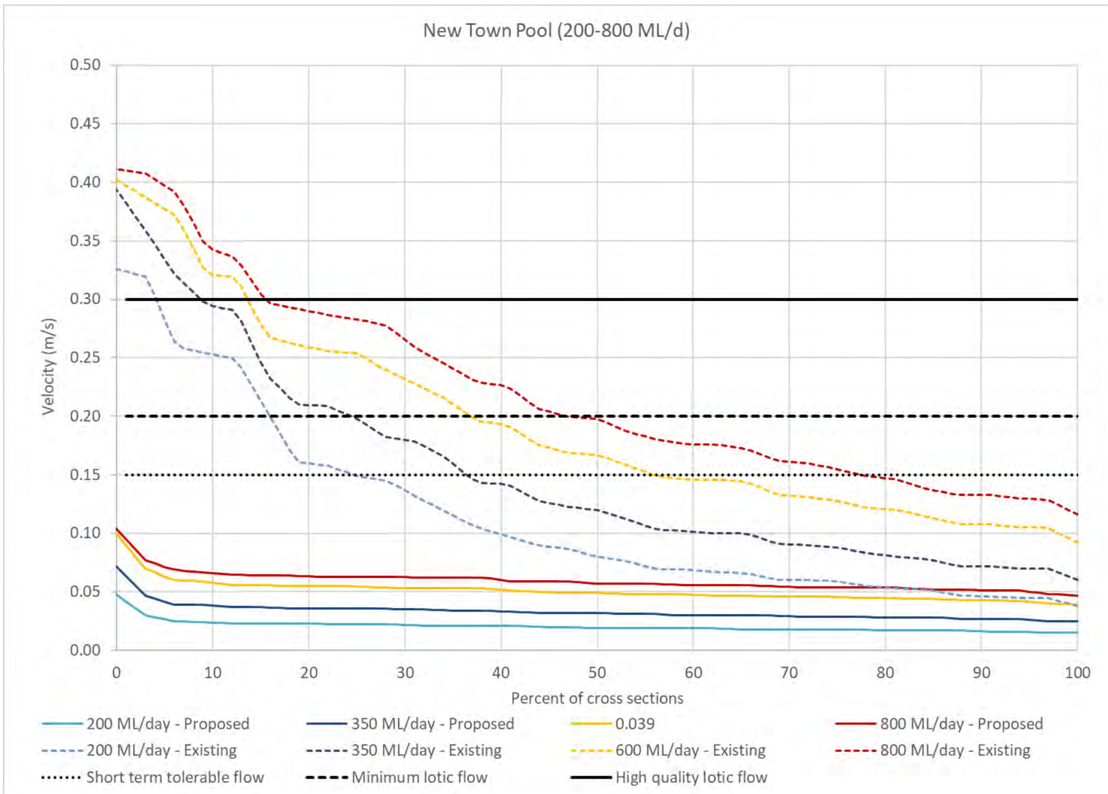
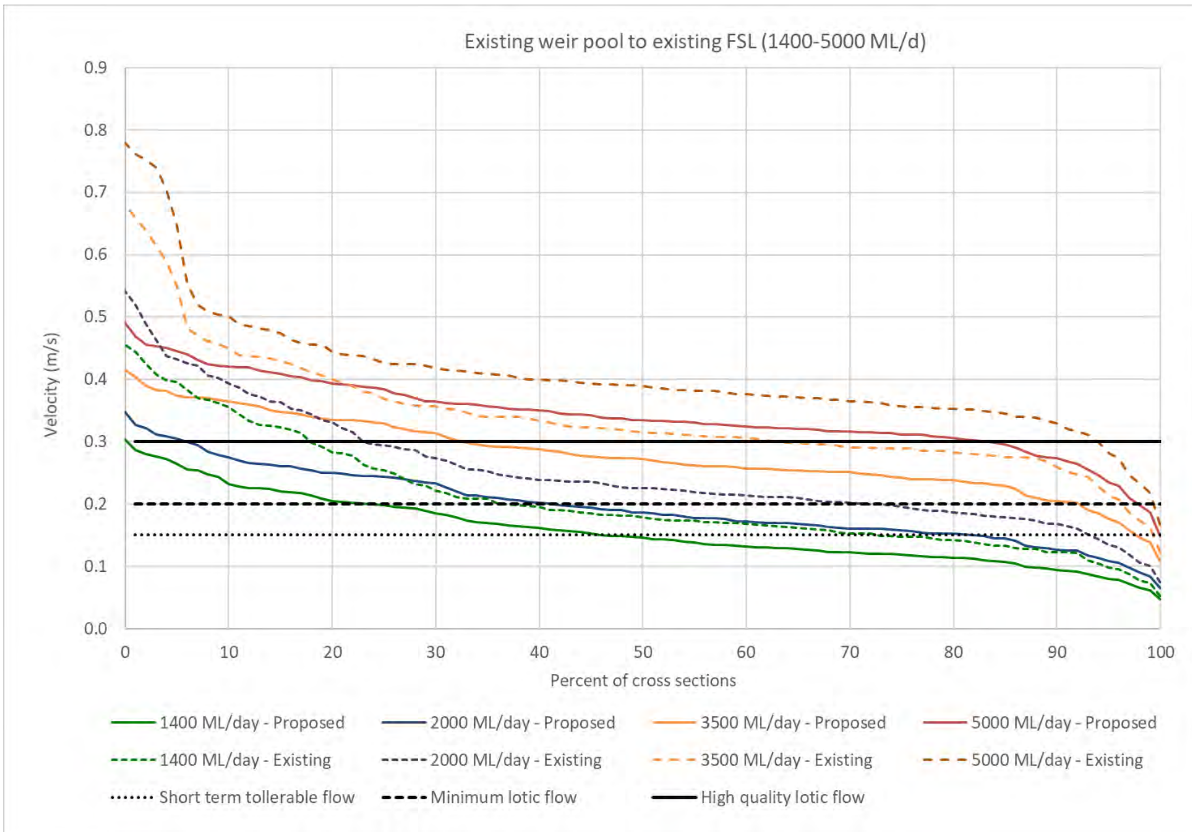


Figure 13-4 Comparison of water velocities to the flowing water habitat criteria in the new town pool (chainage - 4920 to 0)



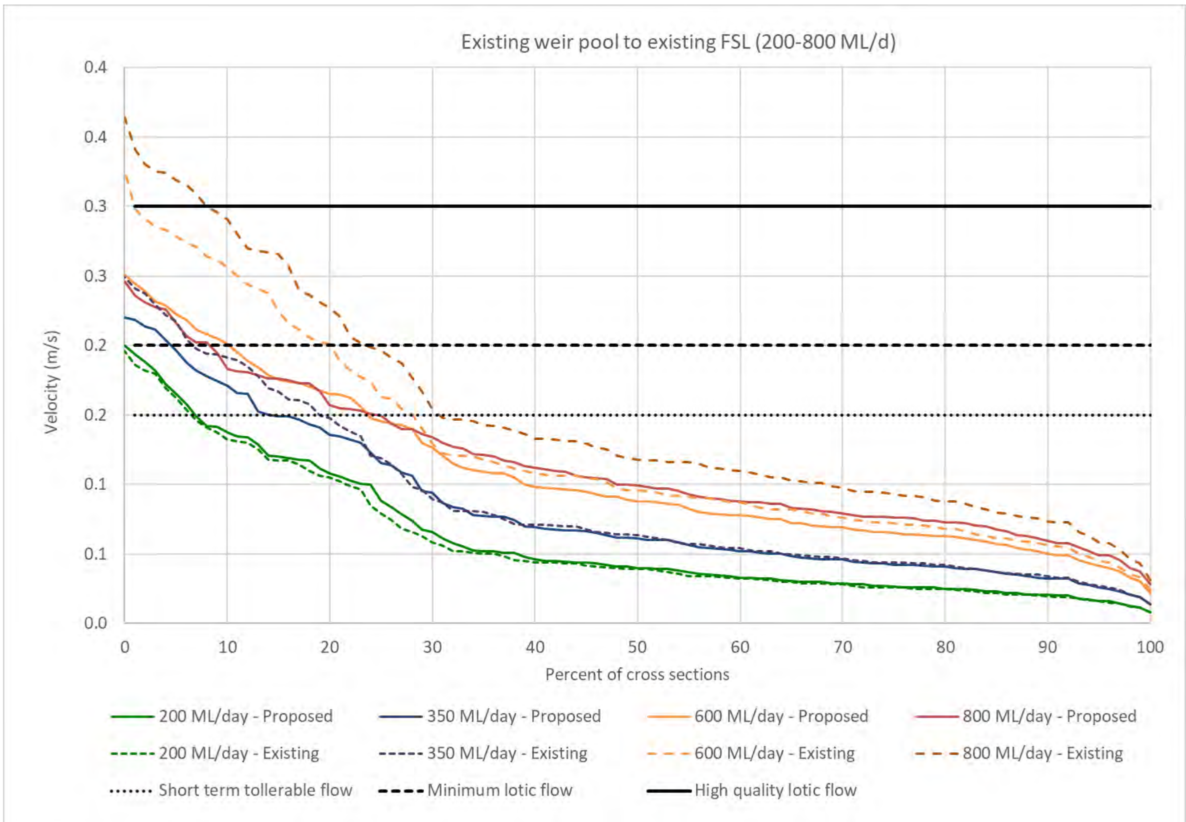


Figure 13-5 Comparison of water velocities to the flowing water habitat criteria in the existing weir pool (chainage 0 to 61790)

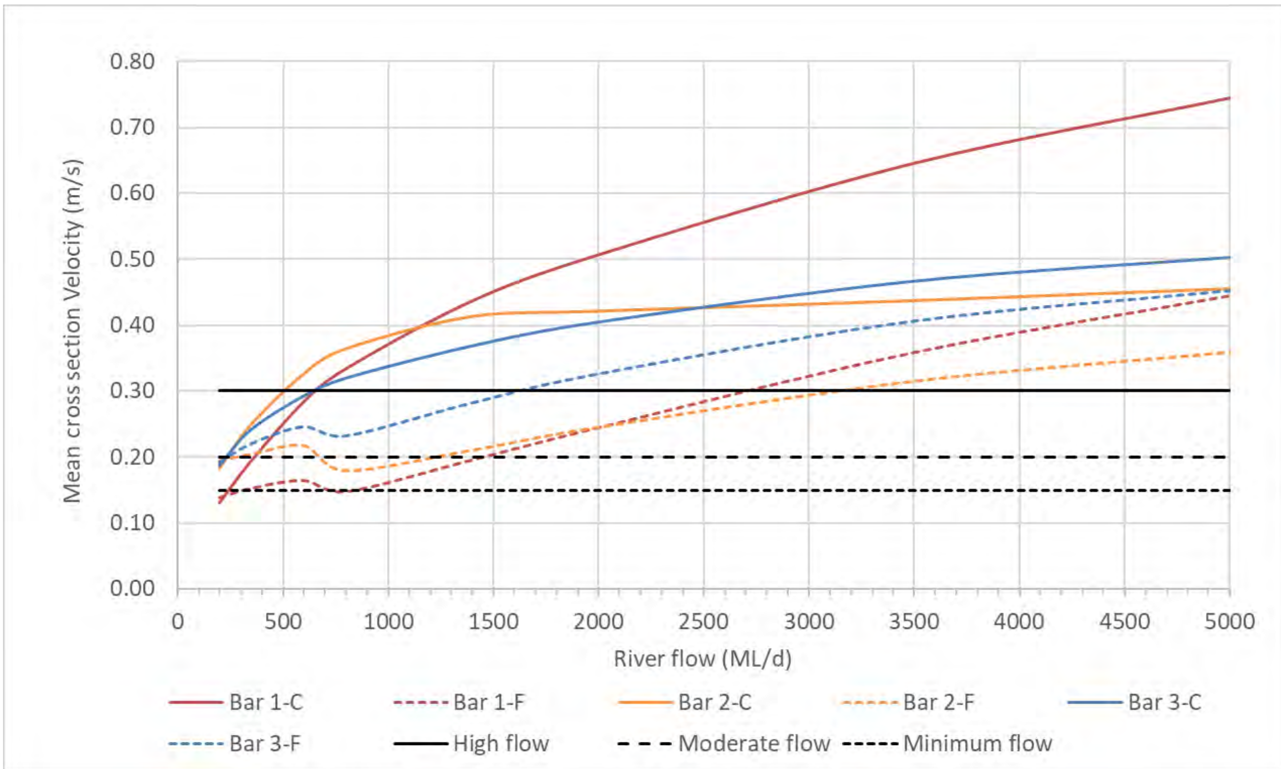
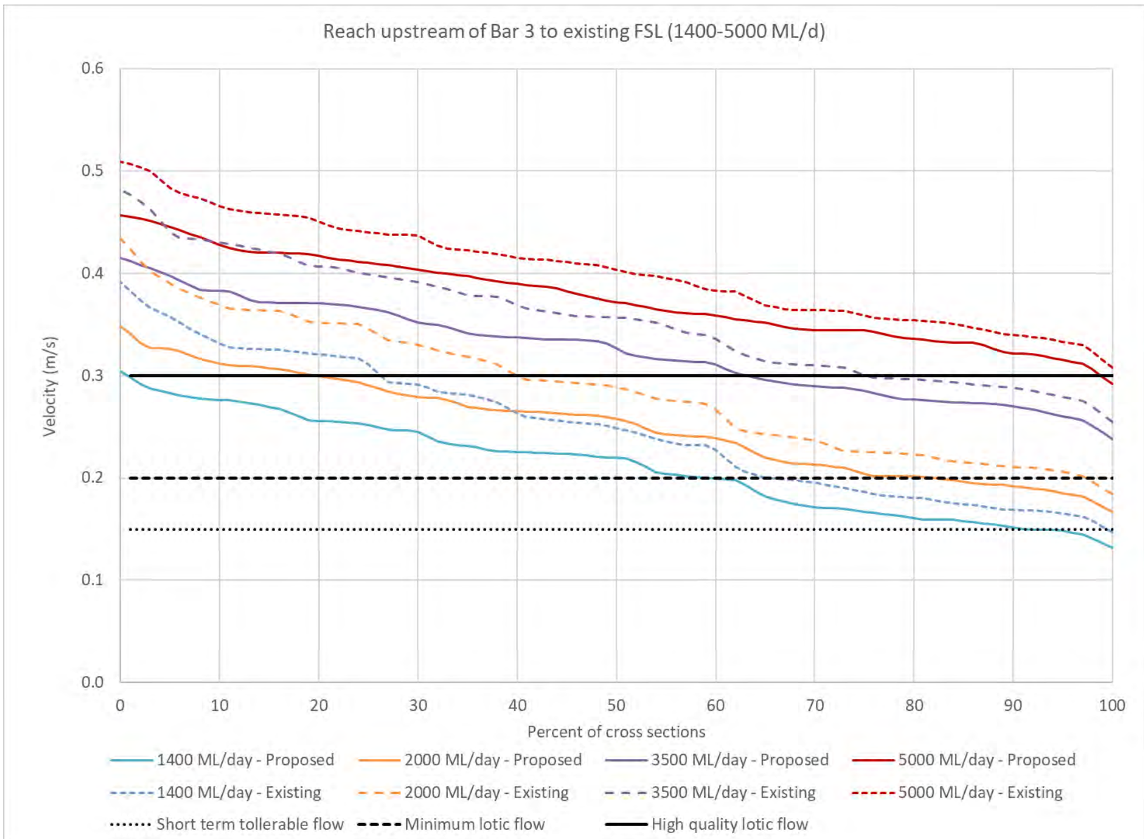


Figure 13-6 Change in water velocity at Bars 1, 2 and 3 between current (C) and future (F) conditions during normal operation mode at flow rates up to 5,000 megalitres per day



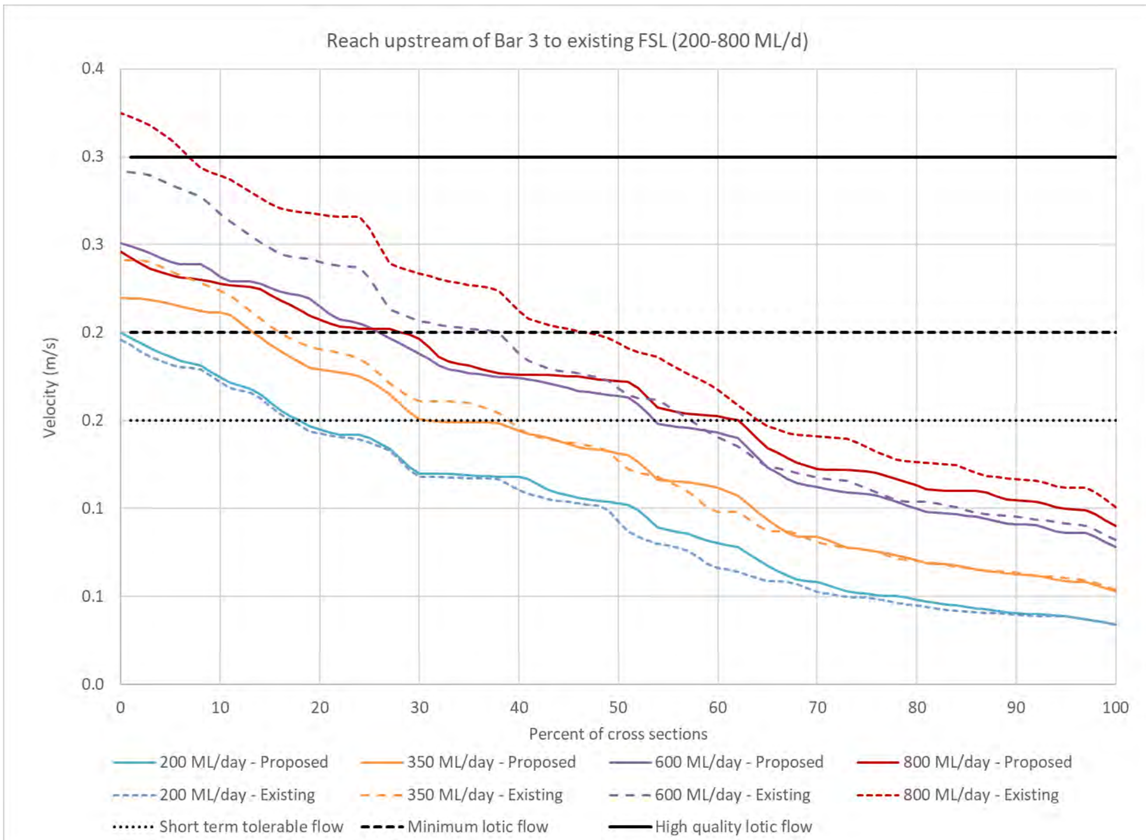
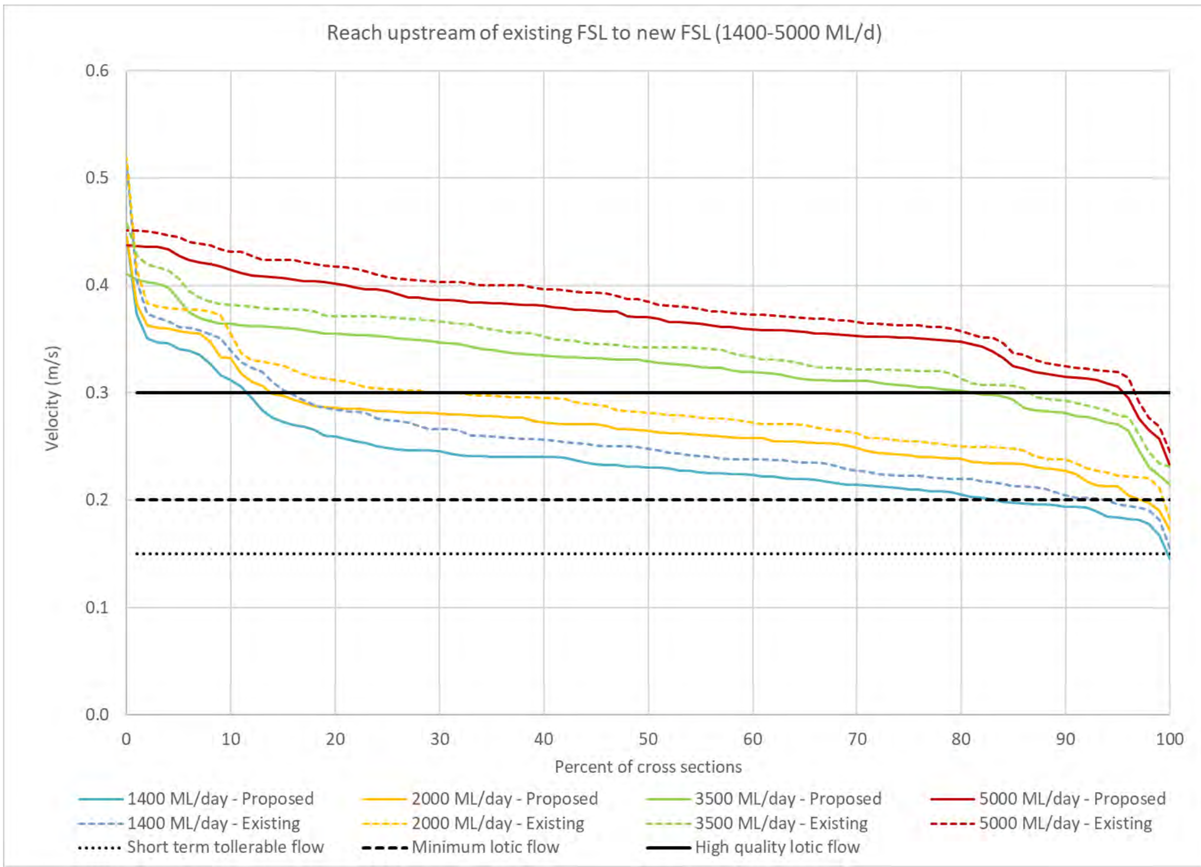


Figure 13-7 Comparison of water velocities to the flowing water habitat criteria between Bar 3 and the existing weir pool extent (chainage 49200 to 100412)



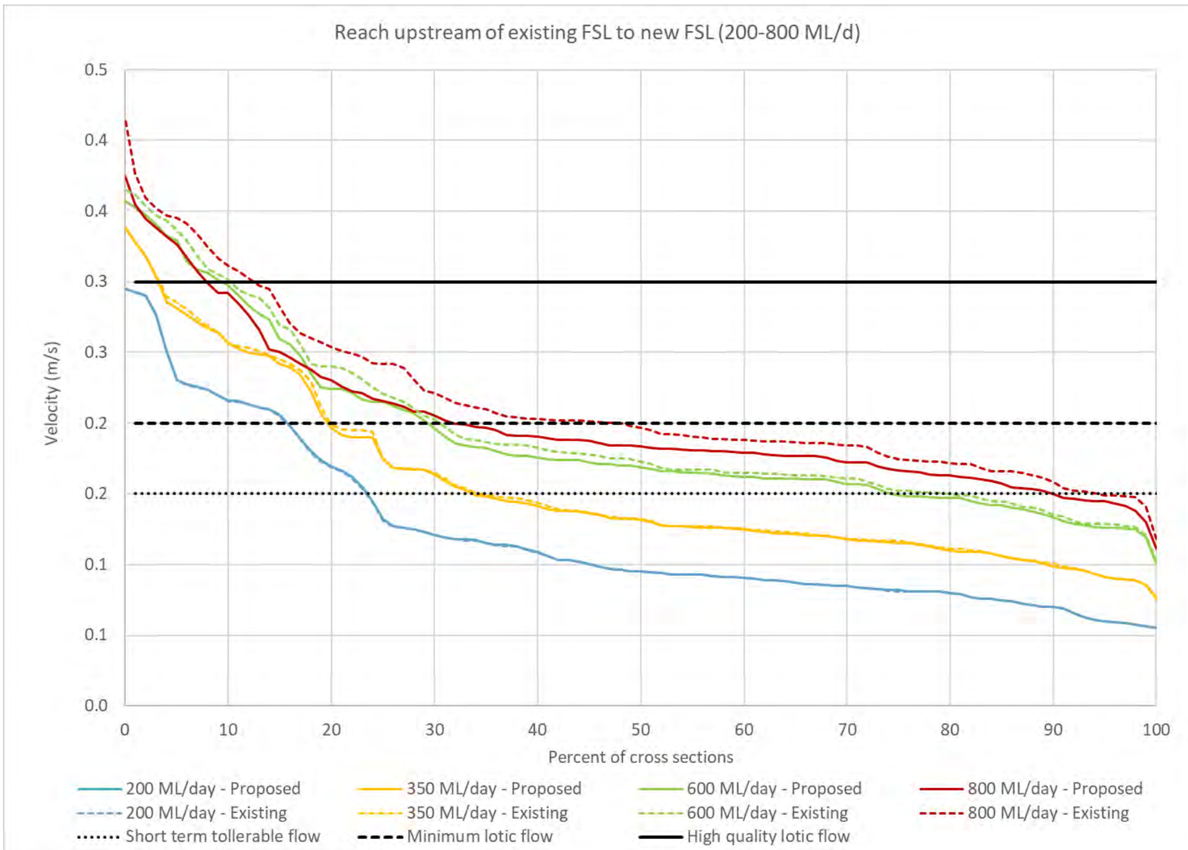


Figure 13-8 Comparison of water velocities to the flowing water habitat criteria between the existing and new weir pool extents (chainage 61790 to 80683

New town pool

As noted above, the greatest impact of the proposal on water velocity would occur at the new town pool. between the new and existing weirs. The hydraulic characteristics of this reach of the river would change from a “flowing” environment to a “no to low flow” environment. The following impacts may occur due to permanently inundating this section of the river channel:

- Reduced habitat diversity and decreased habitat suitability for native species that prefer flowing habitat (habitat specialists)
- Reduced opportunities for native fish spawning and juvenile recruitment due to impediment of egg and larval drift
- Increased water depth, potentially leading to stratification and subsequent water quality issues such as hypoxic or anoxic (low or no oxygen) environments, or leaching contaminants from bottom sediments
- Alteration of temperature regimes within the impoundment which can impact behavioural cues for spawning
- The new permanently inundated reach would no longer be suitable habitat for the River Mussel or the Darling River Snail
- Sedimentation within the weir pool which can lead to infilling habitat features, smothering aquatic plants, and clogging fish gills. Highly turbid conditions can additionally decrease light penetration through the water column which can limit photosynthesis of aquatic plants thereby reducing the overall productivity of the system
- Creation of deeper pool habitat may also result in reduced productivity in bottom waters.

Under current conditions, during periods of no flow, this reach contracts to several isolated refuge pools. The new weir would create a larger refuge pool during periods of no flow and enable mobile aquatic biota to access habitat across the entire weir pool rather than be restricted to isolated refuge pools. During ‘flowing’ conditions the reach would experience a range of hydraulic conditions from slow flowing pools to faster flowing sections over sandbars. The river channel includes some large woody habitat on the lower banks (some of which is partly submerged in the low flow channel and refuge pools) and sandbars. The native Freshwater Fish Community Status in this section of channel has been classified as fair (Department of Primary Industries, 2015). The habitat conditions are overall poor and it is unlikely that the reach represents critical spawning or refuge habitat for threatened species, however, some live River Mussels were observed during site inspections.

The conversion of this reach from ‘flowing’ to ‘no to low flow’ has the potential to impact on species that prefer flowing conditions, however it would also increase the availability of refuge habitat during dry conditions and higher levels of inundation would engage more woody habitat. Although there is a reduction in ‘flowing’ habitat there is not a total loss of habitat and the conversion to ‘no to low flow’ habitat is not likely to impact on the availability of critical habitat for threatened species or impact on life-history requirements for threatened species when compared with the availability of suitable flowing habitat elsewhere along the river.

Further, with the inclusion of the fishway at the new weir and the partial removal of the existing weir, habitat connectivity between the new town pool the river upstream of the existing weir would be improved significantly from existing conditions where there is currently a lack of connectivity between the existing weir pool and downstream habitat for the majority of the time. The fishway together with the partial removal of the existing weir would make about 240 kilometres of the river between the existing Wilcannia Weir and Tilpa Weir more accessible for aquatic species. Therefore, while the reach of the river at the new town pool would be adversely effected by a shift in the type of available habitat from highly variable ‘flowing’ habitat to ‘no to low flow’ habitat, native fish would benefit from the provision of fish passage between the currently disconnected upstream and downstream habitats. The benefits of improved habitat connectivity include providing species with a greater ability to complete migration, spawning and larvae dispersal, as well as reduced population fragmentation.

13.6.4 Operational impacts – downstream flows

Impacts to aquatic ecology downstream of the new weir were considered by analysing the outputs from the hydraulic modelling for cease-to-flow, very-low-flow and other low flow events. The hydrology impact assessment of the proposal has identified that the new weir would result in an increase in short duration cease-to-flow events, and therefore an increase in the total number of cease-to-flow events, but that the mean duration of cease-to-flow events would reduce for events of both less than and more than 20 days duration (refer to **Section 7.6.2**).

The predicted increase in short duration cease-to-flow events has the potential to result in local scale impacts immediately downstream of the new weir. There is the potential for aquatic fauna (e.g. River Mussels) to be stranded on channel margins if the new weir stops discharging suddenly when it transitions to drought security operation mode causing downstream water levels to drop rapidly. There is also the potential for benthic fauna restricted to shallow riffle, bar and run habitat (e.g. River Mussels, Darling River Snail and other invertebrates) to be more frequently exposed to desiccation (removal of moisture) as a result of an increase in the frequency of cease to discharge conditions. The downstream extent of any impact to aquatic ecology is likely to be short for the predicted increase in short duration cease-to-flow events given that discharge from the new weir would recommence relatively quickly (within days). Downstream flows would continue as pools drawdown and these pools would refill once discharge from the weir recommences. The short duration of the increased number of cease-to-flow spells at the weir discharge point means that downstream pools are unlikely to draw down to levels that would result in downstream flows ceasing before refilling occurs.

The increase in cease-to-flow spells predicted by the downstream spells analysis is based on operating rules that trigger a transition of the new weir from normal to drought security operation mode when upstream flows fall below a trigger level without the benefit of climate and catchment context. It is probable that the predicted increase in short duration cease-to-flow events could be avoided by adaptive management and decision making regarding the decision to enter drought security operation mode.

13.6.5 Impacts to threatened aquatic species and ecological communities

An assessment of the significance of the potential impacts of the proposal on threatened aquatic species and ecological communities is provided in Section 7.2 and Appendix B of **Technical Report 3**. The key findings are:

- Darling River Endangered Ecological Community — The community would experience additional inundation at the new town pool and when the new weir is in drought security operation mode. The increase in the area of inundation may provide additional refuge habitat for fish during non-flowing periods which could benefit some native species but may also benefit pest species (such as Carp). The inundation of the new town pool would only impact a minor portion of the flowing habitat that is available within the entire Barwon-Darling River (Baaka), therefore a change in flow within this 4.92-kilometre reach of the river is not expected to significantly impact the overall function of the aquatic ecosystem as a whole. The temporary nature of the additional inundation upstream of the existing weir pool when the new weir is in drought security operation mode should enable flow dependent species, such as River Mussel, to persist within this reach of the river. The overall impact of operation of the proposal on the community is likely to be small because under current conditions there are large lengths of inundated river reach that provides similar habitat for native and non-native fish. Additionally, it is expected that the hydraulic conditions at the most upstream extent of the temporary inundation (in the top one to two kilometres of the study reach) would remain largely unchanged (either dry/isolated pools during drought security operation mode, or flowing during normal operation mode). This portion of upstream habitat has the more important flowing habitat in the reach because of the presence of bedrock riffles and River Mussels and historical evidence of colonisation by Darling River Snails. Downstream of the new weir, the predicted changes to flows are considered insignificant and would not result in a substantial change in the distribution of base flows to the extent that certain flow components are lost from the system. The short duration of downstream flow disruption is not expected to have a major impact on fish migration. The assessment concluded that the proposal is not likely to significantly impact on the Darling River Endangered Ecological Community

- Olive Perchlet — The additional permanent and temporary inundation of river reaches caused by the operation of the proposal is not expected to impact on the survival of Oliver Perchlet individuals. The new inundation areas could assist to submerge new structural features such as large woody debris, exposed roots and over hanging vegetation, which Olive Perchlet use for habitat and spawning. In addition, the new fishway would provide Oliver Perchlet with improved ability to complete migration, as well as reduce population fragmentation which will in turn boost biodiversity, long-term population resilience and contribute to food webs. Changes to flow downstream of the new weir structure are not expected to impact on the survival of Oliver Perchlet populations downstream of the proposal. The assessment concluded that the proposal is not likely to significantly impact on Olive Perchlet
- Silver Perch — The additional permanent and temporary inundation of river reaches caused by the operation of the proposal is not expected to impact on the survival of adult Silver Perch individuals directly, however loss of flowing habitat and an increase in no and low flow conditions may impact breeding success as this species requires flowing habitat for egg and larvae dispersal. This does not present a major change from current conditions however because the existing weir pool already experiences no and low flow conditions, therefore larvae dispersal in this region would be limited. The new fishway would provide Silver Perch with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which would in turn boost biodiversity, long-term population resilience and contribute to food webs. Changes to flow downstream of the new weir structure are not expected to impact on the survival of Silver Perch populations downstream of the proposal. The assessment concluded that the proposal is not likely to significantly impact on Silver Perch
- Murray Cod — The additional permanent and temporary inundation of river reaches caused by the operation of the proposal is not expected to impact on the survival of Murray Cod individuals. There is, however, potential for no and low flow habitat to result in reduced recruitment success. The impact on recruitment success is expected to be minor as similar conditions currently occur within the existing weir pool. The new inundation areas could assist to submerge new structural features such as large woody debris, exposed roots and over hanging vegetation which Murray Cod use for laying eggs. In addition, the new fishway would provide Murray Cod with improved ability to complete migration for spawning, as well as reduce population fragmentation. Changes to flow downstream of the new weir structure are not expected to impact on the survival of Murray Cod populations downstream of the proposal. The assessment concluded that the proposal is not likely to significantly impact on Murray Cod.

13.6.6 Impacts to key fish habitat

The proposal would impact key fish habitat as follows:

- Temporary instream construction works — The works associated with the construction of the proposed new weir and partial removal and decommissioning of the existing weir may result in temporary loss of key fish habitat due to direct disturbance of streambeds, clearance of vegetation and removal of woody debris on the streambed and on the banks, as well as partial obstruction of fish passage due to temporary instream structures (cofferdams and silt curtains). Mitigation measures are proposed to minimise potential loss of key fish habitat during construction and these are expected to prevent any long-term degradation of key fish habitat
- Permanent instream footprint of the new weir — The proposal would result in a permanent loss of aquatic habitat within the footprint of the new weir, including the weir crest and embankment, and fishway
- Hydrological changes upstream of the existing weir pool — As discussed in **Section 13.6.3**, the proposal would not significantly reduce flowing water habitat conditions upstream of Bar 3 and especially upstream of the existing weir pool, which currently provide good quality aquatic habitat. While there would be a small decrease in high quality flowing water habitat conditions at high flow rates, these habitat conditions would still exist at many locations in this reach of the river. Additionally, when the new weir is in drought security operation mode the proportion of time the about 18.81 river kilometre temporary extension of the weir pool would be wet but not flowing would be comparable to the length of time that the channel would have otherwise been dry (i.e. there is no substantial shift in conditions from flowing to non-flowing, the shift is from dry to wet but not flowing). This would preserve in-stream habitat including keeping structural features such as exposed roots and large woody debris submerged. It would also enable River Mussels to

survive submerged within the expanded weir pool for a period of time equivalent to the existing duration of dry conditions

- Hydrological changes in the new town pool — The inundation of the new town pool would result in it changing from 'Type 1- Highly Sensitive Key Fish Habitat' to 'Type 2 – Moderately sensitive key fish habitat'. The new town pool would result in alteration of aquatic habitat in this reach of the river from a 'flowing' habitat to a 'no to low flow' environment, however aquatic habitat is not considered to be 'lost' as it is expected that these sections of river will remain available for all aquatic species during these times. Under current conditions, the new town pool comprises about two kilometres of dry riverbed and about three kilometres of shallow isolated pools during non-flow periods. During 'flowing' conditions the reach would experience a range of hydraulic conditions from slow flowing pools to faster flowing sections over sandbars. An inspection of the new town pool observed large woody habitat on the lower banks (some of which were partly submerged in the low flow channel and refuge pools) and sandbars which were sparsely vegetated with a range of exotic and native grasses and non-woody vegetation. The habitat conditions observed were overall poor and it is unlikely that the reach represents critical spawning or refuge habitat for threatened species. It is expected that even though the conversion of this reach from 'flowing' to 'no to low flow' would result in a shift in habitat condition, it would not mean a total loss of habitat and is not likely to impact on the availability of critical habitat for threatened species or the ecosystem as a whole. Further to this and similarly to the upstream temporary inundation area, inundating the new town pool may present some benefits to native benthic and turtle species as it would result in increased availability of refuge habitat during dry conditions, as well as submerge structural features such as exposed roots, large woody debris and overhanging branches utilised by aquatic species. The partial removal of the existing weir would significantly improve habitat connectivity between the new town pool and the river upstream of the existing weir compared to its current state where two completely disconnected upstream and downstream habitats exist for the majority of the time. The improvement in the connectivity of the habitat in the new town pool as a result of the removal of the barrier to fish passage created by the existing weir would offset some of the impact cause to this reach of the river by its inundation.

13.7 Mitigation and management measures

Mitigation and management measures for aquatic ecology impacts are provided in Table 13-1. The management and mitigation measures for hydrology and surface water quality are also relevant to aquatic ecology and are detailed in **Table 7-8** and **Table 10-3** respectively.

Table 13-1 Mitigation and management measures for aquatic ecology impacts

Ref	Impacts	Mitigation and management measures	Timing
AB1	Aquatic fauna salvage	Aquatic fauna salvage will be conducted by a qualified ecologist. A pre-construction survey will be undertaken in areas that would be enclosed by silt curtains and during dewatering of cofferdams. Procedures for undertaking aquatic fauna salvage will be detailed in the biodiversity management plan prepared as a sub-plan of the construction environmental management plan.	Construction
AB2	Rehabilitation of riparian and instream vegetation	Rehabilitation of disturbed areas of riparian and instream vegetation will be undertaken as soon as practical, progressively and in accordance with the rehabilitation strategy. Rehabilitation at both the new and existing weir sites will involve replacing topsoil and re-planting native trees and plants.	Construction

Ref	Impacts	Mitigation and management measures	Timing
AB3	Small fish, larvae and eggs could be entrained in the water supply pumps	Consider the installation of fish screens on pump inlets as part of the aquatic biodiversity offset for the proposal.	Detailed design
AB4	The new town pool would create unsuitable habitat for River Mussels	In consultation with Fisheries NSW, investigate the practicality and feasibility of translocation of River Mussels from the new town pool prior to its inundation.	Pre-operation
AB5	Sediment build-up in the fishway structure causing barrier to fish passage	Inspections and maintenance of the fishway will be carried out on a regular basis to ensure that fish passage is not obstructed.	Operation
AB6	Use of fishway during operation and surrounding habitat	Ongoing monitoring of the fishway and the surrounding aquatic habitat will be carried out following completion of construction and for the first two years during operation to document impacts/benefits on the aquatic ecosystem due to the new weir structure.	Operation

13.7.1 Aquatic biodiversity offset strategy

The proposal would require permanent disturbance to aquatic habitat in the Darling River (Baaka), which is classified as 'Type 1 – Highly Sensitive Key Fish Habitat' (refer to **Section 13.6.6**). An aquatic biodiversity offset is required for the proposal in accordance with the 'no net loss' of key fish habitat policy applied by the Department of Primary Industries (2013). Aquatic biodiversity offsets can include carrying out habitat rehabilitation and/or providing environmental compensation.

Section 3.3.3.2 of the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013) requires habitat compensation on a minimum 2:1 basis for all key fish habitat and at the rate of $56.75/square metre for marine and freshwater vegetation which equates to $113.50/square metre to meet the 2:1 habitat offset requirement.

Water Infrastructure NSW is negotiating with Fisheries NSW on an appropriate aquatic biodiversity offset strategy for the proposal. A discussion on some of the impacts of the proposal that are likely to require an aquatic biodiversity offset is provided in Section 9 of **Technical Report 3**. One suggested element of the aquatic biodiversity offset for the proposal is the installation of a fish screen on the pump inlets to the water filtration plant and water treatment plant and mitigation measure AB3 has been included to investigation this further during the detailed design phase of the proposal.

14. Aboriginal heritage

The potential Aboriginal cultural heritage impacts of the proposal are assessed in **Technical Report 4** and summarised in this section.

SEAR no. 5 provides requirements for the assessment of the proposal's Aboriginal cultural heritage impacts. The requirements of SEAR no. 5 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

14.1 Legislative and policy context

14.1.1 National Parks and Wildlife Act 1974

The NPW Act provides for the protection of Aboriginal objects and Aboriginal places in NSW. An Aboriginal object is defined in section 5 of the NPW Act as:

> *'any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.'*

Under section 89A of the NPW Act it is a requirement to notify Heritage NSW of the location of an Aboriginal object. Identified Aboriginal objects and sites are registered on the Aboriginal Heritage Information Management System (AHIMS) maintained by Heritage NSW.

An Aboriginal place is defined as an area that has been declared by the Minister administering the NPW Act as a place of special significance for Aboriginal culture. It may or may not contain Aboriginal objects.

In October 2020 the Minister for Aboriginal Affairs and the Arts declared two parcels of land known as the Wilcannia Mission Camps and Cultural Places to be Aboriginal places, under section 85 of the NPW Act (refer to **Appendix C**). This is an important declaration of the traditional, spiritual and social significance of these sites as well as recognising their importance as a contemporary cultural learning and teaching space for the Aboriginal communities of NSW.

The proposed new weir site and construction areas are located outside of this declared Aboriginal place, however the new town pool and community river place fall within the larger of the two parcels of land, upstream from the new weir site.

The existing southern access track does extend into the gazetted Aboriginal place (refer to **Figure 16-1**), however consultation with Heritage NSW in October 2020 has confirmed that the access track, which is located on lands owned by the Wilcannia Local Aboriginal Land Council and utilised for cultural purposes within and adjacent to the Aboriginal place is considered an existing use and is not considered to contradict the values that the Aboriginal place was gazetted for. The preliminary management plan prepared to support the Aboriginal place gazettal states that "maintenance and upgrade of existing vehicle tracks is allowed within the curtilage, but tracks need to be rationalised and a management plan drawn up to minimise tracks".

The proposal would include maintenance and upgrade of the access track, including the portion that falls within the Aboriginal place, however no new tracks would be created within the Aboriginal place.

The Steamers Point Aboriginal Place was gazetted in 2014 and is located one kilometre upstream of the existing weir, on the right riverbank. The proposal is not expected to impact on this Aboriginal place. Steamers Point is also a Category 2 Travelling Stock Reserve, which indicates its importance for biodiversity conservation, Aboriginal cultural heritage and recreational purposes.

The Aboriginal cultural heritage assessment report includes further discussion on the potential impacts of the proposal on Aboriginal places (refer to **Technical Report 4**).

The NPW Act seeks to protect natural and cultural heritage by prescribing offences and defences relating to, but not limited to, Aboriginal heritage and the preservation of native title within NSW. Under Part 6 section 86 of the NPW Act, it is an offence to harm or desecrate an Aboriginal object or Aboriginal place.

Harm is defined under Part 1 section 5 of the NPW Act as any act or omission that:

(a) destroys, defaces or damages the object or place, or

(b) in relation to an object—moves the object from the land on which it had been situated, or

(c) is specified by the regulations, or

(d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c),

but does not include any act or omission that:

(e) desecrates the object or place, or

(f) is trivial or negligible, or

(g) is excluded from this definition by the regulations.

Section 87(1) of the NPW Act provides that it is a defence to sections 86(1), (2) and (4) if the harm or desecration act is authorised by an Aboriginal heritage impact permit and the conditions to which that permit was subject were not contravened. Section 90 of the NPW Act outlines the conditions where an Aboriginal heritage impact permit may be issued.

As noted in **Section 4.3.2**, under section 5.23 of the EP&A Act, an Aboriginal heritage impact permit under section 90 of the NPW Act is not required for State significant infrastructure. Nevertheless, the proposal is required to comply with the NPW Act to protect and preserve any Aboriginal object or Aboriginal places on any land.

Procedures that accompany the NPW Act are discussed in the following sections and include the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water, 2010a), the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water, 2010b), and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (Office of Environment and Heritage, 2011).

14.1.2 Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water, 2010a) establishes the requirements for consultation (under Part 6 of the NPW Act) with Aboriginal stakeholders as part of the heritage assessment process to determine potential impacts of proposed activities on Aboriginal objects and places.

Aboriginal parties were invited to register their interest in the proposal and representatives of the registered Aboriginal parties attended the archaeological surveys discussed in **Section 14.5.5** and participated in the development of the Aboriginal Cultural Heritage Assessment Report provided in **Technical Report 4** in accordance with the requirements.

14.1.3 Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW

The *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water, 2010b) sets out the detailed requirements for archaeological investigations of Aboriginal objects in NSW for activities that require assessment under Part 5 of the EP&A Act. The Code sets out in detail:

- Minimum qualifications for anyone undertaking archaeological investigation under the Code in NSW
- Assessment steps required to be undertaken for all archaeological investigation
- Assessment steps that may be required to be undertaken to adequately characterise the Aboriginal objects being investigated.

14.1.4 Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW

The *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (Office of Environment and Heritage, 2011) provides guidelines for the investigation and assessment of Aboriginal cultural heritage (under Part 6 of the NPW Act) to explore the harm of a proposed activity on Aboriginal objects and declared Aboriginal places and to clearly set out which impacts are avoidable, and which are not. It identifies DPE's requirements for the preparation of an Aboriginal cultural heritage assessment report.

14.2 Assessment methodology

The method for preparing an Aboriginal cultural heritage assessment of the proposal included:

- Reviewing the documented history of the Wilcannia (refer to **Sections 14.5.1**)
- Defining a study area of about 20.84 hectares for the assessment that comprised the proposed development footprint and the riverbanks between the existing and proposed new weirs
- Carrying out a database search of previously recorded Aboriginal sites within and near the study area (refer to **Section 14.5.2**)
- Reviewing archaeological investigations previously carried out within and near the study area (refer to **Section 14.5.3**)
- Using an archaeological predictive model to identify areas of archaeological sensitivity within and near the study area
- Carrying out an archaeological surveys of the study area with representatives of the RAPs
- Identifying the potential impacts of the construction and operation of the proposal on recorded and potential Aboriginal sites (refer to **Section 14.6**)
- Identifying suitable measures to avoid or minimise these potential impacts to Aboriginal sites (refer to **Section 14.7**).

14.3 Risk

The proposal is located in an area with a high density of Aboriginal artefacts and ground disturbance work has the potential to disturb unexpected Aboriginal heritage items.

14.4 Avoidance and minimisation of impacts

Due to the acknowledged importance of the Wilcannia area, and in particular the Darling River (Baaka), careful consideration of Aboriginal cultural heritage constraints and issues was a core component of the development of the design for the proposal.

During the early development phase for the selection of the new weir location, extensive consultation and engagement with the local community informed both the development of options and the confirmation of the preferred location. Further detail on the options development process is provided in **Section 2.2**.

The development of the proposal footprint, particularly the proposed location of construction activities, has incorporated careful consideration of Aboriginal cultural sites and values. Potential impacts on Aboriginal heritage were minimised, as far as practicable, by:

- Utilising existing access tracks as far as practicable to avoid unnecessary ground disturbance
- Early identification and mapping of significant trees along the riverbanks near the new weir site to facilitate avoidance where practicable, particularly culturally modified trees
- Close consultation with the Aboriginal community to ensure Aboriginal cultural values were understood and reflected in the location and design of the proposal
- Reconfiguration of the construction footprint, such as laydown areas, to avoid sensitive cultural heritage sites, in particular the hearths.

14.5 Existing environment

14.5.1 Ethnohistorical background

Ethnographic information relating to Aboriginal peoples' occupation of the Wilcannia area is provided in **Technical Report 4**. The information is derived from publications and other surviving forms of documentation which were compiled by early non-Aboriginal explorers, settlers, missionaries and government officials who went to the region during the mid to late 19th century. Problems encountered with these sources of information are well documented and include language barriers, cultural bias and ethnocentricism. The following information was compiled from a number of written sources based on language research and ethno-historic observations. It should be noted that the information provided here does not necessarily reflect the beliefs of the RAPs regarding their tribal affiliations and boundaries.

Ethnographic accounts do however provide first-hand information on language, social organisation, religion, lifestyle patterns and the material culture in use at the time of European settlement. Combined with archaeological data from prehistoric sites, these accounts provide the best sources of documentation for making predictions about Aboriginal site localities, site types and the types of cultural material likely to be found within the study area.

The area around the central reaches of the Darling River (Baaka) was occupied by several related tribes of the Paakantyi language group. These groups are now known collectively as the Barkandji, after the name given to the Darling River, the Baaka (also spelled Barka) (Hardy, 1976).

The European settlement of the Murray-Darling began in the 1840s, when the importance of the area as a central trading route became established. As the number of overlanding parties increased, so did conflict ensue as recorded in oral testimony:

I am a descendant of the Barkandji, a Nation of Darling River Indigenous Australians. The end began for the Darling River Indigenous Australians when explorers came. In 1836 Mitchell, believing a corroboree was a prelude to an attack, decided to attack first, killing many Barkandji. My people were also often killed for stealing or killing cattle and sheep from travellers. After several conflicts troops were brought in and the Barkandji were treated cruelly. Over the years of 1845 to 1865 the settlers who moved to the area were mostly inflexible and racist. In spite of the inequality produced by the superiority of guns, the Barkandji fought back. The most successful technique was the rushing and slaughter of cattle and sheep. Around the mid 1850's the next colonial dispossession tactic was the native police. By the mid 1850's the native police had killed dozens of Barkandji. From 1845 to 1865 my people conceded defeat, languishing in drunkenness and disease, relying on white handouts. It became accepted that the Barkandji were there to be exploited. They were meagrely paid to remove snags from the river for the paddle steam companies and to care for the sheep. My people lost their land, food supply, culture and basic human rights. Any uprising resulted in massacres and they no longer had the heart to fight back (Elder, 1988).

Small groups of Aboriginal people attempted to continue using their traditional subsistence methods in the sandhill and mallee country, while others are thought to have moved downstream to missions at Swan Hill, Mannum and Point McLeay (Hardy, 1976; Martin, 1996). Employment as stations hands and police trackers was also sought as a means of survival, but with the introduction of artesian bores in the 1880s allowing for more land to be put to use, the total displacement of the Barkandji people was effected. Despite the establishment of further missions and Aboriginal reserves severe decreases in population were noted, due to starvation and the introduction of European diseases.

Fortunately, statements such as ‘almost all trace of the tribal imprint on the land was obliterated’ (Hardy, 1976) need reassessment in light of more recent development in reviving Barkandji language and culture.

Traditional subsistence

Ethnographic accounts provide details of the subsistence and material culture of the Aboriginal people living in the Murray-Darling junction area can be used to gain an understanding of the foods and resources available in the study area. The economy of the Barkandji was based on the riverine resources available during different seasons of the year, dependent on fluctuations in the flow of the rivers and the surrounding environment (Allen, 1974). Peaks in discharge, known as freshes, occurred along the Darling River (Baaka) in summer and early spring; when freshes or floods occurred, the abundance of resources, including shellfish, fish, waterfowl, freshwater crustaceans and aquatic plants increased (Allen, 1974). Certain plant species, such as the bulrush (Typha sp.) and ephemeral grass require summer floods or inundation to germinate, and consequently die back during the periods of low discharge. The other resources available in wetter periods also decreased in availability, with waterfowl leaving the area, and frogs, reptiles and crayfish retreating into semi-hibernation (Allen, 1974).

Allen (1974) has hypothesised that periods of wetter conditions resulted in an increase in the population of people utilising the resources of the riverbanks and waterways. During the dryer months, the population would split into smaller groups and spread out across the extent of Barkandji territory, making use of the riverbanks as well as the back country, where standing water supplies existed. During this time, plant seeds were collected from species such as saltbushes (Chenopodium sp.) and flax (Linum sp.), as well as tubers and fruits (Allen, 1974). Native millet (*Panicum decompositumi*) produces seeds in the summer months, but the explorer Major Mitchell recorded the sun drying or roasting of millet seeds in July (Mitchell 1839), demonstrating that the seeds collected in summer were stored for later use (Allen 1974-314). Sometimes the millet was left in the large drying piles that Mitchell observed, but in other areas it was stored in kangaroo skin bags (Allen, 1974).

Balme (1990) argued that the utilisation of plant fibre for netting used to hunt fish, birds, and mammals may have been the crucial element of the technology that allowed the colonisation of Greater Australia and its surrounds for at least 40,000 years. Fibre nets were often used to hunt small birds, emus, and kangaroos, with weight and mesh size determined by the size of the targeted animal. Nets were strung across creeks and rivers to capture birds, while emus were herded into larger nets measuring up to about 90 metres long. Nets were also used on the Darling River (Baaka) to catch fish, although spears, lines and weirs were also used (Kreft, 1865; Mitchell, 1839; Morey, n.d.; Tindale, 1930).

Fishing, Balme (1990) argues, was the principal adaptation to the Murray Darling lacustrine and riverine environments. Allen (1974) however provides evidence that fish and shellfish were later replaced by large mammal and emu meat, with the red kangaroo (*Macropus rufus*) following a similar pattern by occupying the riverbanks in wetter months and moving onto the plains and ranges in winter (Allen, 1974).

The explorer Edward Eyre noted that nets were constructed using the common rush (Juncus sp.), which was cut then scraped with a shell before being soaked in water. The fibres were then twisted to produce a thin cord. Reeds and wood were used to make fishing spears, which measured about 1.5 metres long (Bonhomme et al. 2001).

Shellfish were also collected, with dense scatters being located on the major waterways and swamps. Canoes were also employed to catch fish, with Eyre recounting the use of fires in canoes to attract fish to the surface, where they were speared (Bonhomme et al., 2001).

Social organisation

Peterson (1976) describes Aboriginal society as a hierarchy of organisational levels and groups with fluid boundaries between them. The smallest group in the hierarchy is the family, which comprises a man with one or more wives, their children and some of their parents. The second level of the hierarchy consists of bands which are small groups of members of several nuclear families who conduct hunting and gathering tasks together for most of the year. The third level of the hierarchy consists of regional networks or clans, comprising a large number of bands. Members of these regional networks usually share beliefs in a common language dialect and assemble for specific ceremonies. The tribe is the next highest unit which is recognised as a linguistic unit with flexible territorial boundaries. The highest level of the hierarchy is the 'cultural area', which consists of groups who share certain cultural characteristics, such as initiation ceremonies and closely related languages.

Kinship was an integral part of Aboriginal society, and created complex relationships between individuals, which governed the foods people consumed, and the land they used. The kinship network extended social links beyond the band and even the language territory, resulting in economic ties outside the core group. As such, other territories could be visited; social gatherings promoted and maintained these extended rights and ties. Inter-clan and inter-tribal participation was also known to occur for ceremonies, such as initiation rites, and trade was a physical expression of these inter-tribal and clan networks (Brayshaw, 1987).

The Barkandji language is part of a linguistic and cultural group spanning the length of the Darling River (Baaka) (Baaka) (Hardy, 1976; Tindale, 1974) with subgroups evident in different local areas. Throughout this area, it is spoken in different dialects by individual, or sub-groups (Pardoe, 1995).

The Barkandji social organisation operated on a 'binary matrilineal moiety system' consisting of moieties called 'Kilparra' (crow totem) and 'Makwarra' (Eaglehawk totem) (Cameron, 1885; Hercus, 1993). Barkandji people could only marry a person from the opposite moiety.

Aboriginal identity and the natural environment

Aboriginal cultural identity and heritage is inherently linked with the natural environment. The land and its flora and fauna are deeply significant and form a fundamental component of Aboriginal identity. Maintenance of intimate relationships with the natural world is extremely important to Aboriginal people, and from these relationships comes much of the oral history and traditions of their culture. The persistence and utilisation of the natural resources left in the bioregions are important to Aboriginal people trying to maintain cultural identity. Sensitive incorporation of values and criteria for cultural heritage as it relates to the natural environment, including culturally significant natural resources and archaeological / historical places are recognised by regional planning instruments as warranting attention.

European and Aboriginal interaction

In 1835 Major Thomas Mitchell followed the Bogan and Darling River (Baaka)s down to Menindee. He named Mt Murchison on the Darling. Settlement commenced prior to 1850 along the Darling, but it was 1855 before the Central Darling runs were consolidated. Captain Francis Cadell's Steamer Albury entered the Darling on 27 January 1859 and reached Mt Murchison in eight days. Later the name was changed to Wilcannia meaning 'a gap in the bank where flood waters escape'.

The township of Wilcannia was notified on 26 June 1866. In 1880 it had a population of 3000 with 13 hotels and was known as 'The Queen City of the West'. Wilcannia became one of the major ports of the Murray Darling system and the paddle steamer trade flourished for 70 years. In 1887, 218 steamers and their barges unloaded stores weighing 36,170 tons, and 222 loaded wool and other produce weighing 26,552 tons at the port of Wilcannia. At one time there were 30 steamers loading or unloading. There were 90 steamers plying the Darling

River (Baaka) in 1890. The total distance from Wilcannia to Goolwa at the mouth of the Murray is 1110 river miles. Eventually rail and road transport killed the river boats and Wilcannia, not on the railway line, lost its former glory . Many fine buildings from the era remain in good condition making Wilcannia one of the best-preserved historic towns in Australia.

During the early days of European settlement local Aboriginal people were subjected to violence, disease and sexual exploitation and populations of local tribal groups suffered as a consequence. Traditional affiliations with endemic species were broken by the changes that took place such as widespread clearing to 'improve' pasture and thus the fecundity of the many species of animal that Aboriginal people relied upon was affected. Similarly changes to the traditional fire regimes used by Aboriginal people to manage their estates caused widespread changes to the distribution of flora and fauna (Gammage, 2012).

The conditions that had allowed dual occupation to occur in the past had now ceased. As a result, Aboriginal communities were driven from their homelands and onto reserves on the outskirts of towns. This served to alienate the Aboriginal community who could now no longer use the land as they had traditionally, due both to their limited access to the land and its changing ecology under agricultural production (NPWS 2000a)(Forsyth and Gavranovic, 2018).

Negative impacts of the interaction of European and Aboriginal in the Wilcannia region have continued to within the living memory of the people living in Wilcannia today. The tragedy of the Stolen Generations process, to pick one example, is captured in this submission from Aunty Phyllo Whyman:

…we was living at the Mission, and then we came here to the riverbank [of the Baaka]. At the Mission, there's not much I can remember about that cause I was too young, but they took Mooey, Adrian, and Blue Eye away from us there. It was heartbreaking. Sort of like when Mum had Robbo Young and them here, I remember we was down here living on the River, and then the welfare came looking for Robbo Young, and he run down the bank and he was dodging em along the riverbank and they had to chase him up and down the riverbank. And we just all stood there crying, you know. They took him, took him and his brothers away. (Phyllo Whyman, quoted in Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018)

14.5.2 Database search results

Heritage NSW maintains a database of Aboriginal places and objects (known as Aboriginal sites) found in NSW. This database is known as the Aboriginal Heritage Information Management System (AHIMS) database and it contains detailed information on over 100,000 registered sites of Aboriginal culture and heritage significance across NSW. An Aboriginal site that is registered on the AHIMS database is known as an AHIMS site.

A search of the AHIMS database was carried out on 15 October 2020. The search area was rectangular, extending from -31.701, 143.154 to -31.4127, 143.6112 (latitude, longitude) with a 1000-metre buffer added to this area. One hundred and twelve previously recorded Aboriginal sites were present within this search area comprising 59 artefact scatters, 20 burial sites, 14 culturally modified trees, four habitation structures, three resource and gathering sites, three fish traps, three quarries, three mythological sites, two mounds and one restricted site. The Aboriginal objects identified in the AHIMS database search that are within or near the construction footprint of the proposal are listed in **Table 14-1**.

One Aboriginal place is partly within the construction footprint of the proposal and another is alongside the Darling River upstream of the existing weir and these are described in the following sections.

Table 14-1 Aboriginal objects identified during in the AHIMS database search that are within or near the footprint of the proposal

AHIMS Site ID no.	Site name	Site type	Description	Proximity to the proposal
24-5-141	Steamers Point Scarred Tree 3	Culturally modified tree	This River Red Gum was alive and in good condition at the time of original recording. It is located on the left bank of the river, around the crest of the riverbank and well above the water line.	This site is located within the Steamers Point Aboriginal Place.
24-5-145	Steamers Point – Where the Ngatji Sunk the Steamer	A site of intangible cultural heritage, relating to the story of the Ngatji and the Paddle Steamer	The story relates an event in which a paddle steamer sank in the river near Steamers Point, due to disturbing and awakening the Ngatji, which then dragged the boat and its cargo barge under. The Aboriginal people in the area assisted in the task of salvaging the paddle steamer and its cargo. Realising that the Ngatji had been the cause of the wreck, and that the Ngatji needed to be subdued before people could enter the river, Clever People sang songs to lull the Ngatji to sleep, enabling people to salvage sunken bales of wool and enabling an Aboriginal Clever Man to dive into the waterhole and retrieve the body of a person who had sunk with the paddle steamer and drowned. (Butcher 2011; Kennedy pers. comm.; Martin pers. comm.; Whyman pers. comm.).	The site is located within the Steamers Point Aboriginal Place. Its boundaries are not defined but is taken to encompass the river channel as the river curves around Steamers Point.
24-5-146	Steamers Point Island Fishtrap	Fish trap and swimming place	It has been documented through oral history work that although the AHIMS lists this site as being located within the Steamers Point Aboriginal Place, it is actually about one kilometre further upstream (near the confluence with the Paroo Channel) and consequently outside the Aboriginal Place (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).	This site is located within the river channel on an island near Steamers Point and the confluence of Paroo Channel and the Darling River (Baaka)
24-5-146	Karl Leppard's Camp	Aboriginal camps from the post-European contact period	These sites are all located with the Steamers Point Aboriginal Place except for 24-5-0144, which is just outside the boundaries of the Aboriginal Place.	All these sites are located well away from the course of the Darling River (Baaka), with the closest site (Karl Leppard's Camp) being about 30 metres from the water's edge and consequently outside the proposal's impact zone, which in this area would involve a rise in water level of about one metre when the proposed new weir is operated in drought security operation mode.
24-5-147	Granny Moysey Camp 1			
24-5-148	Granny Moysey Camp 2			
24-5-008	Wilcannia 03	Open artefact scatters		
24-5-009	Wilcannia 04			

AHIMS Site ID no.	Site name	Site type	Description	Proximity to the proposal
24-5-150	Steamer Point Mukirili Tree	Resource and gathering site		
24-5-144	—	Stone quarry and stone arrangement		
24-5-160	Union Bend Canoe Tree 3	Culturally modified tree	A well-defined south facing scar on a large River Red Gum with broadly spreading foliage, on the edge of the forested strip running along the right riverbank.	The site is located on the right riverbank next to the construction footprint of the proposal. It is about 30 metres north-west of the right riverbank at the new weir site.
24-5-161	The Rocks, or Rocky Crossing/Fish Trap	River crossing place and fish trap	This site is a platform of bedrock outcrop lying in the bed of the river, and extending into the lower flank of the right riverbank. The bedrock has been smoothed and eroded by water, with rounded boulders that have separated from the platform lying in the riverbed around it. The rocks are documented to be a crossing place from the town to the Aboriginal camps and mission on the river's left bank. The area is also used as a playing and swimming area. The area is also speculated as having been utilised as a fish trap (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council 2018).	The entirety of the site is within the riverbed, between the riverbanks.
24-5-162	Springs and Ochre Site	Resource gathering area	A patch of outcropping bedrock in the river's bank, just above the riverbed itself, functioned as a spring where subterranean water seeped out. As a consequence, this spot could have provided drinking water during times when the water level in the river was low and its water quality was poor. Ochre and water weeds were also procured at this site.	The site is located on the right riverbank about 510 metres downstream of Wilcannia Bridge, between the new and existing weirs.
24-5-163	Springs and Stony Bank	Resource gathering area	Water and water weeds were procured at this site. Patches of exposed bedrock in the river's right bank functioned as a spring where subterranean water seeped out. This spot could provide drinking water during times when the water level in the river was low and its water quality was poor.	The site is located on the right riverbank about 660 metres downstream of Wilcannia Bridge, between the new and existing weirs.

AHIMS Site ID no.	Site name	Site type	Description	Proximity to the proposal
24-5-164	Boblo's Hole Fishing Place	Resource gathering area	Boblo's Hole Fishing Place is a deep section of the riverbed to the south of the rock outcrop making up site 24-5-161 (The Rocks). Due to its depth, this area contained almost permanent water during the area's recent (post-European contact) past, and was consequently an important resource and gathering area for the Aboriginal community. The site is named after Boblo Johnson, who had a camp on the riverbank on the east side of the waterhole (i.e. on the left riverbank). The site is documented through oral history work as an important area for procuring fish such as yellow belly, perch (kunparli), black bream, and bony break (nhaampa), It was also used as a swimming area, and was an important area for procuring water, particularly during dry times when shallower parts of the river weren't flowing.	The site is located on the riverbed about 850 metres downstream of Wilcannia Bridge, between the new and existing weirs.
24-5-159	Union Bend Ngatji Waterhole	Intangible cultural heritage site and resource gathering area	The Union Bend Ngatji Waterhole site is a place connected with intangible cultural heritage, known by the Barkandji people as an area in which the Ngatji lived. The concept of the Ngatji and stories relating to the Ngatji, are connected to the physical landscape of Union Bend, in particular the morphology of the river itself. The relatively deep water as the river travels around Union Bend is an important aspect of this connection, as this deep water is viewed as a refuge for the Ngatji. Union Bend is one of a number of deep waterholes in the river upstream that are linked to stories of the Ngatji (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council 2018). The site is also documented as a resource-gathering area for the Aboriginal community. The waterhole has been used as a place to procure water and fish, and as a swimming and meeting place (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018: 27). This site does not have specific spatial boundaries, but is taken to encompass the width of the river channel and the crests of the riverbank. The general morphology of the river (including the river's course, the shape of the river channel and banks, and the water level) constitutes the main physical feature of the site.	The site is within the Wilcannia Mission Camps and Cultural Places Aboriginal Place, gazetted in 2020 (New South Wales Government 2020). The portion of the site within the river channel is within the operational footprint of the proposal and would be impacted by the new town pool. The proposed community river place is also within the site.

AHIMS Site ID no.	Site name	Site type	Description	Proximity to the proposal
24-5-167	Wilcannia Weir Fishtrap	Fish trap	The existing Wilcannia Weir is recorded as an Aboriginal site, mainly due to its use by the Aboriginal community after its construction. The weir was constructed by a workforce that included members of the Aboriginal community, some of whom are still living in the area today. Wilcannia Weir has, since its construction, been continuously used by the Aboriginal community as a fishing and swimming place. The deep pool immediately behind the weir is suited to both purposes. In addition, the rocks of the weir have been periodically moved and repositioned to construct fish traps. The location and design of these traps is changed to suit the water level and water conditions (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). The importance of the existing weir as a focal spot for the community through its use as a fishing and swimming place means that it holds considerable cultural value to the Aboriginal community of Wilcannia. The stories and memories associated with the weir's construction also add to its cultural value.	The existing weir is proposed to be partially removed and decommissioned. Only the central section of the existing weir is proposed to be removed, which would result in much of the rock embankment remaining in place. The section of the river between the new weir and existing weir would be inundated by the new town pool. The retained portion of the existing weir would also be inundated by the new town pool
24-5-158	Granny Moysey's Canoe Tree	Culturally modified tree	The site is a large scar on a living River Red Gum. The scar, more than two metres in length, is close to ground level on the trunk of the tree. The scar was created around 1922 by Granny Moysey, an important elder in the Wilcannia region, for the production of a canoe. Scarred trees of this age are rare and the site's associated oral history add to its rarity and significance. The site holds a high cultural significance to the Aboriginal community.	The tree is located on the right riverbank, about five metres away from the top of the riverbank and about 560 metres upstream of the new weir. It is located within the Wilcannia Mission Aboriginal Camps and Cultural Places Aboriginal Place.

Wilcannia Mission Camps and Cultural Places Aboriginal Place

The Wilcannia Mission Camps and Cultural Places Aboriginal Place is an area running along the river from Wilcannia to the area of the proposed new weir, and downstream of the proposed new weir. The area encompasses the river and areas of ground on both sides of the river (Department of Premier and Cabinet, 2020: 69). The area is gazetted as an Aboriginal Place (New South Wales Government 2020).

The Aboriginal place was nominated on the basis of tangible and intangible cultural heritage values. The tangible cultural heritage values of the place include canoe trees, coolamon trees, a mound site, middens, artefacts, ovens, and material remains of camping places from the 1920's to 1980's, as well as fishing places and the Ngatji (rainbow serpent) waterhole and related features. (Department of Premier and Cabinet, 2020).

Intangible cultural heritage values connected with the Aboriginal place include stories related to the Ngatji (which are particularly associated with deeper waterholes in the river), oral histories relating to traditional cultural practices such as the procurement of plant and animal foods and other resources from the landscape, and oral histories and stories relating to Aboriginal life in the area during the post-contact period.

Steamers Point Aboriginal Place

The stretch of water near Steamers Point, like Union Bend, holds cultural heritage value through being associated with the Ngatji. Steamers Point is gazetted as an Aboriginal Place (New South Wales Government Gazette, 2014). Steamers Point is connected with a specific story involving the Ngatji, set in the post European contact period. The story relates an event in which a paddle steamer sank in the river near Steamers Point, due to disturbing and awakening the Ngatji, which then dragged the boat and its cargo barge under. The Aboriginal people in the area assisted in the task of salvaging the paddle steamer and its cargo. Realising that the Ngatji had been the cause of the wreck, and that the Ngatji needed to be subdued before people could enter the river, Clever People sang songs to lull the Ngatji to sleep, enabling people to salvage sunken bales of wool and enabling an Aboriginal Clever Man to dive into the waterhole and retrieve the body of a person who had sunk with the paddle steamer and drowned. (Butcher, 2011; Kennedy pers. comm.; Martin pers. comm.; Whyman pers. comm.).

As with Union Bend, the depth of water at Steamers Point is probably a reason for the area's association with the Ngatji. It is possible that the association of Steamers Point with the Ngatji and stories associated with the Ngatji might have been reinforced by the fact that the river here forms part of the weir pool behind the existing weir. As a result there is water in this section of the river much more frequently than many other stretches of the river in recent times, and this might consequently be viewed as a refuge for the Ngatji.

14.5.3 Previous archaeological studies

Archaeological sites have been recorded in the Wilcannia region over recent decades, mostly as individual finds. A large-scale and systematic survey of the area around Wilcannia, which included most or all of this assessment's study area, was carried out for the Wilcannia Aboriginal Community Heritage Study (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018; Department of Premier and Cabinet, 2020). This survey recorded archaeological sites, and also oral histories and stories related by the Aboriginal community relating to a range of sites and places. Some of the sites associated with oral history are archaeological sites, with tangible objects such as scarred trees, surface artefacts, and the remnants of historical huts. Other places associated with oral history have no archaeological material. An example of a site associated with oral history but without archaeological material is the Union Bend Ngatji Site.

The archaeological sites recorded and documented in the Wilcannia Aboriginal Community Heritage Study include burials, stone arrangements, culturally modified trees, stone quarries, hearths (also known as ovens), middens; stone artefact scatters, fish traps, and Aboriginal sites from the historical (post European contact) period. The historical sites consist mostly of the remains of huts along the river, which are associated with a rich oral history (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). These historical Aboriginal sites, and the oral history and intangible cultural heritage to which they are connected, were one of the main drivers behind the nomination and declaration of the Wilcannia Mission Camps and Cultural Places Aboriginal Place (Department of Premier and Cabinet, 2020).

Rock art sites and stone arrangements have been recorded in the wider region but have not been recorded within the study area or similar landscapes. They are generally restricted to hilly terrain with exposed rock outcrops, away from the river. The exception to this is a cluster of stone mounds recorded near Steamers Point, upstream from the study area (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Culturally modified trees are a common site in the region. Scarred trees can possess scars of varying size: the largest scars were probably the result of harvesting bark for canoes. Smaller scars are probably the result of harvesting bark for shields or coolamons (dishes). The smallest scars are the remnants of holes cut to extract honey, possums or other tree-dwelling animals. Small scars could also have been cut to provide toe-holds for climbing the tree, or as marks cut on the tree for symbolic or communication functions (for example, to mark specific locations in the landscape). European surveyors also cut marks into trees, though these are usually recognisable for containing chiselled letters or numbers identifying the survey mark (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Stone quarries are an infrequently recorded type of site in the region. The low number of recorded quarries is likely to be the result of survey effort, as these sites are most likely to occur in hilly or elevated areas with exposed outcrops of stone, rather than in the alluvial sediment landscape along the course of the Darling River (Baaka), where most previous archaeological effort has been invested. The only quarry site recorded near the river is a silcrete quarry recorded near Steamers Point (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Stone fish traps, which consist of low lines or walls of stone arranged on the beds of rivers, have been recorded in the Wilcannia region, but are infrequent in the landscape. These sites are likely to have exhibited a low rate of survival during the historical period, as many were likely to have been destroyed or dismantled to clear the river for paddle steamer traffic (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Hearths are one of the most frequent site types recorded in the region. These structures are constructed to retain the heat of fires, usually for cooking plant and animal foods. In the Wilcannia region, the material used in their construction is usually clay or clay-rich sediments, though hearths made from stone are found in areas away from the river where stone is more common and more easily procured. Hearths are found in all landscapes in the region, and the construction and use of hearths is a practice has been in continuous use by the Aboriginal community up to the present day (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Middens, which consist of cohesive mounds or diffuse scatters of shellfish and animal bones, have been frequently recorded in the region, along the edges of the Darling River (Baaka) and its associated lakes and flood channels. These sites are prone to destruction during floods, and consequently generally only survive on elevated banks, river terraces, or sandhills. Middens around Wilcannia are generally dominated by shellfish remains, with the most common species being freshwater mussel and freshwater snail. Bones of fish, birds, and mammals, and fragments of turtle shell, can also be present (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Stone artefacts are the most frequently found Aboriginal object in the Wilcannia region, and scatters of stone artefacts are one of the most frequently recorded site types. Artefacts found in the region include flaked artefacts (flakes, cores, retouched flakes and a variety of implements including backed artefacts and pirri points). Ground artefacts, including grinding dishes and topstones, are also found – though in lower frequencies than flaked artefacts, probably due to the longer use-life of a grindstone. A variety of materials have been used by Aboriginal people in the region for the production of stone artefacts, including sandstone, quartzite, and silcrete for grindstones and hammerstones, and chert, quartz, and silcrete for flaked artefacts. The more fine-grained silcretes are more commonly used for the production of small delicate artefacts such as backed artefacts and small blades, while coarse-grained silcretes a more commonly used in the production of large robust flakes (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Burials have been recorded in the Wilcannia region. Mounded burials were noted by early European explorers in the region (Bonney, 1883; Mitchell, 1839). The mounded shape of burials is likely to degrade over time and might well be indistinguishable from the surrounding landscape's topography in their present context. Burials have been recorded archaeologically in a number of locations around Wilcannia, including within the town itself, at Union Bend, and near the golf club at the town's eastern edge. Burials previously recorded in the region have generally been located on elevated ground, within sandy sediments, near the river (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018).

Aboriginal camps

A large number of Aboriginal camps next to the river between the existing weir and the proposed new weir have been identified through oral history recording work. The camps largely date to the period when Aboriginal people were excluded from living in Wilcannia town itself (Forsyth and Gavranovic, 2018) and developed as fringe camps next to the town and to the Wilcannia Aboriginal Reserve (The Mission).

Most of the camps were located to be close to the river but beyond the riverbank crest, for ease of procuring water, fish, and other riverine resources. Some camp components would have extended into the river channel itself (windlasses and other equipment for gathering water, for example). The camps were positioned in the shade provided by the wooded strip of trees along the riverbank. People positioned their camps to be close to others in their family group, with distance maintained between the camps of separate family groups (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018.

Individual camp sites have specific stories and bodies of history associated with them. The oral history accounts of life in the camps, recorded in the Wilcannia Aboriginal Community Heritage Study (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018) overwhelmingly give the impression that life in the camps was one of considerable material poverty, involving long hours of work for survival and maintaining basic necessities, but also a period of great social cohesion.

Today, visible material traces remain of most or all of the camp sites. These include fragments of sheet metal, 44 gallon drums, some car parts, and abundant small fragments of glass, ceramic, metal, and in some cases freshwater mussel shell. Few large structures remain, as housing materials were salvaged when the population relocated to other parts of the region following the large floods in 1950, 1951 and 1956. No visible material traces of the camps remain within the river channel between the riverbanks due to being either deconstructed or destroyed by flooding. (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018)

Most of the recorded Aboriginal camps are located within the Aboriginal Mission Camps and Cultural Places Aboriginal Place.

Cultural values relevant to the study area

The Darling River (Baaka) holds considerable cultural value to the Barkandji people. The river has been a focal point of Aboriginal occupation of the region during both the historic (post European contact) and pre-contact periods. The river and its associated lakes and ephemeral channels possess a higher biomass and diversity of plant and animal species than the surrounding arid and semi-arid environments, as well as possessing permanent fresh water. As a straightforward consequence of this, the riverine environment offered Aboriginal people a much greater quantity and diversity of resources which they could utilise. Aboriginal groups spent most of their time living near the river, with forays away from the river probably being brief by comparison. The richness of the landscape around the river also meant that Aboriginal people could live together in large groups, enabling different 'clan' groups to coalesce together and carry out social activities such as corroborees, trading, and marriages.

The important role of the river in Aboriginal life is evidenced by the fact that the geographical range through which Barkandji language speakers live extends along the river from Bourke to Wentworth (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). This demonstrates that the river and its surrounds created a corridor in which Aboriginal groups could successfully live, travel, and interact with other groups frequently enough that their shared language remained and did not fragment into separate languages over time through lack of contact. The name 'Barkandji' derives from the name of the river (the Baaka/Barka), and means people belonging to the Baaka River (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). The rich riverine corridor, stretching as it does through generally arid landscapes with scarce resources, has created a deep connection between the Barkandji people and the river.

Descriptions of Aboriginal people in the region written by early European explorers, settlers, and ethnographers focus almost exclusively on Aboriginal interaction with the river and utilisation of its resources. Accounts depict Aboriginal people hunting for fish and waterbirds using nets and spears, from the bank or from canoes in the water (Kreft, 1865; Mitchell, 1839; Morey, n.d.; Tindale, 1930). Immense time and effort were invested into the making of nets, from fibres extracted from river plants such as rushes (Brock, 1844; Morey, n.d.). River plants also provided food – rushes in particular, which were pounded and ground up to make into cakes (Sturt, 1849).

The Aboriginal community has lived continuously around Wilcannia since first European contact, and the oral history of the community focuses on the people's connection to and relationship with the river in the recent past. Aboriginal camps (mostly on the south bank of the river, due to exclusion of Aboriginal people from the town itself) were mostly built on or near the bank of the river (Department of Premier and Cabinet, 2020). The stories and memories recorded in the Wilcannia Aboriginal Community Heritage Study (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018) frequently focus on people's use of the river: swimming, fishing, catching prawns and yabbies, and procuring resources such as tree bark and birds' eggs from the riverbanks.

The importance of the river and the resources it provided has resulted in the river and its surrounding landscape possessing considerable intangible cultural value. The Aboriginal community view the river as having been created by the Ngatji (Rainbow Serpent), and the river – in particular, deep waterholes – is viewed as still being home to the Ngatji (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018), Stories relating to the Ngatji include at least one from the post-contact period, involving the Ngatji being responsible for the wreck of a paddle steamer, attesting to the continued importance of stories involving the Ngatji, and its power and control of the river, to the modern Aboriginal community. The believe that the Ngatji lives in or sleeps in waterholes and deep stretches of the river demonstrates that as well as being associated with the river in general, the intangible cultural heritage of the Ngatji and stories relating to it is connected with specific features of the river's morphology.

The river and the land immediately next to it is of particular significance around Wilcannia, due to the concentration of Aboriginal occupation in this area in the recent (post European contact) past, and the rich oral history and memories that the Aboriginal community in Wilcannia has of their ancestors' recent life in and use of the area. Until low-lying areas along the river were flooded out in 1956, the Aboriginal community lived in these camps. The strong connection within families and within the community in general during this period is strongly remembered in the recorded oral history (Central Darling Shire and Wilcannia Local Aboriginal Land Council, 2018). Tangible remnants of these camps are present in the current landscape, and natural landmarks such as large trees have also enabled older members of the community to identify where their families' homes were.

The strength of the community within the camps, and the positive consequences this had for people's lives, have led to the area being intrinsically connected with this intangible cultural heritage. The area along the river's banks is associated with a traditional Aboriginal way of life, centred on the family unit and inter-familial bonds. The intangible cultural heritage values of the area is one of the reasons for the nomination (and ratification) of the Wilcannia Mission Camps and Cultural Places Aboriginal Place (Department of Premier and Cabinet, 2020). The Aboriginal place extends along both banks of the river, from Wilcannia township to just downstream of the study area's western end (i.e. downstream of the site of the proposed new weir). The designation of this area as an Aboriginal place demonstrates the high level of cultural value (both through tangible archaeological sites, and through its association with intangible cultural heritage) assigned to the river and the land along the riverbanks in this region.

Information conveyed verbally from RAP representatives during the archaeological surveys for the proposal reinforce the high level of cultural value assigned to the landscape in and around the study area. It was repeatedly stated to Jacobs archaeologists that the river itself is of critical importance to the Aboriginal community, and central to their whole way of live. Consequently, the river is strongly connected to their continuation of cultural practices. These include (but are not restricted to) swimming, fishing, collecting traditional foods such as fish, yabbies and mussels, and preserving traditional practices such as manufacturing bark canoes and wooden artefacts.

In short, the Aboriginal community is strongly connected to and invested in the welfare of all features of the region's landscape and natural environment, due to its connection to their families in the recent past, to traditional cultural practices, and to their life in the Wilcannia area today. The entirety of the study area and its surrounds can be taken as possessing high cultural value.

14.5.4 Archaeological predictive model

An archaeological predictive model was used to identify areas of archaeological sensitivity. A 'land system' or 'archaeological landscape' model was used, which predicts site location based on known patterns of site distribution in similar landscapes, and across landform types. The predictive model is based on an interpretation of the distribution of known sites close to the study area and a review of previous impacts to the proposal area and the potential effects of these impacts on the archaeological record.

The following specific predictive points are noted for the landscape the study area sits within:

- Elevated landforms next to watercourses have high archaeological potential
- Landforms next to permanent watercourses have a higher archaeological potential than those next to ephemeral watercourses
- Landforms with thick soil or sediment profiles in alluvial or aeolian sands have high archaeological potential
- Areas of remnant vegetation close to waterways contain culturally modified trees if of sufficient age
- Areas of potential archaeological deposit are likely to be present close to water, in areas with surface soil or sediments and also areas on the edge of the Darling floodplain
- The most common archaeological site types are isolated stone artefacts, clusters of stone artefacts, freshwater mussel middens, modified trees, hearths (as evidenced by clusters of baked clay/termite heat retainers, resource/gathering sites (for example Quandong trees) and burials
- Burials have the highest potential to occur within elevated sandy deposits near the river
- Stone artefacts, middens and hearths can be present on the ground surface or buried in subsurface soils and sediments.

Identifying areas of high disturbance is an important factor in the predictive model because post-depositional processes can result in disturbance or destruction of archaeological sites. Disturbance can alter the patterns of site location expected from the points above. The following general predictive points relate to the effects of site disturbance:

- Landforms that have been subject to frequent high-energy flooding events have reduced archaeological potential. High energy flooding is likely to be restricted to river channels, with floodwaters outside riverbanks typically being slow-moving
- European land-use practices can have a range of impacts to sites. Areas that have been excavated, inundated, or buried under fill or stockpiled materials have low archaeological potential.

Many post-depositional processes result in the movement of Aboriginal objects away from their original location and context, without resulting in damage or destruction to the objects themselves. Some post-depositional processes will result in the destruction of some, but not all, artefacts within a site. Only severe processes will destroy or remove all Aboriginal objects from a landform. Factoring post-depositional disturbance into the assessment of a landform's archaeological potential should consequently take a precautionary approach. A landform should be assumed to retain archaeological potential unless there is compelling evidence for severe disturbance that can be confidently inferred to have removed all sites from the landform.

The archaeological predictive model informed the approach to the archaeological surveys and the assessment of the proposal's potential impacts.

14.5.5 Archaeological surveys

An archaeological survey was undertaken from 5 to 10 November 2020 of the study area. The survey was undertaken by Jacobs archaeologists and seven representatives from the registered Aboriginal parties. The aims of the archaeological survey were to:

- Determine whether any Aboriginal objects are present within the impact zone of the proposal
- Identify any areas with a likelihood of Aboriginal objects being buried beneath the surface, and which should be regarded as areas of potential archaeological deposit
- Gather and record information on any sites associated with intangible cultural heritage that are present within or near the study area.

The purpose of the archaeological survey was to gather information on the nature of Aboriginal objects present in the study area and the archaeological 'site' or 'sites' they make up. This information was used as a basis for a significance assessment of each site and its contents and recommendations for managing and mitigating the potential Aboriginal cultural heritage impacts of the proposal.

The survey assessed whether any areas have a high potential to contain buried Aboriginal objects and should consequently be designated as areas of potential archaeological deposit. The decision to designate areas of potential archaeological deposit was made in consultation with the RAP representatives attending the survey.

The archaeological survey adhered to the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (Department of Environment, Climate Change and Water, 2010b). The survey involved systematically investigating areas with the potential to contain Aboriginal sites within the study area. Previously recorded sites within the study area were identified prior to the survey and investigated during the survey if possible.

The attributes of archaeological sites or areas of potential archaeological deposit encountered during the survey were recorded. For sites that are associated with intangible cultural heritage, information provided by registered Aboriginal party representatives during the survey was recorded. The survey also recorded land disturbance, survey coverage variables (ground exposure and archaeological visibility) and landform types across the study area. Data was captured using a GPS enabled tablet computer running the GISella recording platform. Standard measuring tools such as tape measures and callipers were used where required.

Another archaeological survey was undertaken on 17 February 2021 of an additional area of proposed construction laydown footprint on the left (southern) riverbank. Two representatives from the registered Aboriginal parties attended this small additional survey. The purpose of this survey was to confirm if this additional area is suitable for use as a construction laydown, so as to reduce the footprint in previously surveyed areas where objects (such as hearths and stone artefacts) are located.

A survey of the community rive place was undertaken on 26 October 2021. This survey was attended but two representatives from the registered Aboriginal parties.

During the field survey the following archaeological sites were recorded:

- 30 culturally modified trees
- 12 open archaeological sites, containing stone artefacts, hearths (fire places) and shell middens, which in total included:
  - 36 hearths (including two 'emu ovens')

- 517 stone artefacts
- five mussel shell clusters, interpreted as middens.

These results are discussed in more detail in the following sections.

No Aboriginal objects were found within the proposed community river place.

Culturally modified trees

Eight of the culturally modified trees recorded during the archaeological survey are within or near the footprint of the proposal and are described in **Table 14-2**. The other 22 culturally modified trees recorded during the archaeological survey are not located near the proposal and so are not considered further.

Table 14-2 Culturally modified trees recorded near the proposal during the archaeological surveys

AHIMS Site ID no.	Site name	Description	Proximity to the proposal
24-5-185	Old Wilcannia Weir Canoe Tree 3	A living Red River Gum with a well-defined south facing scar that has significant regrowth.	Located about 50 metres south-east of the southern end of the existing weir.
24-5-186	Old Wilcannia Weir Canoe Tree 2	A living River Red Gum in poor health with a moderately defined, largely overgrown south-east facing scar that has significant regrowth.	Located about 35 metres directly south of the southern end of the existing weir.
24-5-187	Old Wilcannia Weir Canoe Tree 1	A dead River Red Gum with a well-defined north-west facing scar that has significant regrowth.	Located about 35 metres south-south-west of the southern end of the existing wall.
24-5-191	Union Bend Coolamon Tree 13	A living River Red Gum with a well-defined south facing scar, and toe holds cut into the trunk. It is located about midway between the existing weir and the southern-most extent of Union Bend, on the east (left) riverbank.	Located within the riverbanks between the proposed new weir and the existing weir, where the new town pool would occur.
24-5-204	Union Bend Coolamon Tree 8	A living Box with a small well-defined west facing scar on a horizontal branch of the tree.	Located on the south (left) riverbank about 950 metres south-east (upstream) of the proposed new weir, along the section of river where the new town pool would occur.
24-5-208	Union Bend Canoe Tree 7	A dead River Red Gum that has fallen and currently rests on the sloping bank of the river. It is in poor condition having undergone significant decomposition. The scar had substantial regrowth when it died. It is likely to be the oldest of the culturally modified trees recorded during the archaeological survey.	Located within the construction footprint for the proposed new weir.
24-5-209	Union Bend Canoe Tree 6	A living River Red Gum that exhibits a moderately defined south-east facing scar that is substantially overgrown.	Located on the left riverbank about 125 metres south-east of the proposed new weir and outside the clearing boundary,
24-5-210	Union Bend Coolamon Tree 1	A living River Red Gum that exhibits a small but well-defined west facing scar that is substantially overgrown.	Located within the construction footprint for the proposed new weir, where a crane is proposed to be used to transfer materials between the riverbank and the work site for the new weir.

Open archaeological sites

Three of the open archaeological sites recorded during the archaeological survey are within or near the footprint of the proposal and are described in **Table 14-3**. The other nine open archaeological sites recorded during the archaeological survey are not located near the proposal and so are not considered further.

Table 14-3 Open archaeological sites recorded near the proposal during the archaeological surveys

AHIMS Site ID no.	Site name	Description	Proximity to the proposal
24-5-176	Wilcannia New Weir 1	An extensive scatter of 283 stone artefacts over an about 900 metre by 50 metre area with a cluster of hearths at its northern extent, closer to the river. Most of the artefacts (210) are unretouched flakes or fragments thereof with the other artefacts comprising 30 flaked pieces, 19 retouched flakes, 15 cores, one grindstone (bottom) and one hammerstone. Most (237) of the artefacts are made from silcrete. Most of the artefacts are spread along the existing access track through 'Yeoval' and the Wilcannia Mission Camps and Cultural Places Aboriginal Place. The extent of the site is determined to a large degree by visibility conditions with the graded track providing a shallowly excavated, deflated, devegetated window into the immediate subsurface, but also partly due to the limited extent of the study area. The linear site is aligned parallel to the river for most of its length, at an average of about 200 metres west of the western (right) riverbank, converging towards the river at its northern extent. The 11 hearths recorded at this site were all identified on the basis of clustered baked clay nodules. All were recorded as being surface scatters of material, suggesting that they occur in deflated contexts that may not have a subsurface extent.	The site overlaps to a significant extent with the proposal on the western side of Union Bend, with most of this site lying within the proposal's construction footprint.
24-5-177	Wilcannia New Weir 2	An extensive site composed of 19 hearths interspersed with 14 stone artefacts and in proximity to several culturally modified trees. The 19 hearths recorded at this site were all identified on the basis of clustered baked clay nodules. Five were recorded as being a surface exposure with potential subsurface depth, one was a lag deposit and the remainder were surface scatters of material only. None of the hearths exhibited surface evidence of any content other than baked clay although two were within about one metre of surface artefacts. All of the hearths are located on subtle rises in the landscape, avoiding the lower lying areas and shallow flood runners. The 14 stone artefacts are sparsely distributed throughout the site extent, with less patterning with regard to topography than observed for hearths.	The site is located on the northern side of the proposed new weir and includes the site of the proposed fishway. Of the 19 hearths recorded, two are within the construction footprint of the proposed laydown area and two are on or near the alignment of the proposed new road and truck turning circle.

AHIMS Site ID no.	Site name	Description	Proximity to the proposal
		Surface visibility was compromised by moderate vegetation cover and a lack of deflation suggesting the potential for substantially more stone artefacts to exist at the site. All of the stone artefacts were found in excess of 100 metres from the riverbank, but surface visibility reduced with proximity to the river. Eight of the stone artefacts are unretouched flakes, with three cores, two hammerstones and one grindstone (bottom) also present.	
24-5-180	Wilcannia Mission AP 4	The artefacts are spread along the existing access track through 'Yeoval' and the Wilcannia Mission Camps and Cultural Places Aboriginal Place, with very loose clusters towards the eastern and western extents. The extent of the site is determined to a large degree by visibility conditions with the graded track providing a shallowly excavated, deflated, devegetated window into the immediate subsurface, but also partly due to the limited extent of the study area. The linear site is about 225 metres from the river at its closest (the western most point), and about 580 metres from the river at its eastern end. The recorded site extent of 24-5-180 overlaps to a significant extent with the access track through Yeoval. Thirty-eight artefacts were recorded of which 28 artefacts are unretouched flakes. Other artefacts comprised five retouched flakes, two cores, and three grindstones (two of which are indeterminate, one of which is a topstone). Most of the artefacts are made from silcrete (33 artefacts), with quartzite (four artefacts), quartz (one artefact) and ochre (one artefact) also present.	An extensive scatter of stone artefacts over an about 700 metre by 25 metre area aligned about east-west to the south of Union Bend.

14.6 Assessment of impacts

14.6.1 Impacts to Aboriginal objects

The potential impact of the proposal to Aboriginal objects is detailed in Table 14-4. Note that this table lists impacts that would be anticipated if no mitigation and management measures were implemented. The design and construction of the proposal would be carried out with the objective of avoiding impacts to Aboriginal heritage items where possible. Engagement with the RAPs has already resulted in refinement of the design of the proposal to minimise impact to the Wilcannia Weir Fishtrap (24-5-167) by partially removing the existing weir instead of removing the entire weir.

Table 14-4 Assessment of impact to Aboriginal objects if no mitigation and management measures are implemented

Activity	Type of harm (assuming no mitigation measures)	Degree of harm	Consequence of harm
Construction of the new weir	Direct harm: Excavation for footings and weir wall would destroy Union Bend Canoe Tree 7 (24-5-208). Excavation might also affect currently unidentified subsurface Aboriginal objects, which could include artefacts, hearths, midden and potentially human burials.	High on 24-5-208. Potentially high on any currently unidentified subsurface Aboriginal cultural material.	Total loss of Union Bend Canoe Tree 7 (24-5-208).
Construction of the fishway	Potentially direct harm: Excavation might affect currently unidentified subsurface Aboriginal objects, which could include artefacts, hearths, midden and potentially human burials.	High degree of harm to any currently unidentified subsurface Aboriginal cultural material.	Potential total loss of any subsurface cultural material.
Equipment and machinery laydowns on north and south sides of river at the new weir	Direct harm: Ground-disturbing works would disturb Aboriginal objects on the ground surface at Wilcannia New Weir 1 (24-5-176) and Wilcannia New Weir 2 (24-5-177). Ground disturbance might also impact currently unidentified subsurface Aboriginal objects.	High degree of harm to any sites, or site components intercepted by ground-disturbing works.	Partial loss of surface sites Wilcannia New Weir 1 (24-5-176) and Wilcannia New Weir 2 (24-5-177), where these intercept ground-disturbing works. Potential loss of any subsurface cultural material.
Tree trimming to enable operation of a crane (swinging and lifting) to construct the new weir	Direct harm: Where a crane is currently proposed to operate would impact Union Bend Coolamon Tree 1 (24-5-210).	Potential high degree of harm to Union Bend Coolamon Tree 1 (24-5-210), if the tree were to be impacted by the crane and/or removed.	Total loss of Union Bend Coolamon Tree 1 (24-5-210).
Site compound on south side of river near new weir	Direct harm: Grubbing of vegetation and grading/levelling of the site would displace surface artefacts and hearths at Wilcannia New Weir 1 (24-5-176). These activities would also impact any currently unidentified subsurface Aboriginal objects.	High degree of harm to any sites, or site components intercepted by ground-disturbing works.	Partial or total loss of Wilcannia New Weir 1 (24-5-176). Potential loss of any currently unidentified subsurface Aboriginal objects within area(s) of ground-disturbing works.

Activity	Type of harm (assuming no mitigation measures)	Degree of harm	Consequence of harm
Access track and power supply works, on the right (northern) bank of the river next to the new weir	Direct harm: Grubbing of vegetation and grading/levelling of the new access track and parking area has the potential to disturb surface and subsurface objects including Wilcannia New Weir 2 (24-5-177). Indirect harm: Damage to Union Bend Canoe Tree 3 (24-5-160) if the works intersect the tree.	High degree of harm on any surface or subsurface sites intercepted.	Total loss of any material intercepted by ground-disturbing works.
Upgraded access track from the Barrier Highway to the new weir location (southern side) (about three kilometres in total)	Direct harm to artefact scatters on the road including Wilcannia New Weir 1 (24-5-176) and Wilcannia Mission AP 4 (24-5-180).	Moderate degree of harm to those artefacts within the graded track – they would remain in the site but be further displaced and some potentially broken.	Partial loss of any material intercepted by ground-disturbing works.
New 270 metre unsealed access track from Union Bend Road to the new weir location (northern side)	Direct harm to artefacts and hearths at Wilcannia New Weir 2 (24-5-177): Grading of new track.	Moderate degree of harm to those artefacts within the area of ground-disturbing works – they would remain in the site but be further displaced and some potentially broken. High degree of harm to hearths within the area of ground-disturbing works. Harm to any subsurface artefacts or hearths that might be present.	Substantial loss of any material intercepted by ground-disturbing works.
Partial removal of the existing weir	Direct harm: The existing weir is registered as an Aboriginal site (Wilcannia Weir Fishtrap (24-5-167)), due to its long-term continuing use as a fish trap.	High degree of harm to the existing weir, and therefore Wilcannia Weir Fishtrap (24-5-167).	Permanent inundation of Wilcannia Weir Fishtrap (24-5-167) by the new town pool.
	Indirect harm: Impact to Old Wilcannia Weir Canoe Tree 3 (24-5-185), Old Wilcannia Weir Canoe Tree 2 (24-5-186) and Old Wilcannia Weir Canoe Tree 3 (24-5-187) if care not exercised to avoid them.	Moderate to high degree of harm if Old Wilcannia Weir Canoe Tree 3 (24-5-185), Old Wilcannia Weir Canoe Tree 2 (24-5-186) and Old Wilcannia Weir Canoe Tree 3 (24-5-187) are intercepted by heavy machinery.	Partial or full loss of Old Wilcannia Weir Canoe Tree 3 (24-5-185), Old Wilcannia Weir Canoe Tree 2 (24-5-186) and Old Wilcannia Weir Canoe Tree 3 (24-5-187) depending on severity of damage.

Activity	Type of harm (assuming no mitigation measures)	Degree of harm	Consequence of harm
Creation of the new town pool between the existing weir and proposed new weir	Direct harm: Increased water levels over The Rocks, or Rocky Crossing/Fish Trap (24-5-161), Springs and Ochre Site (24-5-162), Springs and Stony Bank (24-5-163) and Boblo's Hole Fishing Place (24-5-164).	High degree of harm through removing access to sites.	Loss of fish trap and resource-gathering sites.

14.6.2 Impacts to Aboriginal places

Wilcannia Mission Camps and Cultural Places Aboriginal Place

When the Wilcannia Mission Camps and Cultural Places Aboriginal Place was nominated, the anticipated location of the proposed new weir was excluded from the nominated area, in negotiation with Water Infrastructure NSW, so as to eliminate or reduce the impact of the proposal on the heritage values of the Aboriginal place (Department of Premier and Cabinet, 2020). As a consequence of this decision, most of the construction footprint of the proposal is outside the boundaries of the Aboriginal place. The exception to this is the existing southern access track, which cuts through a corner of the Aboriginal place's western edge. The proposal includes an upgrade to this access track. The intersection of the southern access track with the Aboriginal place is the only location where the proposed construction works would have an impact within the boundaries of the Aboriginal place. Wilcannia Local Aboriginal Land Council (as the owners of this land) would use the upgraded track following the construction of the new weir.

In terms of tangible cultural heritage, the proposal would impact one Aboriginal object within the Aboriginal place, Wilcannia New Weir 1 (24-5-176). Some of this artefact scatter is in the area where the southern access track cuts across a corner of the Aboriginal place. The nature of the anticipated impact to this site is detailed in Table 14-4.

Consultation between Water Infrastructure NSW and Heritage NSW, in October 2020, has confirmed that the southern access track is considered by Heritage NSW to be an existing use and is not considered to contradict the values that the Aboriginal place was gazetted for. Heritage NSW does not consider that the proposed upgrade of the access track would substantially diminish the cultural values of the Aboriginal place. The southern access track is located on land owned by the Wilcannia Local Aboriginal Land Council and the property is used for cultural purposes. The upgraded track would be used by the local traditional owners who would benefit from the improved access to the rest of the property.

The community river place would also be located within the Aboriginal place. Works would involve the creation of a car park area, and the placement of seating, artwork panels and interpretive signage. These works would be positioned in clear areas with no existing trees. Water Infrastructure NSW has consulted with the RAPs on the location of the community river place. Feedback from this consultation does not indicate that the RAPs consider the community river place to represent a negative impact to the intangible cultural heritage associated with the Aboriginal place. Water Infrastructure NSW has also consulted with Heritage NSW about this location, which has established that Heritage NSW has no objections as long as the Aboriginal community are consulted, supportive and there are no impacts to Aboriginal archaeological sites.

In terms of intangible cultural heritage values connected with the Aboriginal place, a possibility exists that the creation of the weir pool and the raising of the river's water level from its current state could impact these values. It is noted that many of the intangible cultural heritage values cited as being of significance to the Aboriginal place relate to the river. For example, stories relating to the Ngatji and the waterholes in which it lives; oral histories relating to the procurement of food and drinking water from the river during historical occupation of the camps within the Aboriginal place; and oral histories associated with fishing spots used historically and in continued use today.

The operation of the proposal would result in the section of the Darling River (Baaka) that runs through the Aboriginal place becoming part of the new town pool. This section of the river would be inundated by up to about four metres of pooled water. This would make the riverbed inaccessible at all times and would make the location of deep waterholes along the river less recognisable, which could have an impact on stories relating to the Ngatji and oral histories relating to past historical use of this section of the river.

Alternatively, the proposal might have the effect of enhancing the connection of the river within the Aboriginal place and the intangible cultural heritage with which it is associated because the water level could be seen to better reflect that in the river prior to European contact. The local Aboriginal community has not indicated that the proposal would negatively impact the intangible cultural heritage values connected with the Aboriginal place. It is assessed here, consequently, that the proposal would not have an impact on intangible cultural heritage connected with the Aboriginal place.

Steamers Point Aboriginal Place

The water level at Steamers Point would be at the same full supply level as the existing weir when the new weir is in normal operation mode. When the new weir is in drought security operation mode, the full supply level would increase by up to one metre above the normal full supply level.

The proposal is not expected to cause changes in the morphology of the river around Steamers Point during large flows (including floods) because the new weir would operate at the normal full supply level, so the water level at Steamers Point would be the same as if the existing weir remained in operation. There is potential for minor changes in morphology when the new weir is in drought security operation mode and the water level is up to one metre above the normal full supply level, which would result in more of the bank being wet and there is potential for wave action to parts of the bank above the normal full supply level. As with Union Bend, it is important to note that the current morphology of the river is a consequence of post-contact water extraction upstream and the weir pool created by the existing weir. The morphology of the river within living memory is substantially different from today, and it is highly probable that typical water levels were higher prior to European contact and increased water extraction upstream. As discussed in relation to Union Bend, the water level created by the new weir would create a river morphology around Steamers Point that is more similar to the 'natural' pre-contact morphology of the river than the river's current morphology is. It is also noted that in periods of flood, the water level in this area rises to levels equivalent to or exceeding the level that would be created by the new weir when operating at its full supply level. In other words, the water level at the full supply level would not be unprecedented or unusual when compared with water levels during flood events that the river currently periodically experiences. As a consequence, it cannot be assumed that the alteration of the river's morphology resulting from the proposal would represent a negative impact on the intangible cultural heritage values associated with Steamers Point.

RAP representatives have communicated that they do not anticipate the proposal would have any negative impact to Steamers Point's association with the Ngatji, or to the intangible cultural heritage values attached to Union Bend through its connection with the Ngatji and stories relating to the Ngatji.

It is assessed here that the proposal would not have a negative impact on intangible cultural heritage values connected with Steamers Point.

There are a number of archaeological sites (including Aboriginal camps dating to the post-European contact period, culturally modified trees, stone artefact scatters, stone arrangements in the form of low mounds, middens, and a silcrete quarry) in the landscape around Steamers Point (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018; New South Wales Government Gazette, 2014). Most of these archaeological sites are outside of the Darling River's (Baaka's) incised channel, and would be unaffected by the rise in water level (up to one metre) the proposal would result in. It is assessed here that the proposal would not have any impact on archaeological sites around Steamers Point.

An island near Steamers Point and the confluence of Paroo Channel and the Darling River (Baaka) is also listed as a fish trap and swimming place (24-5-146) (Central Darling Shire Council and Wilcannia Local Aboriginal

Land Council 2018: 15). It has been documented through oral history work that although the AHIMS lists this site as being located within the Steamers Point Aboriginal Place, it is actually about one kilometre further upstream (near the confluence with the Paroo Channel) and consequently outside the Aboriginal Place (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). As with Steamers Point Aboriginal Place in general, it is anticipated that the minor change in water levels that would occur only during drought security operation mode of the proposed new weir would not result in an impact to this site and its associated cultural heritage value.

14.6.3 Impacts to other culturally significant sites

Union Bend Ngatji site

The waterhole at Union Bend is associated with one or more stories relating to the Ngatji (or Rainbow Serpent), a creature involved in the creation of the Darling River (Baaka). The stretch of the river along the whole of Union Bend is associated with the intangible cultural heritage relating to the concept of the Ngatji (Central Darling Shire Council and Wilcannia Local Aboriginal Land Council, 2018). The association between waterholes such as the one at Union Bend with the Ngatji is that these deeper areas of the river are known to the Barkandji people as areas in which the Ngatji lives (Department of Premier and Cabinet, 2020: 6).

The new weir would inundate the Darling River (Baaka) at Union Bend, with water depths of between about 3.5 to 4.5 metres on a fairly consistent basis, with much less fluctuation in water level compared with the current state. This change may negatively impact on the intangible cultural heritage of stories relating to the Ngatji, given that the Ngatji is associated with creating the river and is consequently associated with the morphology (in other words, the physical state or appearance) of the river. It is important to note, however, that the current morphology of the river is very different from its pre-contact state. Current water levels in the river are the product of water extraction upstream of Wilcannia.

The higher water level that would be created in the new town pool by the new weir might be seen by the Aboriginal community as a return to a state similar to 'the old days' prior to intensive water extraction upstream. As a consequence, the change in water level at Union Bend might have a positive effect in relation to its intangible cultural value associated with the Ngatji and stories relating to the Ngatji, through returning the river to a state that is closer in appearance to its pre-contact state.

During the archaeological survey, it was communicated to Jacobs by RAP representatives that they did not anticipate the proposal would have any negative impact to Union Bend's association with the Ngatji, or to the intangible cultural heritage values attached to Union Bend through its connection with the Ngatji and stories relating to the Ngatji.

It is assessed here that the proposal would not have a negative impact on intangible cultural heritage values connected with the Union Bend Ngatji Site.

Falling Star

The Falling Star site is a rocky area in the riverbed, held to be the place where a falling star struck the earth during the dreamtime. The site is located about 10 kilometres (linear distance) upstream of the proposed new weir pool extent. The proposal would not impact on the site, either directly or indirectly. The proposal is not anticipated to have any impact on the intangible cultural heritage value of the Falling Star story.

Billilla Rocks

The Billilla Rocks site is located about 30 kilometres to the south-west of the new weir site. Based on the distance between the proposal and this site, the proposal would not impact the Billilla Rocks site, either directly or indirectly.

14.7 Mitigation and management measures

Mitigation and management measures for Aboriginal heritage impacts are provided in Table 14-5.

Table 14-5 Mitigation and management measures for Aboriginal heritage impacts

Ref	Impacts	Mitigation and management measures	Timing
AH1	Direct disturbance of Aboriginal heritage items	Detailed design and construction planning will avoid direct impacts on identified items/sites of Aboriginal heritage significance as far as reasonably practicable. The configuration of the construction compounds and associated access tracks will be reviewed, as far as practicable, to avoid and minimise impacts on Aboriginal heritage.	Pre-construction
AH2	Removal of a culturally modified tree (24-5-208 (Union Bend Canoe Tree 7))	The scarred section of the tree will be 3D scanned to create an archival 3D model. Management outcomes for the tree following scanning will be developed in consultation with the local Aboriginal community. If the tree is relocated into the river to form a ‘snag’ or fish habitat, the location would be chosen to avoid impeding the function of the new weir.	Pre-construction
AH3	Management of salvaged items	A detailed salvage methodology will be prepared by a suitably qualified archaeologist in consultation with the RAPs. The methodology will be included in an Aboriginal cultural heritage management plan and will ensure any artefacts salvaged are managed in accordance with the requirements of the NPW Act. The salvage methodology will apply to both the collection of surface artefacts (AH5) and archaeological excavations (AH4 and AH6). The salvage methodology will describe the process for consultation with the RAPs in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water, 2010a). The registered Aboriginal parties will be engaged to assist in the salvage, which will be managed by an appropriately qualified archaeologist. The salvage methodology will specify how salvaged archaeological material will be analysed, and will specify the temporary and long-term storage locations for this material. Analysis and reporting of archaeological material collected will be provided to Heritage NSW.	Pre-construction

Ref	Impacts	Mitigation and management measures	Timing
AH4	Disturbance of hearth sites	Directly impacted hearths within the identified sites and within the construction footprint will be subject to salvage excavation to examine their subsurface structure and contents and to recover dateable material (e.g. charcoal). It is estimated that about 20 hearths will be directly impacted by the proposal. Results of these excavations will be documented in an Aboriginal Archaeological Report.	Pre-construction
AH5	Salvage of surface artefacts	Surface collection of artefacts within the construction footprint, from sites along the southern access track (part of 24-5-177, whole of 24-5-180) will occur in a corridor for five metres either side of the approximate centreline of the existing track. Collection will be undertaken by a qualified archaeologist in cooperation with members of the local Aboriginal community and include recording and documentation to professional standards in laboratory conditions. Collected artefacts will be held in temporary storage in Wilcannia at a location agreed with Wilcannia Local Aboriginal Land Council, and ultimately in long-term storage in the Barkandji Cultural Heritage Centre. Results of the surface collection will be documented in a salvage report.	Pre-construction
AH6	Archaeological excavations	Archaeological excavations will be conducted at representative locations across the construction footprint to assess the potential for undiscovered subsurface archaeological material to be present, and to salvage a sample of this material. An archaeological excavation methodology will be prepared in in consultation with the registered Aboriginal parties. Findings of the archaeological excavations will be documented in an Aboriginal Archaeological Report. This report will contain recommendations specifying whether any further archaeological work should be undertaken. The report will be distributed to the RAPs for review and comment.	Pre-construction
AH7	Trimming of a culturally significant tree	Union Bend Coolamon Tree 1 (24-5-210) will remain in situ and be lopped to a position that will allow movement of the construction crane but above the upper extent of the cultural scar. Trimming of the tree will be undertaken by a tree surgeon and monitored by the registered Aboriginal parties.	Pre-construction

Ref	Impacts	Mitigation and management measures	Timing
AH8	Low awareness of the cultural heritage significant of the locality amongst visitors to the community river place and new weir	Opportunities to develop a heritage interpretation and education strategy will be investigated during detailed design, in consultation with the RAPs and the wider local Aboriginal community. This could include signage and other treatments to increase understanding and protection of the site.	Pre-construction Operation
AH9	Partial removal and decommissioning of the existing weir	The rocks that make up the existing weir will be reused locally, where possible. The nature of re-use of the rocks will be developed in consultation with the registered Aboriginal parties and the wider local Aboriginal community. Possible actions include using the rocks in the community river place, or constructing new fish trap(s) in the river. It must be noted that new fish traps could not be placed within the safety exclusion zone of the new weir.	Construction Operation
AH10	Minimising impacts during construction	An Aboriginal cultural heritage management plan will be prepared in consultation with the RAPs. It will include measures to minimise impacts to Aboriginal heritage including: ▪ Unexpected finds procedure ▪ Detailed site salvage strategy ▪ Management and care and control plans for salvaged Aboriginal objects ▪ Plans and installation procedures for fencing and protective coverings ▪ Heritage components of induction package for construction workers and supervisors ▪ Outcomes of further investigations that occur after approval of the proposal.	Construction
AH11	Monitoring of ground disturbing works	Monitoring of preliminary ground disturbance works will be undertaken by the RAPs during the construction phase. Any artefacts found will be collected, or other cultural remains identified. Monitoring should be undertaken by a team of four people, if four RAP representatives are available.	Construction
AH12	Avoiding impact to culturally modified trees	The four identified canoe trees (24-5-160 (Union Bend Canoe Tree 3), 24-5-185 (Old Wilcannia Weir Canoe Tree 3), 24-5-186 (Old Wilcannia Weir Canoe Tree 2) and 24-5-187 (Old Wilcannia Weir Canoe Tree 1)) will be fenced prior to construction and construction site personnel will be made aware of their location and importance. Fences will be placed at a minimum five metre buffer outside the dripline of the trees. No work, including storage of materials or machinery, is to be undertaken within the fenced area around the tree.	Construction

Ref	Impacts	Mitigation and management measures	Timing
AH13	Monitoring potential indirect impact	A monitoring program will be developed for scarred trees with potential to be destabilised. This monitoring will be carried out by the construction contractor, or the RAPs.	Construction
AH14	Avoiding indirect impact	Aboriginal sites will be temporarily fenced with high visibility material, and marked on site plans as areas to be avoided.	Construction
AH15	Avoiding accidental impact	A cultural heritage induction will be developed for all construction personnel attending the construction site. The induction will be delivered by the Barkandji community and developed by the RAPs and a qualified archaeologist.	Construction
AH16	Unexpected finds	An Unexpected Finds Procedure will be developed and included in the construction environmental management plan. It would set out procedures for dealing with Aboriginal objects, human remains and suspected humans remains found during the construction works. Where unknown human or suspected human skeletal remains are found on the site, works must stop in the immediate area, the area made secure from further disturbance and the Water Infrastructure NSW project manager notified. In accordance with the *Coroners Act 2009*, the NSW Police must be called to enable them to investigate whether the remains are human and if they are associated with a crime. In the case where the NSW Police determine that the remains are historic, Heritage NSW and all RAPs will be notified of the historic heritage find.	Construction

15. Non-Aboriginal heritage

The potential non-Aboriginal heritage impacts of the proposal are assessed in **Technical Report 5** and summarised in this section.

SEAR no. 6 provides requirements for the assessment of the proposal's potential non-Aboriginal heritage impacts. The requirements of SEAR no. 6 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

15.1 Legislative and policy context

15.1.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act protects heritage places listed on several heritage lists, including the Commonwealth Heritage List, National Heritage List and the Register of the National Estate. Proposed actions or development that might impact on these listed heritage items (including any MNES) must be assessed according to guidelines and assessment processes to determine if any action is likely to have a significant impact on the heritage item or heritage value of places.

The proposal would not have any impact to heritage items or places listed on the Commonwealth Heritage List, National Heritage List and Register of the National Estate.

15.1.2 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 proposal 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. However, as noted in **Section 4.3.2**, this requirement for a section 139 approval is excluded for State significant infrastructure projects. Since the proposal is declared State significant infrastructure, an excavation permit approval is not required, however all other sections of the *Heritage Act 1977* remain applicable.

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* establishes a register of heritage items owned by NSW Government agencies. The proposal would not impact on any items listed in a Section 170 Register.

Part 3C of the *Heritage Act 1977* protects historic shipwrecks and relics. Shipwrecks located inland which are more than 75 years old, and of recognised local or State significance must not be disturbed without approval from the Heritage Council of NSW. The proposal would not directly impact on any maritime heritage items, however there are three items listed on the NSW maritime heritage database which are located in the study area for the statement of heritage impact (refer to **Technical Report 5**).

15.1.3 Central Darling Local Environmental Plan 2012

Schedule 5 of the Central Darling Local Environmental Plan 2012 lists items of local heritage significance. Relevant heritage items listed in Schedule 5 have been assessed during the site inspection carried out for the statement of heritage impact (refer to **Technical Report 5**). Two items listed in Schedule 5 (Wilcannia Bridge, (local environmental plan identification number I15) and Wilcannia Conservation Area (local environmental plan identification number C1)) would be impacted by the proposal and an assessment of potential impacts to these items is provided in **Section 15.6.1** and recommended mitigation and management measures are provided in **Section 15.7**.

15.1.4 The Burra Charter

Australia is party to international treaties including the *Burra Charter of Australia's International Council on Monument and Sites* (The Burra Charter) (Australia ICOMOS, 2013). The Burra Charter provides best practice standards for heritage management, conservation and preservation. The statement of heritage impact has been informed by the Burra Charter to recommend best practice mitigation measures in assessing potential impacts to non-Aboriginal heritage as a result of the proposal.

15.1.5 NSW Heritage Manual

The NSW Heritage Manual (NSW Heritage Office, 1996) included policies and documents that provide minimum standards expected in heritage assessment, reporting and excavation. The minimum standards include:

Assessing Heritage Significance (NSW Heritage Manual) (NSW Heritage Office, 2001)

Guidance and Minimum Standards Relating to the Preparation of Statements of Heritage Impact (NSW Heritage Manual) (NSW Heritage Office, 2002)

Significance and significant fabric fact sheet (Heritage NSW, 2020).

15.2 Assessment methodology

The non-Aboriginal heritage impact assessment in the statement of heritage impact involved the following:

- Establishing and defining the study area as the construction footprint of the proposal and new weir pool inundation area upstream of the new weir location (refer to **Figure 15-1**). The study area also included an initial 150 metre buffer zone which was refined during later assessment stages
- Conducting desktop assessment searches of relevant Australian heritage registers and databases to identify potential heritage items
- Conducting review of primary and secondary sources including maps, community heritage information, and literature review of previous studies and reports
- Reviewing recent aerial imagery of the study area to identify potential historical occupation and development
- Consulting with local historians
- Reviewing levels of significance of registered heritage items
- Carrying out field survey inspection of heritage items carried out from 9 to 13 November 2020
- Assessing potential impacts of the proposal on identified heritage items in accordance with SEARs, including significance assessment
- Recommending management and mitigation measures for the proposal to minimise or avoid potential impacts to non-Aboriginal heritage items.

15.2.1 Significance assessment

Heritage significance in NSW is assessed using the gazetted heritage significance criteria detailed in *Assessing Heritage Significance* (NSW Heritage Office, 2001), which is based on the principles established in the Burra Charter (ICOMOS, 2013). In order to be considered of heritage significance, an item must fulfil at least one of the criteria. Standard practice also includes an assessment of intactness and integrity of a heritage item which assessing significance and grading.

Significance assessments were reproduced or prepared for each listed or potential heritage item within the study area. Places outside of the study area were not assessed for their significance, as their physical distance from proposal site makes them unlikely to be impacted.

Details of the significance criteria and grading of significance is provided in **Technical Report 5**.

15.3 Risk

The proposal includes construction work and therefore has the potential to impact recorded heritage items and unexpected heritage items. Specific risks include:

- Partial removal and decommissioning of the existing weir may impact and heritage values associated with this item
- Construction of the new weir may disturb unexpected heritage items.

15.4 Avoidance and minimisation of impacts

In general, potential non-Aboriginal heritage impacts have been avoided by mapping and avoiding known heritage sites where possible. Mitigation and management measures are proposed to preserve the heritage values of the existing weir where possible.

15.5 Existing environment

15.5.1 Historical context

The traditional owners of Wilcannia and the Darling River (Baaka) in this region are the Barkandji people. The Darling River (Baaka) was explored by Charles Sturt and Major Thomas Mitchell from the 1820s to the 1840s (Baker, 1967). By the mid-1840s most of the Lower Darling was occupied by squatters and settlement in the form of large land holdings and pastoral stations were gradually established from the 1850s (Jervis, 1948, p. 150).

Paddle steamer ships were operating along the Murray (Tongala) and Darling River (Baaka)s by 1859 and commercial trades included flour, wool and other goods. The Darling River (Baaka) and the river trade soon formed a large network of river ports connecting South Australia, Victoria, New South Wales and Southern Queensland. The shipping businesses were very important to Wilcannia and the surrounding region, and Wilcannia became the trades hub for transporting goods via camel trains to other townships such as Bourke, Menindee, White Cliffs and Cobar (Dell, 1981).

As Wilcannia became a central port along the Darling River (Baaka), its commercial businesses expanded to include a wharf, the Mount Murchison Woolshed, Wilcannia Post Office. By the 1880s the township of Wilcannia has become fully established as the wool industry continued to grow locally and regionally. Wilcannia also became known as a connection centre between several gold and opal mining towns. The historic buildings in the township that supported the river and in land trade routes remain today as items listed on the local and State heritage registers.

To facilitate crossing of the Darling River (Baaka) at Wilcannia, a lift bridge was constructed in1896 and was designed with a central platform that can be moved to enable paddle steamers to have free passage through the river. The Wilcannia Weir was built in 1942-46 to manage the fluctuating and intermittent flows of the Darling River (Baaka) in order to create a more secure water supply for the town.

15.5.2 Database records of historic items

A search of all relevant Commonwealth, State and local heritage registers were carried out on 8 December 2021, and the recorded heritage items that are within the study area are identified in **Table 15-1**. **Figure 15-1** shows the heritage item identified from database searches.

Table 15-1 Items recorded on heritage databases within the study area

Item	Address or approximate location	Register and ID number	Distance from study area
Centre lift bridge over the Darling River	Barrier Highway, Wilcannia	Central Darling Local Environmental Plan 2012, ID #I15 NSW maritime heritage database, ID #2749 Register of the National Estate, ID#583	Intersecting
Wilcannia Conservation Area	Wilcannia	Central Darling Local Environmental Plan 2012, ID #C1	Intersecting
Paddle steamer *Moira*	Wilcannia The location of the shipwreck is unknown, although it was reported to have burnt to the waterline whilst tied up at Wilcannia Wharf.	NSW maritime heritage database, ID #836	Potentially intersecting
River port, Wilcannia	Wilcannia This is only an historical reference to the port and is not a physical heritage item.	NSW maritime heritage database, ID #2152	n/a

Figure 15-1: Heritage items identified from database searches and literature review

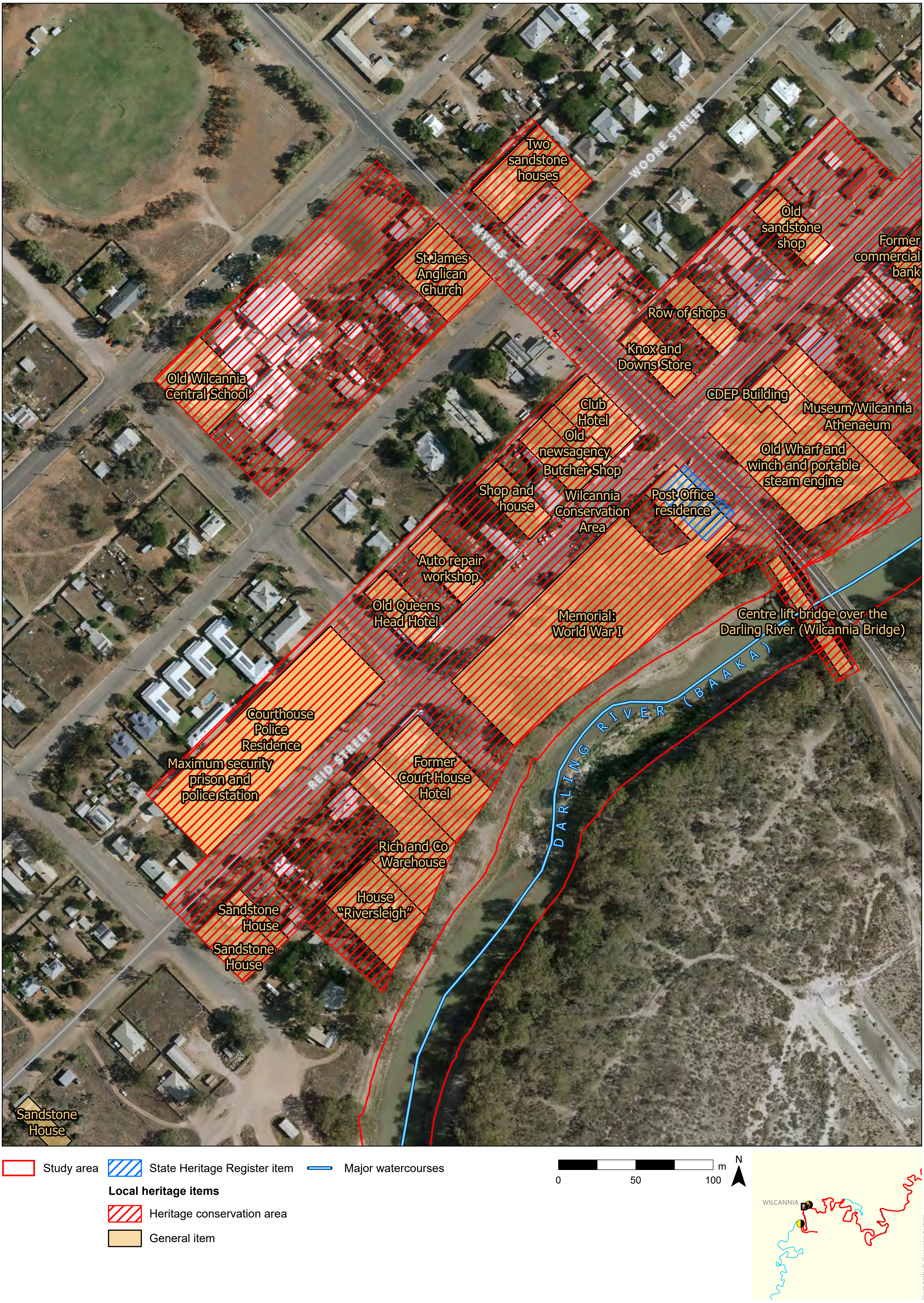


Figure 15-1: Heritage items identified from database searches and literature review

Figure 15-1: Heritage items identified from database searches and literature review

15.5.3 Site inspection results

In addition to listed heritage items being examined, potential sites of historical interest and potential heritage items were identified during a field survey carried out in November 2020.

The discovered potential heritage items were typically found along the riverbanks and were reported by Jacobs archaeologists and aquatic ecologists. The potential heritage items are generally more than 150 metres from both the new weir site and the existing weir and included remains of an iron hut, windmill, tanks, bricks and glass midden. Twelve sites or items were identified as having potential heritage significance, as shown in **Figure 15-2**. Descriptions of all the potential heritage items are provided in **Technical Report 5**.

Two items are located within the river channel, and the rest are located on riverbanks or on the floodplain.

Centre lift bridge over the Darling River (LEP ID #115)

The Wilcannia Bridge spans about 90 metres across the Darling River (Baaka) next to the Barrier Highway. The Wilcannia Bridge is listed on the Central Darling Local Environmental Plan 2012 due to its local significance. The vertical lift span bridge is strongly associated with the paddle steamer operations and river trade in Wilcannia's history, and consists of a timber and remnant asphalt surface. The bridge pylons are made of riveted iron plates and currently show significant corrosion and degradation. The impacts of the proposal on the Wilcannia Bridge is assessed in **Section 15.6.1.1**.

Photo 15-1 Wilcannia Bridge and central lift span, facing north-east from left riverbank downstream

Wilcannia Conservation Area

The Wilcannia Conservation Area (LEP ID #C1) was gazetted into the Central Darling Local Environmental Plan 2012 (Amendment No 3) on the 4 June 2021. The conservation area is located in the centre of Wilcannia and extends along Reid Street and Myers Street (Barrier Highway). The conservation area includes Wilcannia Bridge.

The Wilcannia Conservation Area contains heritage items that are representative of many sandstone and timber buildings built in Australia from the 1870s onwards. The area contains several nineteenth century sandstone buildings attributed to NSW Government Architect James Barnett.

The streetscapes of Reid Street and Myers Street are reflective of the major contribution of the township to the wool industry from the 1860s. The Wilcannia Conservation Area represents a rare example of the impact of the wool trade on the Darling River (Baaka) and its influence on settlement growth and the streetscape development. The heritage items within the area have remained relatively intact and unchanged.

Existing Wilcannia Weir

The existing Wilcannia Weir was not previously assessed for its heritage significance, and is not listed on any heritage registers. However the Wilcannia Weir is located in the study area and its heritage significance has been assessed in the statement of heritage impact (refer to **Technical Report 5**). The existing weir is located in the Darling River (Baaka) below the riverbanks of the Wilcannia Hospital and extends about 50 metres across the river. Existing fabric and materials include wooden fencing, concrete sandbags, poured concrete walls and stone rubble and boulders (refer to **Photo 15-2**). The weir structure is eroded near the right riverbank and water escapes around this edge. The weir is considered to have heritage potential.

Photo 15-2 Existing Wilcannia Weir, facing south from the right riverbank

Brick remains

A potential heritage site with brick remains was discovered about 350 metres east of the Union Bend Road access track on the right riverbank. The site includes a dense scatter of fragmented brick, as well as glass, ceramic, metal and a clay tobacco pipe. Closer to the top of the riverbank, there are signs of bank modification that may represent the remnants of a goods ramp or informal wharf. This site may have been the location of a wool scour operation, or a brick clamp kiln. Due to the uncertainty as to the full extent of the site, there is potential for archaeological relics and in situ deposits to be present (refer to **Photo 15-3**). However, this site was not investigated further because it would not be impacted by the proposal due to its distance from the new and existing weir sites.

Photo 15-3 Dense scatter of brick fragments with occasional historical artefacts, facing north-east (Jacobs, 2022)

Potential brick kilns

Another potential brick kiln site is located about 780 metres south-east of the existing weir site on the right riverbank. Extensive mounds of fragmented bricks interspersed with fragmented historical artefacts were found, with some of the material eroding down into the river channel. This site and the artefacts may be related to temporary camping occupation or discarded rubbish, and local history suggest it may have been the location of the town brickworks (refer to **Photo 15-4**).

Photo 15-4 Fragmented historical artefacts across the mounds of fragmented bricks (Jacobs, 2022)

Various other historical artefacts and potential sites of heritage items were discovered during the site inspection, with field surveys detailed further in the statement of heritage impact (refer to **Technical Report 5**).

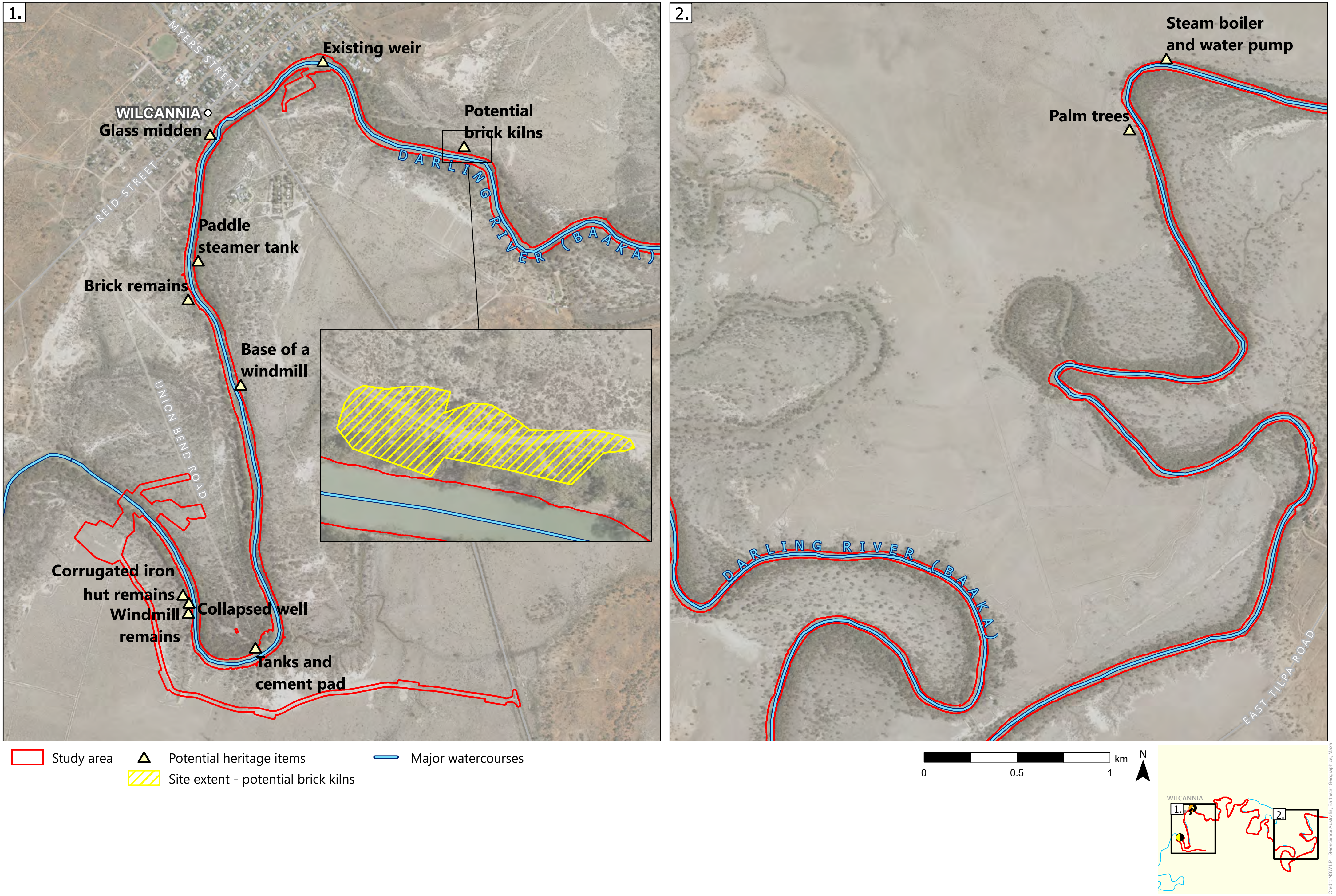


Figure 15-2: Sites of historical interest / potential heritage items identified during site inspection

15.6 Significance assessment

The significance assessment was carried out only for the listed items within the study area and potential heritage items identified during the field survey. Listed items or potential heritage items surveyed beyond the study area are not assessed further due to the unlikely potential impacts of the proposal on these items or sites.

Following the significance assessments it has been assessed that there are four heritage items which fulfil one or more heritage criteria for local significance within the study area (refer to **Figure 15-3**):

- Centre lift bridge over the Darling River (LEP ID #I15)
- Wilcannia Conservation Area (LEP ID #C1)
- The existing Wilcannia weir
- Potential brick kilns.

The assessment of potential impacts from the proposal has therefore been restricted to these four heritage items.

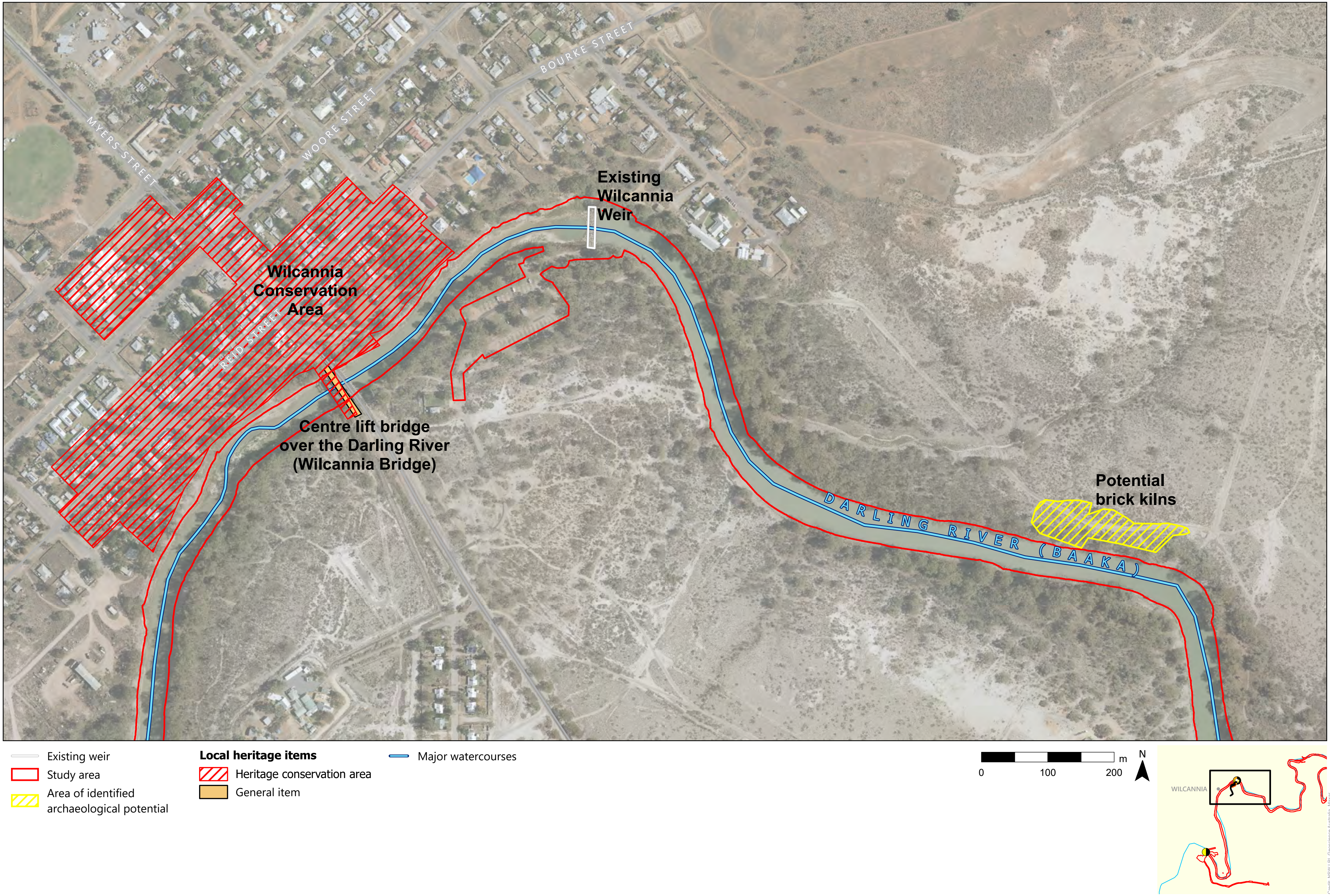


Figure 15-3: Heritage items which fulfil one or more heritage criteria for local significance within the study area

15.6.1 Assessment of impacts

15.6.1.1 Construction impacts

Centre lift bridge over the Darling River (LEP ID #I15)

Construction of the proposal would not have a direct impact on the Wilcannia Bridge. The proposal would not result in the generation of vibrations that may impact on the bridge due to its distance from the proposal sites.

Wilcannia Conservation Area (LEP ID #C1)

Wilcannia Conservation Area would not be directly impacted by construction of the proposal due to its distance from the construction sites.

Existing Wilcannia Weir

The existing weir would be partially removed and decommissioned once the new weir is completely built and commissioned. These works would have direct and indirect impacts to this heritage item. Partial removal of the existing weir is necessary to prevent it from storing water, to connect the new town pool to the raw water intake pipe, and to enable fish passage.

The local heritage values of the existing weir are associated with its historical, aesthetic, and social qualities. The reuse of rocks from the existing weir would partly enhance this heritage and strengthen the connection between the Barkandji and the Darling River (Baaka). Some of the rocks from the existing weir would be reused in landscaping of the new weir site, community river place and existing weir site. Further mitigation and management measures to maintain a cultural connection to the existing weir at the new weir site are proposed in **Section 15.7**.

Potential brick kilns

The potential brick kilns would not be directly or indirectly impacted by the construction of the proposal. The location of the brick mounds site at the top of the riverbank means the variable flows of the Darling River (Baaka) would not affect its site integrity during construction at both new weir and existing weir sites.

15.6.1.2 Operation impacts

Centre lift bridge over the Darling River (LEP ID #I15)

Once the new weir is operational, Wilcannia Bridge would be located within the new town pool and the bridge piers and cross braces would be inundated by a greater depth of water than occurs currently with flowing water under the bridge. The depth of inundation of the bridge piers and cross braces would fluctuate when the new weir is in normal operation mode and be temporarily higher when the new weir is in drought security operation mode. These changes in the level of the new town pool have the potential to exacerbate existing corrosion issues on the bridge piers and cross braces. It would also complicate any attempts at stabilisation or remediation once the new weir is operational.

Other components of the proposal including partial removal and decommissioning of the existing weir, construction and upgrades of access tracks and establishment of the community river place would not be expected to impact on Wilcannia Bridge.

Wilcannia Conservation Area (LEP ID #C1)

Wilcannia Conservation Area includes Wilcannia Bridge and the area would only be impacted by operation of the proposal to the extent that Wilcannia Bridge is impacted.

Existing Wilcannia Weir

The decommissioning and partial removal of the existing Wilcannia Weir would be of major direct and indirect impact to this heritage item. Given that its primary value relates to historical and social significance there is potential for these impacts to be mitigated through appropriate mitigation measures.

Potential brick kilns

Due to its location at the top of the riverbank, the potential brick kilns site would not be impacted by the operation of the proposal.

15.7 Mitigation and management measures

Mitigation and management measures for non-Aboriginal heritage impacts are provided in **Table 15-2**.

Table 15-2 Mitigation and management measures for non-Aboriginal heritage impacts

Ref	Impacts	Mitigation and management measures	Timing
NAH1	Corrosion risks to the Wilcannia Bridge	To preserve the heritage fabric of the Wilcannia Bridge (LEP ID #I15), stabilisation of the existing corrosion damage and remediation works will be undertaken prior to the construction of the new weir as per the community proposal. Water Infrastructure NSW will continue to liaise with the DPE and Central Darling Shire Council to ensure remediation works to the Wilcannia Bridge are completed prior to the commissioning of the new weir.	Pre-construction Construction
NAH2	Partial removal and decommissioning of the existing Wilcannia Weir	3D scan the existing weir to create a reality textured model. Prior to and during its partial removal and decommissioning, an archival photographic recording of the existing weir will be undertaken (by an appropriately experienced heritage professional) in accordance with *Photographic Recording of Heritage Items Using Film or Digital Capture* (Heritage Council of NSW, 2006) and *How to Prepare Archival Records of Heritage Items* (Heritage Council of NSW, 1998). The accompanying report to the archival recording will include the collection of oral histories related to the weir from the local community.	Pre-construction Construction
NAH3	Social and historical values of the community	A heritage interpretation plan for the existing Wilcannia Weir will be prepared to provide a framework for the interpretation of the item, set out key interpretive themes and identify appropriate communication strategies to relay social values and oral histories related to the existing weir. Opportunities for interpretation which will be considered during the development of the heritage interpretation plan include: ▪ Adaptive reuse of some of the weir fabric e.g. the sandstone rock fill, in the new community river place ▪ Interpretive signage commemorating the history and location of the existing weir at a suitable location.	Pre-construction Construction Operation

Ref	Impacts	Mitigation and management measures	Timing
NAH4	Unexpected historic heritage or human remain finds	An unexpected finds protocol will be developed for inclusion in the construction environmental management plan to provide a consistent method for managing any unexpected heritage or archaeological items (including unexpected human remains) for the duration of the demolition and construction phases of the proposal. Any human skeletal remains discovered during construction will be managed in accordance with *Skeletal Remains – Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977* (NSW Heritage Office, 1998). Other relevant legislation and guidelines for managing human skeletal remains discovered during construction include *NSW Health Procedures Exhumation of human remains* (NSW Department of Health, 2013), Public Health Regulation 2012 (NSW), *Heritage Act 1977* (NSW), *Work Health and Safety Act 2011* (NSW), *Coroners Act 2009* (NSW), *National Parks and Wildlife Act 1974* (NSW).	Construction
NAH5	Heritage awareness during construction	Historical heritage awareness training will be undertaken by all site workers prior to commencement of demolition or construction works. This training will promote an understanding of potential heritage items in the area and the requirements of the unexpected finds procedure.	Pre-construction Construction
NAH6	Salvage of weir rocks	In consultation with the local community, rocks from the existing weir will be salvaged and reused in landscape remediation works including at the community river place and new and existing weir sites.	Construction

16. Social, land use and property

This section provides a social, land use and property impact assessment of the proposal, and recommends mitigation and management measures to address these impacts.

SEAR no. 7 includes requirements for the assessment of the social impacts of the proposal. The requirements of SEAR no. 7 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

16.1 Legislative and policy context

16.1.1 Crown Land Management Act 2016 and Commons Management Act 1989

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 proposal is located on Crown land, including the Darling River (Baaka), the river embankments at the existing and proposed new weir locations, and the community river place. Consultation with the DPE Crown Lands has been carried out and is detailed in **Section 5**.

Lot 7314 DP1181235 (land next to the right riverbank near the new weir) is Crown land administered under the *Commons Management Act 1989* and managed by the DPE Crown Lands.

Lot 7315 DP1181235 (land that includes the site of the proposed community river place) is reserved under the *Crown Land Management Act 2016* for 'public recreation', and is managed by Central Darling Shire Council as the gazetted Crown and manager. Central Darling Shire Council has developed a draft plan of management to include the proposed community river place. Consultation with DPE Crown Land and Barkandji Native Title Group Aboriginal Corporation is required to finalise the plan of management.

Under section 80 of the *Public Works and Procurement Act 1912*, the Water Administration Ministerial Corporation has the power to enter and occupy land to construct public works. Consequently, a Crown lands access licence would not be required to construct the new weir.

There are no Travelling Stock Reserves at the proposal location, however there is one Category 2 Travelling Stock Reserve (Steamers Point) located two kilometres upstream of the existing weir. No impacts are expected on the Travelling Stock Reserve at Steamers Point from the proposal. Another Travelling Stock Reserve is located at the end of the proposed weir pool extent, about 100 metres south of Paroo-Darling State Conservation Area, and about 82 river kilometres upstream of the existing weir on the right riverbank. The proposal is not expected to impact on this Travelling Stock Reserve.

An easement for the power supply to the new weir site would be sought in accordance with section 5.47 of the *Crown Land Management Act 2016*. The easement authority would be vested to WaterNSW at the time they become responsible for operation and maintenance of the new weir.

16.1.2 Native Title (New South Wales) Act 1994

The *Native Title (New South Wales) Act 1994* operates to implement the Commonwealth *Native Title Act 1993* in NSW and to ensure consistency with the standards set in the Commonwealth Act. Native title recognises rights over land and water according to traditional laws and customs and native title holders may be entitled to certain procedural rights under the *Native Title Act 1993* where acts affect their rights and interests.

The Barkandji Native Title Group Aboriginal Corporation is the recognised representative for the common law native title holders for the lands where native title has been determined by the Federal Court of Australia to exist.

Native title (non-exclusive) is held over a portion of the proposal area (NCD2015/001 – Barkandji Traditional Owners #8 Part A), including the existing weir, the Victory Park Caravan Park, the length of the Darling River (Baaka) affected by the proposal, and the area at the new weir on the right riverbank and inclusive of Union Bend Road (refer to **Figure 16-1**).

Native title (exclusive) is held over a portion of the proposal area (NCD2017/001 – Barkandji Traditional Owners #8 Part B). This area covers the embankments on the right riverbank at the new weir location, including the access track connecting the proposal site to the Barrier Highway. The same area is subject to the Barkandji Weinteriga and Yobel Station Indigenous Land Use Agreement registered on 13 July 2018 (NI2018/003).

Notice under section 24HA(2) of the Commonwealth *Native Title Act 1993* has been issued to the legal representatives for the Barkandji Native Title Group Aboriginal Corporation.

Engagement with the Barkandji Native Title Group Aboriginal Corporation regarding the proposal has included:

- Attendance by a Barkandji Native Title Group Aboriginal Corporation meetings at four Project Reference Group meetings held during the COVID-19 pandemic between June and September 2020
- Presentation at a Barkandji Native Title Group Aboriginal Corporation board meeting in October 2020
- Four meetings with representatives of Barkandji Native Title Group Aboriginal Corporation in March 2021, May 2021, December 2021 and May 2022
- Email and letter correspondence to Barkandji Native Title Group Aboriginal Corporation including providing progress updates on the proposal and invitations to community information sessions and other events.

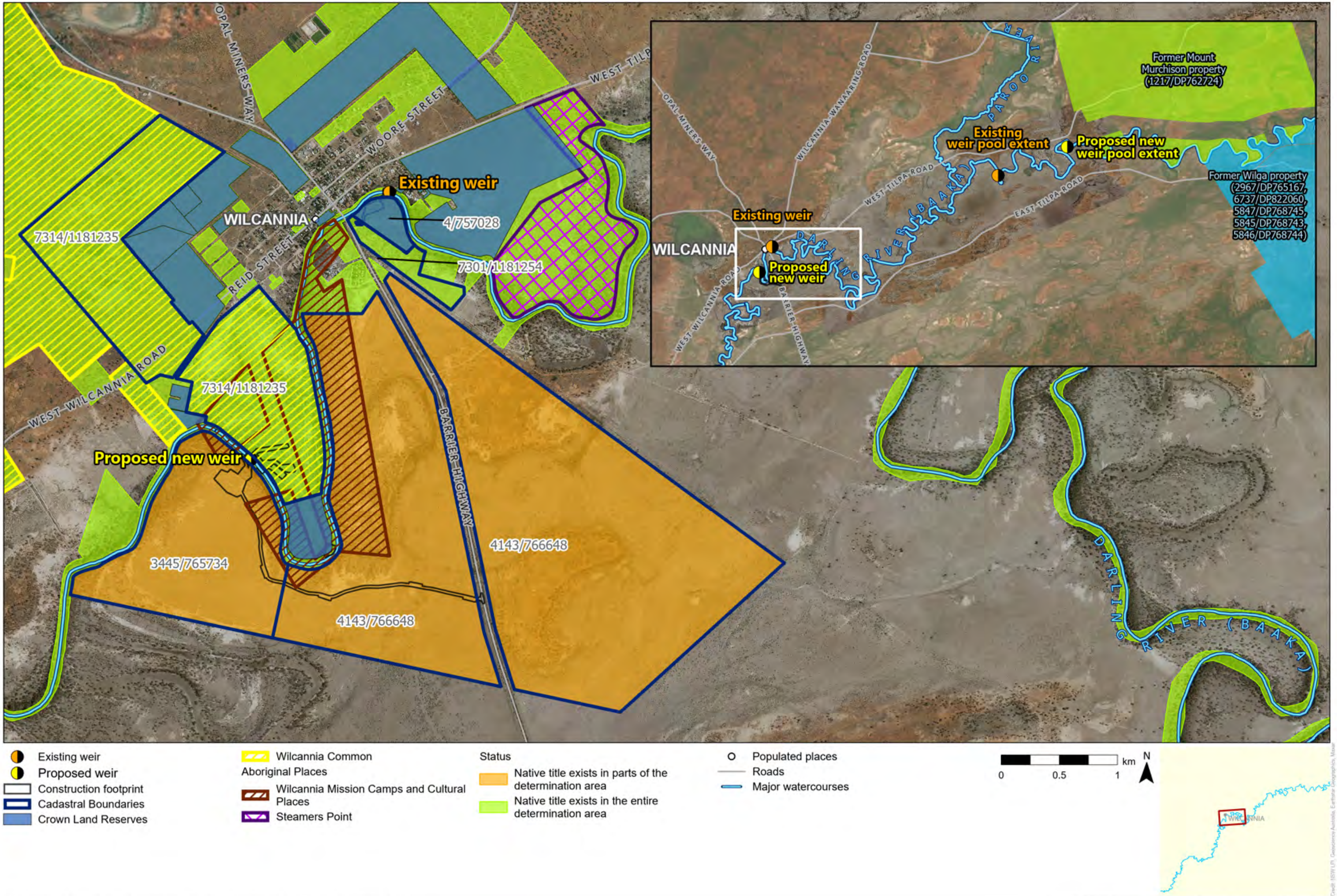


Figure 16-1 Land use and land interests near the project

16.1.3 Central Darling Local Environmental Plan 2012

The Central Darling Local Environmental Plan 2012 establishes the land use planning framework for the Central Darling local government area. While the provisions of the Central Darling Local Environmental Plan 2012 do not apply to this proposal, the relevant land use objectives have been considered.

As noted in **Section 4.2**, the new weir and existing weir are located within the banks of the Darling River (Baaka) on land zoned as W1 Natural Waterways. The land adjoining both sides of the river at the site of the new weir and at the community river place is zoned as RU1 Primary Production (refer to **Figure 16-2**). This area mainly comprises intact bushland and no agricultural activities are carried out on the site. The land around the existing weir is zoned R1 General Residential to the north and RE2 Private Recreation to the south. Upstream of the existing weir pool, the area surrounding the river is zoned RU1 Primary Production.

Table 16-1 Land use zoning and objectives

Zone	Objectives
W1	▪ To protect the ecological and scenic values of natural waterways ▪ To prevent development that would have an adverse effect on the natural values of waterways in this zone ▪ To provide for sustainable fishing industries and recreational fishing.
RU1	▪ To encourage sustainable primary industry production by maintaining and enhancing the natural resource base ▪ To encourage diversity in primary industry enterprises and systems appropriate for the area ▪ To minimise the fragmentation and alienation of resource lands ▪ To minimise conflict between land uses within this zone and land uses within adjoining zones.
R1	▪ To provide for the housing needs of the community ▪ To provide for a variety of housing types and densities ▪ To enable other land uses that provide facilities or services to meet the day to day needs of residents ▪ To minimise land use conflict between land uses on land within the zone and land uses on land within adjoining zones.
RE2	▪ To enable land to be used for private open space or recreational purposes ▪ To provide a range of recreational settings and activities and compatible land uses ▪ To protect and enhance the natural environment for recreational purposes.

The proposal would be consistent with the land use zone objectives under the Central Darling Local Environmental Plan 2012.

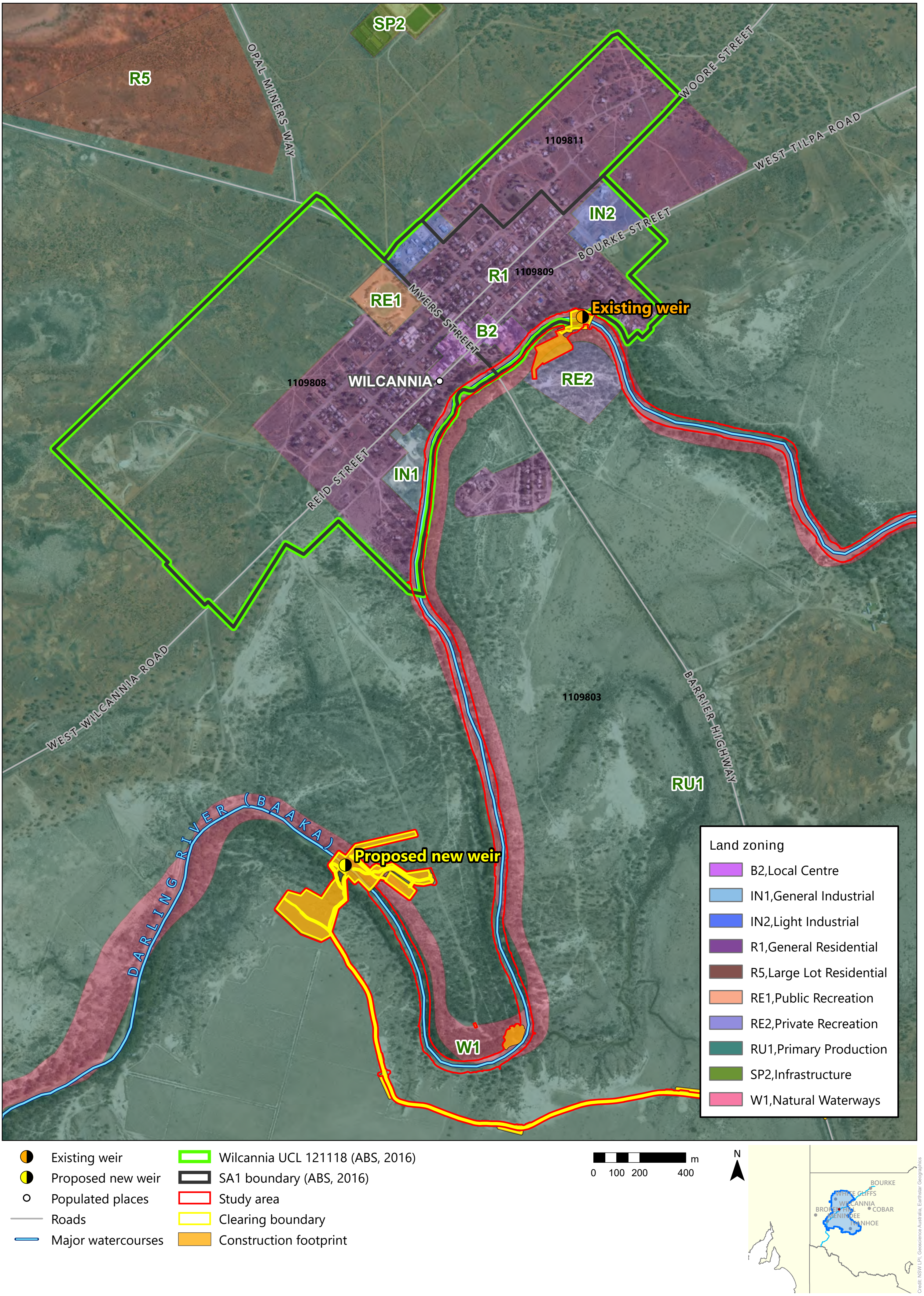


Figure 16-2 Socio-economic study area

16.1.4 Central Darling Shire Community Strategic Plan 2017-2027

The *Central Darling Shire Community Strategic Plan* (Central Darling Shire Council, 2017) sets out the goals, objectives and strategies for the Central Darling Shire. The plan outlines four main goals to help achieve its vision of being a great place to live and visit, of which those relevant to the proposal include:

- A healthy and cohesive community receiving recognition and supported by coordinated, appropriate and affordable services
- A strong regional economy supported by developing industries, strong businesses and increased employment
- A protected and supported natural environment and a sustainable and well maintained built environment.

A key objective of the plan is the delivery of safe and reliable water supplies for communities, cultural and arts awareness and pride and improved opportunities for communities.

The proposal would contribute to the goals and objectives set out in the plan, through the provision of a new weir and improved infrastructure that would provide greater water security for the town. The associated programs and initiatives that have commenced will also contribute to community arts awareness and pride, and provide opportunities for training and employment.

Responses from community members during consultation for the *Central Darling Shire Community Strategic Plan* indicated that the highest priorities for service and facility provisions in Wilcannia are water, youth facilities, streetscaping/beautification, health and nutrition, public safety and tourism development (Central Darling Shire Council, 2017).

The proposal addresses short and long-term community concerns about water security and would provide a weir with greater storage capacity to ensure Wilcannia has access to essential water services during drought periods. The proposal would also incorporate local artwork at the community river place and the downstream face of the weir crest. The proposal would contribute to improved health and wellbeing by providing a clean and reliable water supply, and maintaining the Darling River (Baaka) environment to enhance cultural connections. The new weir and community river place would facilitate public safety and tourism activities through appropriate landscape design (refer to **Technical Report 6**).

16.1.5 Wilcannia Community Action Plan

The *Wilcannia Community Action Plan* (Wilcannia Community Working Party, 2019) was developed with the support of Murdi Paaki Services Limited to inform external agencies of the priorities of the Wilcannia Aboriginal community. The Wilcannia Community Working Party is the peak Aboriginal governance and representative body for the Wilcannia Aboriginal Community. It is one of 16 community working parties forming the Murdi Paaki Regional Assembly, which is the peak body representing the interest of Aboriginal and Torres Strait Islander people in communities across Western NSW.

The Wilcannia Community Working Party sets community priorities to guide external groups such as government departments, non-government organisations and the private sector in developing policies and programs for the Aboriginal community. All agencies and other parties are expected to follow the engagement process set by the Working Party to ensure they adhere to the principles of local decision-making, co-design and community capacity building.

The six priorities recognised in the *Wilcannia Community Action Plan* are culture and heritage, housing, safety and healthy communities, economic development, education, employment and training.

The proposal is consistent with the priorities of the *Wilcannia Community Action Plan* as the weir replacement, community river place and new town pool would contribute positively to culture and heritage, healthy communities and economic development in Wilcannia.

16.1.6 Aboriginal Procurement Policy

The *Aboriginal Procurement Policy* (NSW Treasury, 2021) aims to support employment opportunities for Aboriginal people and to support the sustainable growth of Aboriginal businesses by driving demand via Government procurement of goods, services and construction.

The policy applies to all NSW Government departments, statutory authorities, trusts and other government entities. NSW Government agencies must include minimum requirements for 1.5 per cent Aboriginal participation in all contracts valued at $7.5 million or above and, where feasible, agencies should give first consideration to Aboriginal businesses for procurements up to $250,000.

The policy sets out three targets to be achieved by 31 December 2021:

- One per cent of total addressable spend in each NSW Government cluster be spent on Aboriginal businesses
- Three per cent of total goods and services contracts within each cluster be awarded to Aboriginal businesses
- 3,000 full-time equivalent opportunities for Aboriginal people through NSW are supported.

Aboriginal participation in the construction phase of the proposal would be promoted. The Wilcannia Weir Local Business Register has been established and the details of businesses on the register would be shared with the principal contractors who tender for the construction of the new weir so that they can select and partner with registered businesses as part of their commercial offer.

16.1.7 National Agreement on Closing the Gap

The *National Agreement on Closing the Gap* (July 2020) was developed by a partnership between all Australian Governments and the Coalition of Aboriginal and Torres Strait Islander Peak Organisations (Coalition of Peaks). The agreement aims to enable Aboriginal and Torres Strait Islander people and governments to work together to overcome the inequality experienced by Aboriginal and Torres Strait Islander people, and achieve life outcomes equal to all Australians.

The outcomes of the agreement include shared decision making, building community-controlled sector, improving mainstream institutions, provide and use Aboriginal and Torres Strait Islander-led data, and achieving 16 socio-economic targets with associated indicators.

Socio-economic targets in the agreement that are relevant to the proposal include:

- Outcome 1 – Aboriginal and Torres Strait Islander people enjoy long and healthy lives
- Outcome 6 – Aboriginal and Torres Strait Islander students reach their full potential through further education pathways
- Outcome 7 – Aboriginal and Torres Strait Islander youth are engaged in employment or education
- Outcome 8 – Strong economic participation and development of Aboriginal and Torres Strait Islander people and communities
- Outcome 15 – Aboriginal and Torres Strait Islander people maintain a distinctive cultural, spiritual, physical and economic relationship with their land and waters.

The proposal would be consistent with socio-economic targets of the *National Agreement on Closing the Gap*, and would support Aboriginal and Torres Strait Islander people to enjoy healthy lives, further their education and to maintain cultural connections with the land and water around the Darling River (Baaka). Further details on consultation, including community training program delivered to local students are provided in **Section 5.3**.

16.1.8 NSW Water Strategy

The *NSW Water Strategy* (DPIE, 2021b) is a 20-year state-wide strategy to improve the security, reliability and quality of the State's water resources over the coming decades. The strategy addresses key challenges and opportunities for water management and service delivery across the State and set the strategic direction for the NSW water sector over the long-term. It is part of a suite of long-term regional strategies including the Western Regional Water Strategy (refer to Section G.2.4 of **Appendix G**).

The strategy outlines seven key priorities; the following priorities are relevant to the proposal:

- Priority 2 – Recognise First Nations/Aboriginal People's rights and values and increase access to and ownership of water for cultural and economic purposes
- Priority 3 – Improve river, floodplain and aquifer ecosystem health, and system connectivity
- Priority 4 – Increase resilience to changes in water availability (variability and climate change).

The proposal would align with these priorities by improving access to water in the new town pool and support river ecosystems at the Darling River (Baaka) in Wilcannia. The new weir would also support increased resilience to changes in river flow and water availability through the proposed design, which includes gates and a fishway, and the operational framework.

16.2 Assessment methodology

16.2.1 Methodology overview

Social impact assessment involves identifying, assessing and evaluating changes to or impacts on, communities, business and industry that are likely to occur as a result of the proposal. A socio-economic, land use and property impact generally refers to a consequence experienced by people (i.e. individuals, households, groups, communities or organisations) due to changes from a project (DPIE, 2021d).

This assessment has been developed in accordance with the *Social Impact Assessment Guideline for State Significant Projects* (DPIE, 2021d) (the SIA Guidelines) and to address the socio-economic, land use and property matters outlined in SEARs no. 7. It involved:

- Scoping the likely range of potential socio-economic, land use and property issues relevant to the proposal and identifying the communities likely to be affected by the proposal's construction and operation, based on a review of background information relevant and consideration of the outcomes of consultation carried out for the proposal. The scoping of likely issues was informed by the SEARs and the SIA Scoping Worksheet in the SIA Guidelines
- Describing the existing social environment based on the review and analysis of existing available information, outcomes from consultation with local communities, and site visit conducted in October 2020, and preparing a baseline of existing socio-economic, land use and property characteristics, values and conditions
- Assessing and evaluating the potential socio-economic, land use and property impacts of the proposal relating to local amenity, access and connectivity, social infrastructure, business and community values. A matrix was used to evaluate the significance of potential positive and negative socio-economic, land use and property impacts associated with the construction and operation of the proposal
- Identifying measures to mitigate or manage potential socio-economic, land use and property impacts and maximise potential benefits.

A site visit was undertaken in October 2020 by the environmental impact statement and socio-economic, land use and property impact assessment team. The purpose of the site visit was to familiarise the assessment team with the proposal site, and gather information to inform the characterisation of the existing environment and understanding of community values and issues.

16.2.1.1 Scoping of socio-economic, land use and property issues

Potential issues for this assessment were identified based on a review of the following information:

- Strategic plans and community plans for the region
- Community engagement undertaken for the proposal
- Findings of other technical studies prepared for the proposal.

The relevant strategic plans, community engagement and findings from technical studies provided insight into potential issues that the community may currently face and potential impacts to the community during construction and operation of the proposal. The scoping of issues was informed by the SIA Scoping Worksheet within the SIA Guidelines.

16.2.1.2 Social baseline

A description of the existing social environment (social baseline) was compiled to form the basis for predicting or measuring the potential socio-economic, property and land use benefits and impacts of the proposal. The social baseline was developed for the social locality and the regional study area as outlined in **Section 16.2.3**. The social baseline is developed by reviewing local and state government policies, data and information on existing population and demography, identification of social infrastructure and community values, including those related to Aboriginal cultural heritage.

The following sources were used to prepare the social baseline:

- Australian Bureau of Statistics (ABS) Census 2016 for the local and regional study area
- Central Darling Shire Council website and publications
- NSW Government data such as DPE population projections
- Information from stakeholder consultation, site visits, and other technical studies undertaken for the environmental impact statement
- Published research and previous studies and reports relevant to the area
- Land use and property information obtained from NSW cadastre, Native Title registers, Crown Land databases and mapping contained in the Central Darling Local Environmental Plan 2012.

Population and demographic data presented in this report is from the 2016 ABS Census, which was conducted on 9 August 2016. The 2021 Census of Australia's population was conducted on 10 August 2021, with data planned to be released from June 2022. While this data is five years old, it is the most comprehensive information currently available for Australia's population and demography. Data from the 2016 Census is supplemented with more recent information from the ABS and NSW Government where this is available.

16.2.1.3 Assessment of social benefits and impacts

The likely significance of potential positive and negative social impacts of the proposal were rated using the evaluation matrix shown in **Figure 16-3**.

Likelihood level		Magnitude level 1 Minimal	2 Minor	3 Moderate	4 Major	5 Transformational
A	Almost certain	Medium	Medium	High	Very High	Very High
B	Likely	Low	Medium	High	High	Very High
C	Possible	Low	Medium	Medium	High	High
D	Unlikely	Low	Low	Medium	Medium	High
E	Very unlikely	Low	Low	Low	Medium	Medium

Figure 16-3 Social impact significance matrix

Source: DPIE (2021d)

The evaluation matrix considered the likelihood and magnitude of each impact based on the likelihood and magnitude criteria defined in **Table 16-2**. The dimensions of social impact used to determine the level of magnitude are identified in **Table 16-3**.

Table 16-2 Likelihood levels of social impacts (DPIE, 2021d)

Level	Meaning
Likelihood	
Almost certain	Definite or almost definitely expected (e.g. has happened on similar projects)
Likely	High probability
Possible	Medium probability
Unlikely	Low probability
Rare	Improbable or remote probability
Magnitude	
Transformational	Substantial change experienced in community wellbeing, livelihood, infrastructure, services, health, and/or heritage values; permanent displacement or addition of at least 20 per cent of a community.
Major	Substantial deterioration/improvement to something that people value highly, either lasting for an indefinite time, or affecting many people in a widespread area.
Moderate	Noticeable deterioration/improvement to something that people value highly, either lasting for an extensive time, or affecting a group of people.
Minor	Mild deterioration/improvement, for a reasonably short time, for a small number of people who are generally adaptable and not vulnerable.
Minimal	Little noticeable change experienced by people in the locality.

Source: DPIE (2021d)

Table 16-3 Dimensions of social impact magnitude (DPIE, 2021d)

Dimension	Meaning
Extent	Who specifically is expected to be affected (directly, indirectly, and/or cumulatively), including any vulnerable people? Which location(s) and people are affected? (e.g. near neighbours, local, regional, future generations).
Duration	When is the social impact expected to occur? Will it be time-limited (e.g. over particular project phases) or permanent?
Severity or scale	What is the likely scale or degree of change? (e.g. mild, moderate, severe)
Intensity or importance	How sensitive/vulnerable (or how adaptable/resilient) are affected people to the impact, or (for positive impacts) how important is it to them? This might depend on the value they attach to the matter; whether it is rare/unique or replaceable; the extent to which it is tied to their identity; and their capacity to cope with or adapt to change.
Level of concern/interest	How concerned/interested are people? Sometimes, concerns may be disproportionate to findings from technical assessments of likelihood, duration and/or intensity.

Source: DPIE (2021d)

16.2.1.4 Recommended social impact mitigation measures

Recommended social impact mitigation and management strategies were identified to enhance the benefits for stakeholders and communities and manage or mitigate negative impacts from the proposal.

16.2.2 Community and stakeholder engagement

A comprehensive engagement program with the local community and stakeholders has been implemented throughout the proposal planning and design process, as detailed in **Section 5**.

Key issues raised by stakeholders relevant to this socio-economic, land use and property assessment are summarised in **Table 16-4**, along with information on where the issues have been addressed in the social impact assessment.

Table 16-4 Summary of key social and land use issues raised by stakeholders

Key issues raised by stakeholders	Where issues are addressed
Desire to see enhanced recreational values for the river, particularly for children	**Section 16.7.2**
Desire to see enhanced tourism opportunities	**Section 16.7.2**
Social and cultural importance of the rocks in the existing weir and the desire to see them reused or relocated	**Section 3.6.5** and **Technical Report 6**
Provision of toilet facilities to be made available at the community river place	**Appendix D**
Need for greater employment opportunities in the town for locals	**Section 16.7.1**

16.2.3 Social locality

The social locality for the proposal includes those communities that are likely to experience changes due to the construction and operation of the proposal.

The social locality has been defined as the ABS Urban Centres and Localities area in Wilcannia (Urban Centre and Locality number 121118), as shown in **Figure 16-2**. The securing of the town's water supply is of direct benefit to all community members. Given the remoteness of the town from surrounding localities, it is not expected that other communities would be directly or indirectly impacted, however for reference, the Central Darling local government area has also been considered for comparison with the social locality.

Due to the dispersed and discrete nature of the proposal components and potential impacts, discussion of the potential proposal impacts have been grouped into two physical areas:

- New weir site and new town pool
- Existing weir site.

The proposal would result in a temporary extension of the upstream extent of the existing weir pool and an increase in the full supply level of one metre when the new weir is in drought security operation mode (refer to **Section 3.1**). However, the increased storage would be contained within the riverbanks for the entire length of the extended weir pool, and would only occur when there are no or low inflows to Wilcannia Weir, and so are not considered to be a worsening of the existing conditions for landowners along the Darling River (Baaka).

It is acknowledged that the Darling River (Baaka) is of cultural and spiritual importance to all Barkandji people, regardless of where they reside. Where possible, consultation and engagement activities have sought to include consideration of their values through the representatives of the broader Wilcannia Aboriginal community, and registered Aboriginal parties for the Aboriginal Cultural Heritage Assessment (refer to **Section 14.1.2**), including those that were (and continue to be) local Aboriginal members of the Barkandji Native Title Group Aboriginal Corporation.

16.2.4 Alignment with SIA Guidelines

The SIA Guidelines identify a number of principles that underpin the guideline's approach to social impact assessment. **Table 16-5** presents the alignment of the proposal with these principles and where they have been addressed in the assessment.

Table 16-5 Alignment with SIA Guidelines

Principle	Description	Where principle is addressed
Action-oriented	Defines specific actions to deliver practical, achievable and effective outcomes for people.	The new weir and the associated weir pool would provide increased water security for the local community by making the town's water supply more reliable during dry periods. The assessment has considered potential impacts and proposed mitigation measures that could minimise adverse impacts and enhance positive impacts of the proposal. The measures to be implemented are provided in **Section 16.8**.

Principle	Description	Where principle is addressed
Adaptive	Establishes systems to respond to new or different circumstances to support continuous improvement.	The new weir has been sized having considered the potential future impact of climate change. The new weir has been sized based on a secure yield analysis that recognises the potential future impact of climate change by allowing for increased evaporation from the weir pool and a period of no inflow into the weir pool that is 10 per cent longer than the longest recorded period of no inflow to the existing weir pool. Further detail on how the proposal has factored in future climate change is provided in Section 4.1.2 of **Technical Report 1**.
Culturally responsive	Develops culturally informed approaches and methodologies to ensure Aboriginal and culturally diverse communities are engaged appropriately, and their perspectives, insights and feedback are valued.	The proposal design has involved Aboriginal community consultation and their inputs have been considered. Engagement with the local Aboriginal community is guided by the *Strategy for Delivering Aboriginal Community Outcomes* (Water Infrastructure NSW, 2021). Consultation has sought to ensure appropriate engagement with Aboriginal stakeholders, as detailed in **Section 5**.
Distributive equity	Considers how different groups will experience social impacts differently (particularly vulnerable and marginalised groups, future generations compared with current generations, and differences by gender, age and cultural group).	The proposal is intended to meet the needs of future generations of a vulnerable remote community as well as catering to the immediate needs of current generations by providing increased water security. In addition, the increased presence of permanent water in the town will have cultural, social and recreational benefits for all members of the community. The assessment considers potential impacts of the proposal's construction and operation on different stakeholder groups.
Impartial	Uses fair, unbiased research methods and follows relevant ethical standards.	The social impact assessment has been prepared by a suitably qualified professional in accordance with using industry standards and professional ethics.
Inclusive	Seeks to hear, understand, respect and document the perspectives of all likely affected people. Uses respectful, meaningful and effective engagement activities tailored to the needs of those being engaged (e.g. being culturally sensitive and accessible).	As outlined in **Section 5.3** the proposal development has been informed by continued engagement of stakeholders, including the local community members. Stakeholder engagement and consultation process have been tailored to the needs of the Aboriginal community including providing culturally respectful communication and information, as well as making displayed information accessible such as physical rather than digital presentations.

Principle	Description	Where principle is addressed
Integrated	Uses and references relevant information and analysis from other assessments to avoid duplication. Supports effective integration of social, economic and environmental considerations in decision-making.	The assessment has drawn on the findings from the relevant studies prepared to support the environmental impact statement, such as noise, air quality and traffic, and utilised them to demonstrate social outcomes as they relate to people.
Life-cycle focus	Seeks to understand likely impacts (including cumulative impacts) at all project stages, from pre-construction to post-closure/operation commencement.	The proposal has considered cumulative impacts for social and environmental factors, refer to **Section 22.5.2**. The assessment considers potential impacts of the proposal's construction and operation on different stakeholder groups.
Material	Identifies which likely social impacts matter the most for people and/or pose the greatest risk/opportunity to those expected to be affected.	Scoping of the potential social impacts and benefits of the proposal is presented in **Section 16.5** and the discussion of potential outcomes is presented in **Section 16.7**.
Precautionary	If there are risks of serious or irreversible environmental damage (including harm to people), avoids using any limits on full scientific certainty as a reason for postponing measures to prevent environmental (including social) degradation.	The proposal has taken a precautionary approach including using conservative measures in modelling to predict worst-case scenarios, while providing mitigation measures for such cases. The proposal has sought to minimise environmental harm and degradation while providing environmental goods and improve water security in the Darling River (Baaka).
Proportionate	Ensures the scope and scale of the social impact assessment corresponds to the scope and scale of the likely social impacts.	The proposal has assessed potential social and economic impacts proportionate to the level of anticipated impacts.
Rigorous	Uses appropriate, accepted social science methods and robust evidence from authoritative and trustworthy sources.	The social impact assessment has been prepared using the latest SIA guidelines (DPIE, 2021d). References are included throughout the chapter and full details provided in **Section 25**.

Principle	Description	Where principle is addressed
Transparent	Explains, justifies and makes available information, methods and assumptions so that people can see how their input has been considered.	The methodology for the social impact assessment is provided in **Section 16.2**, including a summary of issues and concerns raised by the community in **Table 16-2** and where these have been addressed in the social impact assessment.

16.2.5 Authorship of social impact assessment

The social impact assessment was prepared by Nicole Philps and Ada Zeng. Qualifications are presented in **Table 16-6**.

Table 16-6 Social impact assessment author qualifications

Name/Role	Position	Qualifications	Professional memberships	Relevant experience
Nicole Philps (Lead Author)	Principal Environmental Planner	Master of Environmental Law (University of Sydney), 2015 Master of Urban and Regional Planning (University of Sydney) 2006 Bachelor of Management (Tourism) (University of Technology Sydney) 1995	Member Planning Institute of Australia (Full)	22 years
Ada Zeng (Support Author)	Environmental Scientist and Planner	Bachelor of Science (Environmental Studies), University of Sydney, 2019 Bachelor of Arts (Socio-Legal Studies), University of Sydney, 2019	Associate Member, Environmental Institute of Australia and New Zealand (EIANZ)	2 years
Nicole Sommerville (Technical Reviewer)	Principal Social Planner	Bachelor of Planning (Hons 1), University of South Australia (1997) Associate Diploma in Built Environment (Architecture), University of South Australia (1996) Graduate Certificate in Legal Studies, Northern Territory University (2001)	Member, Planning Institute of Australia	24 years

I, Nicole Philps, declare that the social impact assessment presented in **Section 16** contains all information relevant to the proposal and that the information is not false or misleading. The assessment was completed on 17 February 2022.

16.3 Risk

The proposal would alter the character of the Darling River (Baaka) between the new and existing weirs, including where the river passes through Wilcannia township. The about 4.92 river kilometre section of the river between the new and existing weirs would be transformed from a flowing river to a permanent weir pool of still water (the new town pool). This would change the potential recreational uses of this section of the river, particularly at the existing weir which would be inundated by the new town pool.

Property risks associated with the proposal include the southern side of the river at the new weir site being privately owned (by Wilcannia Local Aboriginal Land Council), which would make accessing the southern side of the new weir more difficult than if this land was in public ownership.

There would also be some short-term social, land use and property risks during construction of the proposal due to the physical presence of construction works, plant, vehicles, equipment and workers.

16.4 Avoidance and minimisation of impacts

Water Infrastructure NSW has avoided and minimised the social impacts of the proposal by carrying out extensive engagement with the local community about the location and design of the proposal. The inclusion of the community river place in the proposal is a direct result of the community engagement undertaken.

Land use and property impacts new infrastructure have been avoided and minimised by locating new infrastructure on crown land. Wilcannia Local Aboriginal Land Council has been engaged to identify ways in which the proposed temporary access to the southern side of the new weir during construction could provide long-term benefits to their property including providing a permanent upgrade to their access track.

16.5 Scoping of social impacts

Table 16-7 provides a summary of the scoping process for the social impact assessment.

Table 16-7 Summary of the scoping process for the social impact assessment

Social impact area	Description of issues	Preliminary assessment
Construction		
Way of life	Potential for temporary adverse changes to river and recreation access.	Likelihood: Possible Magnitude: Minimal Extent: Wilcannia community Duration: Temporary/short term Severity/ scale: Mild (negative) Intensity/ importance: There are many access points to the river and construction would limit public access to confined areas along the riverbanks at the new weir and existing weir sites only. Level of concern/ interest: The proposal could raise some interest from the local community during the construction activities, including those who might want to observe large river structures such as weirs.

Social impact area	Description of issues	Preliminary assessment
Community	Temporary adverse changes to amenity from construction activities (e.g., decommissioning of the existing weir).	Likelihood: Unlikely Magnitude: Minor Extent: Occupants of nearby houses and visitor accommodation, hospital patients, staff and visitors Duration: Temporary Severity/ scale: Mild (negative) Intensity/ importance: Amenity changes would be temporary and generally occur during daytime construction hours. Level of concern/ interest: Likely to be some interest from occupants of properties near the proposal.
Accessibility	Remoteness of Wilcannia means that nearly all materials will need to be transported over long distances to get to site.	Likelihood: Almost certain Magnitude: Minor Extent: Wilcannia community, road users Duration: Temporary/short term Severity/ scale: Minor (negative) Intensity/ importance: The road network would be able to accommodate proposed construction traffic volumes, and access tracks will be upgraded where required, this upgrade would be important to the landowners and community members who access them. Level of concern/ interest: Sourcing of materials is potentially not of high concern to residents as they would be aware of the limitations of specific supplies in town. Employment opportunities are likely to be of great interest to the community, and procurement opportunities for local businesses.
Culture	Direct impact to some Aboriginal cultural heritage items.	Likelihood: Almost certain Magnitude: Moderate Extent: Barkandji community in Wilcannia Duration: Permanent/long-term Severity/ scale: Medium (negative) Intensity/ importance: The suite of archaeological sites identified within the study area collectively possess considerable cultural value, both for their connection with the Aboriginal community's ancestral past and for their potential use as an educational resource to teach younger members of the community about past Aboriginal life in the Wilcannia region. Construction of the proposal would diminish the suite of sites' value. The extent to which the proposal would diminish the collective value of the area's sites is, however, relatively small. Level of concern/ interest: Representatives from the registered Aboriginal parties indicated that the proposal's impact to the region's cultural value is viewed as being minor and that they view this negative impact as being offset by the value of the proposal to the Aboriginal community currently living in the region.

Social impact area	Description of issues	Preliminary assessment
Livelihoods	Employment and training opportunities during the construction phase.	Likelihood: Likely Magnitude: Minor Extent: Wilcannia community Duration: Short-term Severity/ scale: Minor (positive) Intensity/ importance: The community would like to see more employment opportunities generated in their town. Consultation has indicated that the community place a high level of importance on employment opportunities. The nature of skilled labour required for the construction of the new weir may not match the skills and expectations of all community members. Level of concern/ interest: The level of interest is moderate.
	Temporary demand for visitor accommodation by construction workers has potential to: ▪ Increase income for accommodation providers (positive) ▪ Reduce availability and increase cost of accommodation for visitors and tourists (negative).	Likelihood: Likely Magnitude: Minor Extent: Visiting tourists/ accommodation providers Duration: Temporary/short term (construction only) Severity/ scale: Mild (positive and negative) Intensity/ importance: Tourist accommodation is not extensive and has high seasonal demand. The community and tourist accommodation operators may be highly sensitive to any actual or perceived impacts on accommodation. Level of concern/ interest: Due to the sensitivity of issues relating to accommodation availability, there could be a high level of interest.
	Opportunities for local businesses to support the proposal through procurement and services.	Likelihood: Possible Magnitude: Minor Extent: Wilcannia businesses Duration: Short term (construction) Severity/ scale: Mild (positive) Intensity/ importance: The importance of opportunities for local businesses were identified during consultation for the proposal. Level of concern/ interest: Local businesses have a high level of interest in short and long-term opportunities from the proposal.

Social impact area	Description of issues	Preliminary assessment
Decision-making systems	Community have not been exposed to many major projects like this and consequently are unfamiliar with the typical formalities and procedures for community engagement. Not all households have access to computers and internet.	Likelihood: Almost certain Magnitude: Moderate Extent: Wilcannia community Duration: Short-term, design and construction phases Severity/ scale: Minor (positive) Intensity/ importance: The entire community would be sensitive to major changes in their local community, however the improved long-term water security provided by the proposal would be more important than short-term disruptions. The community would be able to adapt to the short term changes. Level of concern/ interest: The community is likely to have a high level of interest and a carefully planned engagement strategy and its successful implementation will be extremely important.
Operation		
Way of life	Prolonged drought has been difficult for the Barkandji due to loss of access to water for culture, recreation and identify. The new town pool created by the new weir would increase the presence of water through the town centre.	Likelihood: Likely Magnitude: Moderate Extent: Barkandji community in Wilcannia Duration: Permanent/long term Severity/ scale: Moderate (positive) Intensity/ importance: Barkandji community is sensitive to changes as there are cultural ties to the water quality and presence of water in the Darling River (Baaka). Water has a unique cultural identity and the community has the ability to adapt to a positive change where more water is available. Level of concern/ interest: Barkandji community is highly interested in the positive changes expected as a result of the proposal.
Accessibility	Section of river in town centre would be deeper and less safe for small children to swim.	Likelihood: Likely (variable dependent on conditions) Magnitude: Minor Extent: Wilcannia community Duration: Permanent, operation Severity/ scale: Moderate (positive) Intensity/ importance: The community have indicated that increased water levels in the river through town are extremely important to them. It is expected that the community would adapt to the new conditions. Level of concern/ interest: The community want to have more water through the town, however the safety concerns have been identified in consultation as well.

Social impact area	Description of issues	Preliminary assessment
	New weir would alter how locals can access and use the river at the new weir site compared to the existing weir site.	Likelihood: Almost certain Magnitude: Moderate Extent: Wilcannia community Duration: Permanent, operation Severity/ scale: Moderate (positive) Intensity/ importance: The proposal would change river levels and likely access locations to the river for the community. The new weir and community river place would be less accessible than the existing weir because they are located just outside the township whereas the existing weir is close to the centre of the township. However, the new weir and community river place would better cater for visitors than the existing weir. It is expected that the community would adapt to the changes over time. The new town pool through the township would make swimming in the weir pool more convenient than swimming in the existing weir pool Level of concern/ interest: Level of interest is high.
	Inundation of the existing weir and the river through the township would prevent fish trapping in this reach of the river.	Likelihood: Almost certain Magnitude: Major Extent: Barkandji community in Wilcannia Duration: Permanent, operation Severity/ scale: Major (negative) Intensity/ importance: The inundation of the existing weir and new town pool would prevent the use of existing fish trapping spots at the existing weir and along the river between the new and existing weirs. The local Aboriginal community would need to travel to locations downstream of the new weir to carry out fish trapping, which would be less convenient than fish trapping at the existing weir or along the river through the township. Level of concern/ interest: Level of interest is high.
Culture	The Darling River (Baaka) is central to the identity of the Barkandji. Prolonged periods of no water in the river have been difficult to cope with on a cultural and spiritual level.	Likelihood: Likely (variable dependent on conditions) Magnitude: Major Extent: Barkandji community in Wilcannia Duration: Permanent, operation Severity/ scale: Major (positive) Intensity/ importance: Returning visible water levels through Wilcannia is of high importance to the Barkandji as the river is central to their identity. Level of concern/ interest: The level of interest in the proposal is high.

Social impact area	Description of issues	Preliminary assessment
	The lack of water in the river has been identified as a cultural loss as it reduces opportunities for the elders to teach younger generations about cultural practices, such as traditional fishing methods. The new weir and weir pool would increase the likelihood for longer periods of water to be held in the river in town.	Likelihood: Likely (variable dependent on conditions) Magnitude: Moderate Extent: Barkandji community in Wilcannia Duration: Permanent, operation Severity/ scale: Moderate (positive) Intensity/ importance: Elders have expressed a desire for greater access to water in town so that traditional cultural practices can be taught to younger generations. Level of concern/ interest: The level of interest is high.
Health and wellbeing	The lack of water in the river during long periods of drought has been identified as a negative impact on the health and wellbeing of the Barkandji, and the community in general.	Likelihood: Likely (variable dependent on conditions) Magnitude: Major Extent: Wilcannia community Duration: Permanent, operation Severity/ scale: Moderate (positive) Intensity/ importance: Providing greater water security and reducing the potential for future drought impacts is of great importance to the community. Level of concern/ interest: The continued presence of water in the Darling River (Baaka) is of great concern and interest.
Surroundings	Some vegetation and tree clearing would be required, including some substantial River Red Gums that hold high cultural value.	Likelihood: Almost certain Magnitude: Moderate Extent: Wilcannia community Duration: Permanent, operation Severity/ scale: Moderate (negative) Intensity/ importance: The River Red Gums are of cultural and spiritual value to the Barkandji and the Wilcannia community as a whole. Level of concern/ interest: There will be a level of concern regarding the loss of trees to enable construction.

Social impact area	Description of issues	Preliminary assessment
Livelihoods	The community have expressed the desire that opportunities for tourism businesses are opened up.	Likelihood: Likely Magnitude: Moderate Extent: Wilcannia community Duration: Long-term Severity/ scale: Minor (positive) Intensity/ importance: The community feel hopeful that higher levels of water through the town centre will generate opportunities for individuals to establish new business and tourism initiatives. Level of concern/ interest: The level of interest is high.
Decision-making systems	Community have not been exposed to many major projects like this and consequently are unfamiliar with the typical formalities and procedures for community engagement. Not all households have access to computers and internet.	Likelihood: Almost certain Magnitude: Minor Extent: Wilcannia community Duration: Short-term, design and construction phases Severity/ scale: Minor (positive and negative) Intensity/ importance: The entire community would be sensitive to major changes in their local community, however the positive water impacts of the proposal would be more important than short term disruptions. The community would be able to adapt to the short term changes. Level of concern/ interest: The community is likely to have a high level of interest and a carefully planned engagement strategy and its successful implementation will be extremely important.

16.6 Existing environment

This section presents an overview of the existing communities, land use and property in the study area, including population, business, social infrastructure, existing and future land use, tenure and community values. Information is presented for the Wilcannia Urban Centre and Locality, and Central Darling local government area, as well as NSW.

16.6.1 Regional context

Central Darling local government area is the largest local government area in NSW but has one of the lowest populations (Central Darling Shire Council, 2017).

There were 1,833 people in the Central Darling local government area at the 2016 Census and an estimated 1,829 people in the 2020 estimated resident population (ABS, 2020). Wilcannia and Menindee are the two main population centres, with other townships being Ivanhoe, White Cliffs, and Tilpa. Broken Hill is the closest significant urban area to Wilcannia, with this located about 200 kilometres west.

Over a projected 25 year period (2016-2041), Central Darling Shire's population is expected to decrease by 150 to 1750 people, or about 0.33 per cent a year. This is in contrast to the NSW population, which is predicted to grow by 1.26 per cent a year over the same period. By 2041, Central Darling Shire is expected to see a decrease in younger age groups and an increase in older age groups (DPIE, 2020d).

Central Darling local government area is part of the Far West Region of NSW, which is known for the culture and history of the Australian Outback, mining towns such as Broken Hill and Cobar, and the Barwon-Darling (Baaka) river system. The Far West has significant regional economies based on agriculture, mining and tourism (NSW Government, 2021).

Principal economic activities within the Central Darling local government area include pastoral, horticulture, agriculture, opal mining and tourism. Rural grazing properties represent the largest land use, accounting for about 97 per cent of the entire local government area (Central Darling Shire Council, 2017).

On 16 June 2015 and 22 August 2017, the Federal Court of Australia formally recognised the Barkandji Traditional Owners' (Barkandji and Malyangapa People) native title rights, which was the largest native title claim in NSW. The Barkandji and Malayangapa People comprise the Malyangapa People and the Barkandji sub-groups of Thankali, Barkandji, Parintji, Maraura, Wilyakali, Pantjikali/Wanyiwalku, Paruntji and Kurnu/Naulco. The determination area for the native title claim includes the sites of the existing and new weirs, as well as along the Darling River (Baaka). The range of native title rights now formally recognised for the Barkandji and Malyangapa People include the right to fish in the determination area. The Barkandji and Malyangapa People also have the right to fish and gather traditional natural resources in areas where their native title has not been extinguished or is not otherwise excluded, in accordance with their traditional laws and customs (Department of Primary Industries, 2018). The native title right to fish is a non-exclusive right ensuring others are also able to continue to undertake and enjoy fishing activities.

16.6.2 Community profile

Population and demographic data from the 2016 Census is presented in **Table 16-8**. In 2016, Wilcannia had a population of 549 people, representing about 30 per cent of the Central Darling local government area's population.

Compared to NSW, Wilcannia had a:

- Younger population, with a lower median age, higher proportion of children aged up to 14 years and a lower proportion of people aged over 65 years
- Higher proportion of people born in Australia, and more than half of the population whose ancestry was Australian Aboriginal
- Higher proportion of one-parent families and a lower proportion of couple-only families
- Relatively high proportion of houses that were rented, including from a State housing authority; housing co-operative, community or church group; family member or other person; or other landlord type such as an employer or through a residential park or caravan park.

Table 16-8 Population characteristics

Characteristic	Wilcannia Urban Centre and Locality	Central Darling local government area	NSW
Population and age profile			
Total population (2016)	549	1,833	7,480,228
Median age (years)	31	39	38
0 to 14 years	21.6%	19.0%	18.5%
15 to 64 years	69.8%	65.1%	65.2%
65+ years	8.6%	15.8%	16.3%
Cultural diversity			
Australian born	90.9%	79.5%	65.5%
English only spoken at home	84.8%	81.1%	68.5%
Aboriginal and/or Torres Strait Islander people	74.4%	39.5%	2.9%

Characteristic	Wilcannia Urban Centre and Locality	Central Darling local government area	NSW
Families and households			
Couple family without children	16.8%	31.9%	36.6%
Families with children (one parent and couple families)	83.2%	67%	61.7%
One parent family	43.9%	28.9%	16%
Total families	107	370	1,940,226
Housing and employment			
Total occupied private dwellings	160	604	2,604,320
Separate houses	89.4%	90.7%	66.4%
Owned outright or owned with a mortgage	32.7%	47.7%	64.5%
Rented	63.0%	42.1%	31.8%
Median weekly rental costs	$110	$100	$380
Households with rent payments greater than or equal to 30% of household income	6.6%	4.5%	12.9%

Source: Based on ABS Census QuickStats (ABS, 2016)

Socio-economic advantage and disadvantage

Socio-economic vulnerability, as defined by the ABS Index of Relative Socio-Economic Advantage and Disadvantage, indicates the level of relative socio-economic advantage and disadvantage in a specified area. Socio-economic advantage and disadvantage refer to people's access to material and social resources and their ability to participate in society (ABS, 2018). To capture this broad definition, the Index of Relative Socio-Economic Advantage and Disadvantage is based on a range of data sources relating to income, education, employment, occupation, and housing. The indexes are assigned to areas not to individuals and are constructed as a weighted combination of selected variables. The NSW average score is 1000 while the score for Wilcannia is 804.

The Index of Relative Socio-Economic Advantage and Disadvantage divides a population into 10 equal groups. The lowest scoring 10 per cent of these groups are given a decile number of one, which indicates the highest level of disadvantage, and the highest scoring 10 per cent of areas are given a decile of 10, which indicates the highest level of advantage. Both Wilcannia and the Central Darling local government area demonstrate very high levels of relative disadvantage, recording a decile number of one.

16.6.3 Economic profile

Income and employment data from the 2016 Census is provided in Table 16-9. Compared to NSW, Wilcannia had:

- Lower weekly personal and household incomes, higher proportions of low income households and lower proportions of high income households
- Wilcannia has a lower proportion of people employed full time compared to Central Darling local government area, but similar proportion compared to NSW
- A higher unemployment rate, with about 15.3% of people unemployed in 2016.

In 2016, key occupations in Wilcannia included community and personal services workers, labourers and professionals. The top industries of employment included local government administration, primary and secondary education and police services.

Table 16-9 Economic characteristics

Characteristic	Wilcannia Urban Centre and Locality	Central Darling local government area	NSW
Income			
Median weekly personal income	$417	$460	$664
Median weekly household income	$1,006	$901	$1,486
Households with income less than $650 per week	28.0%	34.5%	19.7%
Households with income greater than $3000 per week	0.0%	5.4%	18.7%
Employment			
Total labour force	157	632	3,605,872
Full time work	59.9%	66.9%	59.2%
Unemployed	15.3%	11.2%	6.3%
Occupation	▪ Community and personal services (33.1%) ▪ Labourers (17.3%) ▪ Professionals (15.1%) ▪ Clerical and administrative (11.5%) ▪ Technical and trades workers (7.2%) ▪ Machinery operators and drivers (6.5%) ▪ Managers (4.3%)	▪ Managers (32.7%) ▪ Labourers (18.1%) ▪ Community and personal services (16.3%) ▪ Professionals (10.4%) ▪ Clerical and administrative (6.1%) ▪ Machinery operators and drivers (5.7%) ▪ Technical and trades workers (4.8%)	▪ Professionals (22.2%) ▪ Clerical and administrative (13.6%) ▪ Technical and trades workers (13.5%) ▪ Managers (13%) ▪ Community and personal services (10.8%) ▪ Labourers (9.5%) ▪ Machinery operators and drivers (6.3%)
Industry of employment top responses	▪ Local government administration (14.6%) ▪ Primary and secondary education (13.8%) ▪ Police services (10%) ▪ Hospitals (except psychiatric) (6.2%)	▪ Sheep farming (specialised) (19.3%) ▪ Primary and secondary education (8.2%) ▪ Beef cattle farming (specialised) (7.1%)	▪ Hospitals (except psychiatric) (3.2%) ▪ Cafes and restaurants (2.4%) ▪ Supermarkets and grocery (2.2%) ▪ Aged care (2.0%)

Source: Based on ABS Census QuickStats (ABS, 2016)

Recent data on quarterly labour force and unemployment in the Central Darling local government area between 2016 and 2021 is available from the Labour Market Information Portal Small Area Labour Markets estimates (Labour Market Information Portal, 2021). Estimates for NSW can be found in the ABS' Labour Force, Detailed publication (ABS, 2022). The data in Table 16b of the Labour Force, Detailed publication are in 12-month average terms and are comparable with the smoothed Small Area Labour Markets estimates.

As shown in **Figure 16-4**, the unemployment rate within the Central Darling local government area was similar to NSW between December 2017 and December 2019. From December 2019, unemployment in the Central Darling local government area decreased, compared to an increase over the same period for NSW. The unemployment rate in Central Darling local government area increased between December 2020 and September 2021 from 3.6 per cent to 9.1 per cent. This is compared to a steady decline in unemployment in NSW during the same period. The sharp increase of unemployment in the Central Darling local government may reflect Covid-19 pandemic outbreak-related job losses in the region. The unemployment rate is also shown to be highly variable in the region compared to NSW and could suggest inconsistent availability of local work or movements in population.

Figure 16-4 Unemployment rate 2016-2021

Source: (ABS, 2021; Labour Market Information Portal, 2021)

Business and industry

Businesses in Wilcannia mainly include retail and hospitality uses that cater for the day to day needs of residents, visitors and travellers. The following provides an overview of businesses identified through internet searches and desktop review:

- Temporary accommodation providers or caravan parks – Victory Park Caravan Park, Warrawong on the Darling, Wilcannia Motel, Wilcannia Roadhouse and Grahams Motel
- Service stations – Wilcannia Roadhouse, BP Truckstop
- Other retail – Wilcannia (St Mary) pharmacy
- Eateries and gaming – M&J Kitchen, Miss Barretts Café, Wilcannia Club Hotel, Wilcannia Bankala Coffee Shop, Cooee for Coffee, Wilcannia Golf Club
- Supermarkets and grocers – Friendly Grocer, IGA Wilcannia

- Sporting clubs – Wilcannia Golf Club Golf Course
- Service related – Riverside Traders laundromat, KK Mobile Automotive mechanics, Russell Martin Earthmoving.

Within the Wilcannia township there are two supermarkets (Friendly Grocer and IGA). Other food and dining businesses in the township include M&J Kitchen, Miss Barretts Café, Wilcannia Club Hotel, Wilcannia Bankala Coffee Shop, Wilcannia Roadhouse and Grahams Motel, Wilcannia Motel, and Cooee for Coffee.

There is one business in Wilcannia that conducts or directly supports construction (Russell Martin Earthmoving). Other contractors, service suppliers and material stockists are located in Cobar (about 260 kilometres to the east) and Broken Hill (about 196 kilometres to the west).

The *Wilcannia Weir Replacement Business Case* (Jacobs, 2016) identified that severe water restrictions have had a measurable impact on local businesses with limited water use during daylight hours, limiting operations, employment and output of local firms.

16.6.4 Social infrastructure

The remoteness of towns within the Central Darling local government area means that key services are provided in each township.

Social infrastructure in Wilcannia include health and medical, education, emergency services, recreation, family support and cultural facilities that cater for the needs of residents in Wilcannia and the surrounding area. Social infrastructure identified through review of existing literature, internet searches, and observations during the site visit are listed as follows:

- Health and medical services – Wilcannia Hospital – Multi Purpose Service, Maari Ma Primary Health Care Service
- Education – St. Therese's Community School (primary school), Wilcannia Central School (pre-school to Year 12), TAFE NSW Wilcannia campus
- Other services – Wilcannia Police Station, Wilcannia Court House, Wilcannia River Radio
- Recreation, community and open space – Wilcannia Community Centre, Wilcannia Sport Oval, Wilcannia Swimming Pool, Wilcannia Golf Club Golf Course, Ray Hunter Memorial Park, Reconciliation Park, Baker Park including the Wilcannia War Memorial
- Family support – CatholicCare Wilcannia-Forbes, Wilcannia Community Services Centre
- Places of worship – The Roman Catholic Diocese of Wilcannia-Forbes, St John the Apostle Catholic Church, Saint James Anglican Church.

The NSW and Federal governments have each committed $3.5 million to the construction of the Baaka Cultural Centre at Wilcannia, which will be built on the old Knox and Downs store site. The design of the centre has commenced however neither construction nor targeted completion dates have been announced at the time of preparation of the social impact assessment.

Some of the social infrastructure including community and religious facilities are shown in **Figure 16-5**.

The Far West Region has a lower rate of GPs and GP registrars compared to other parts of NSW (Australian Healthcare and Hospitals Association, 2019).The Wilcannia Multi-Purpose Service Centre provides integrated services including community health, 24 hour emergency care, ambulance, inpatient and residential aged care places. In the 2020-21 period, there were a total of 953 presentations to this hospital's emergency department, including 235 emergency and 115 non-urgent visits (Australian Institute of Health and Welfare, 2022a and 2022b). The Maari Ma Health Service provides general practitioner services, nursing and Aboriginal and Torres Strait Islander health services.

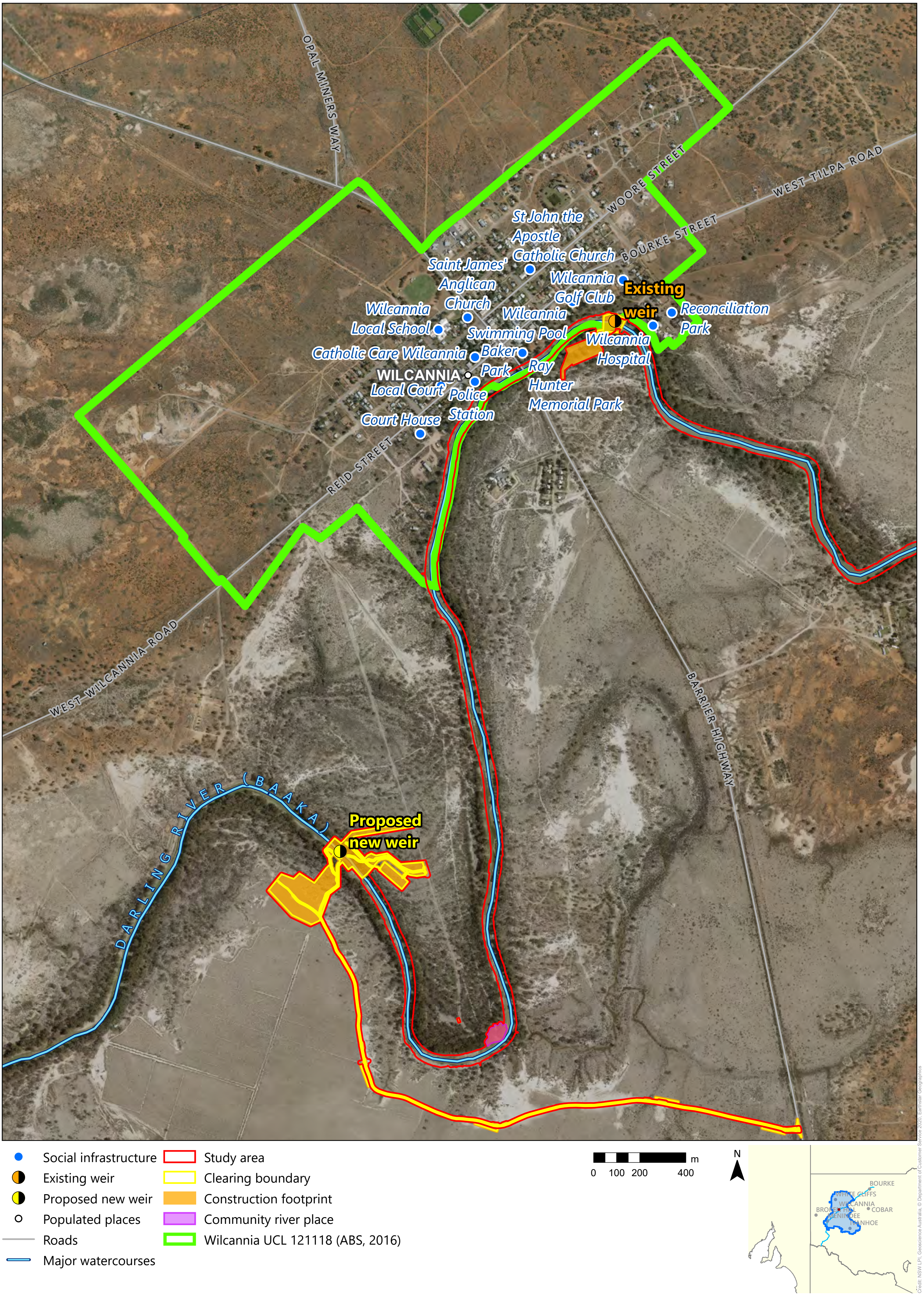


Figure 16-5 Social infrastructure located near the proposal

16.6.5 Recreation and river use

The Darling River (Baaka) is central to the daily life of the residents of Wilcannia, as a source of food, and social and cultural activities. Fishing is a popular past-time as well as being an important cultural activity and an integral part of the Wilcannia community. Individuals and family groups have favoured locations along the river, including the location of the proposed new weir and around the existing weir. Fishing is generally conducted from the riverbanks. The existing weir presents a barrier to fish passage upstream except during high flows.

Consultation with Aboriginal Elders identified concerns that the young people of Wilcannia are losing their cultural fishing knowledge and that too many fish were being taken from the river. A desire has been identified to have increased opportunities for the transfer of cultural knowledge and to encourage more sustainable fishing practices.

Swimming generally occurs in shallower sections of the river, and traditionally only at certain times of the year. Locations for swimming are Baker Park and the existing weir:

- Baker Park is located downstream of the historic Wilcannia Bridge on the Barrier Highway, in the centre of town. The park contains stands of native trees, it is informally stepped down to the river, with grassed clearings scattered throughout. The section of the river at the park is popular for children to play on the sandbanks when water levels are lower
- Extensive use of the existing weir for play, fishing and swimming has been observed, although it is not formally permissible as weirs are a safety hazard to these activities.

The Wilcannia Weir business case observed that "the post-European experience of the Barkandji people has been one of continued disassociation, initially from their traditional river and land and ultimately from the water in the river itself" (Jacobs, 2016). It noted that the community of Wilcannia experiences a highly altered flow regime in the Darling River (Baaka) resulting in a hotter, drier urban environment and significantly reduced community amenity. While the Darling River (Baaka) had natural periods of low flow and influxes of saline water prior to the European occupation of Eastern Australia, these two phenomena have become more frequent and intense due to European land use practices (Jacobs, 2016).

In 2009, the Jumbunna Indigenous House of Learning at the University of Technology of Sydney conducted a study examining "factors affecting crime rates in Indigenous communities in NSW", focusing on Wilcannia and Menindee. Wilcannia was found to have significantly higher crime rates than other parts of NSW including Menindee and Broken Hill, and when asked to identify factors affecting crime rates in Wilcannia the dryness of the Darling River (Baaka) was identified by a number of individuals as a possible contributing factor (Jacobs, 2016).

A 2014 study prepared by the Murdi Paaki Regional Enterprise Corporation found similar feedback from local community members. One member said "if there's water in the river, the kids are always on the river. When there is no river, they just get around and do other things, naughty things they shouldn't be doing. You can notice a big difference when we've got water in the river" (Jacobs, 2016).

Locals have reported that in the past there was some water-skiing upstream of the existing weir, however due to the prolonged drought it has not been possible for a number of years.

There is no boat ramp into the river in Wilcannia township. The nearest boat launching point is at Steamers Point, about two river kilometres upstream of the existing weir.

16.6.6 Tourism

Wilcannia serves as a stop for people travelling between the larger towns of Broken Hill, Cobar and Bourke. Wilcannia provides vehicle refuelling, hospitality services and amenities, and tourist destinations. Visitors to Wilcannia often take day trips to nearby White Cliffs, Paroo-Darling National Park or Menindee Lakes.

Tourist attractions in Wilcannia include historic buildings and sites, local art and opportunities to explore the surrounding environment including bushwalks and river activities. White Cliffs is an opal mining town around one-hour drive north of Wilcannia.

No formal tourism statistics are available for the town, however it is understood to have fluctuated considerably over recent years. Regional NSW is currently enjoying an unexpected boom in tourism as a consequence of the COVID-19 pandemic and an associated increase in local and domestic tourism. It was observed in October 2020 that 100 or more vehicles were stopping in town each day, with more travellers stopping at the township's two caravan facilities on the Darling River (Baaka), Victory Park Caravan Park and Warrawong on the Darling. A list of temporary accommodation facilities in Wilcannia is provided in **Table 16-10**.

Table 16-10 Temporary accommodation in Wilcannia

Accommodation	Address	Number of rooms
Wilcannia Motel	Corner of Hood Street and Barrier Highway	13
Warrawong on the Darling	Barrier Highway	21 units including family cabins 32 powered and unpowered caravan sites
Wilcannia Roadhouse and Grahams Motel	85 Woore Street	11
Victory Park Caravan Park	Barrier Highway	40 powered and unpowered caravan sites

Consultation with management at Warrawong on the Darling has confirmed that a large proportion of the units on the property are utilised year-round by travelling workforce, including WaterNSW operational staff.

Tourism is seasonal in the Far West Region, due to the high temperatures during the summer months. Consultation with Central Darling Shire Council has indicated that the Victory Park Caravan Park typically only has one or two caravans visiting at any one time over summer.

Community consultation has identified a strong desire in the community for increased tourism to be a more permanent feature of the town and they have expressed positive hopes that having the weir relocated to a more advantageous position would increase the number of visitors stopping in Wilcannia for food and accommodation.

16.6.7 Land use and property

The land surrounding Wilcannia township is sparsely settled and generally comprises large land holdings, primarily for sheep farming, cattle farming, and agriculture. Such holdings predominantly fall in the Western Lands Leases which are Crown lands managed under the *Crown Land Management Act 2016*, along with freehold lands. Paroo-Darling State Conservation Area and Paroo-Darling National Park are located upstream of the weir pool and comprise about 193,000 hectares of conservation and national park land.

Land use at the proposed new weir site consists of a natural bushland environment surrounding the Darling River (Baaka). Land zoning relevant to the proposal are detailed in **Section 16.1.3**. Land parcels on the left riverbank at the new weir site are occupied by Wilcannia Local Aboriginal Land Council under Western Lands Leases and are subject to an exclusive native title determination, which means recognised native title rights and interests exist over the entire area, including to the exclusion of all others. Land on the right riverbank contains land parcels that are managed by the DPE Crown Lands (in respect to the Willyama Common) and the Central Darling Shire Council (in respect to land where Council is the Crown Land Manager). This area is subject to a non-exclusive native title determination, which means certain native title rights and interests are recognised to exist over that land.

Land use at the existing weir comprise the Victory Park Caravan Park on the left riverbank and Wilcannia Hospital, residential dwellings and staff accommodation on the right riverbank. Victory Park Caravan Park is on Crown land managed by Central Darling Shire Council and is subject to a non-exclusive native title determination. Wilcannia Hospital is on land owned by the Homecare Building Reserve Trust.

Indigenous land use agreements (ILUAs) exist at and around the proposal area, including ILUA NI2018/003 (Barkandji Weinteriga and Yobel Station ILUA) applying to the left riverbank at the new weir site, and NI2018/007 (Barkandji Interim Licences ILUA) applying to the right riverbank at the new weir, the Darling River (Baaka), the community river place, as well as the left and right riverbanks at the existing weir site. These are voluntary agreements between native title parties and other people or bodies about the use and management of areas of land and/or waters.

An Aboriginal Place has been declared next to the new weir site, namely the Wilcannia Mission Camps and Cultural Places (refer to **Section 14.5.2** and **Figure 16-1**). Zoning of this land is described in **Section 16.1.3** and shown in **Figure 16-2**.

16.6.8 Community values, wellbeing and amenity

Community values are those values held as important to residents for quality of life and well-being.

The *Central Darling Shire Community Strategic Plan (2017-2027)* (Central Darling Shire Council, 2017) identified key themes for the Central Darling local government area including:

- Strong sense of community and belonging
- The outback, remoteness, bush, a quiet and relaxed lifestyle
- Friendly and safe community, the lakes and river.

Key priorities identified by the Wilcannia community were water, youth facilities, streetscaping/beautification, health and nutrition, public safety and tourism development.

The Darling River (Baaka) is essential to all residents of Wilcannia, as it is for communities upstream and downstream of the weir. As well as being central to the cultural identity of the Barkandji people, it is the primary water source for most residents and businesses. It is also a distinctive feature in the landscape, a place for recreation, and leisure. The river provides recreational values in terms of fishing, swimming as well as aesthetic and amenity values when the river is flowing or the water levels are high.

AHRC (2008) identified the cultural value of the river as being derived from:

- Spiritual connection to lands, water and natural resources associated with water places
- Management of significant sites located along riverbanks, on and in the riverbeds, and sites and stories associated with the water and natural resources located in the rivers and their tributaries, and the sea
- Protection of indigenous cultural heritage and knowledge associated with water and water places
- Access to cultural activities such as hunting, fishing, and ceremony.

It has been found that the significantly reduced levels of river flow in the Darling River (Baaka) at Wilcannia are having a negative impact on the economic prospects of Wilcannia and undermining the social capital of the Aboriginal community in Wilcannia who depend on the river flow for spiritual and social reasons (Jacobs, 2016).

Consultation with the community has consistently identified the importance of the return of water in the Darling River (Baaka), particularly through the town centre where it is visible on a daily basis. The community have also identified that all of the ‘major’ trees along the riverbanks, predominantly River Red Gums, regardless of whether they have been culturally modified or not, are held in great value (refer to **Section 14.6**).

Social capital is a broad concept that is often used to understand the network of social connections within a community that can be used to support each other. High levels of social capital are often indicative of the sustainability of a community, of people's desire to remain living there, and of their ability to respond to crises and challenges (Bullen and Onyx, 2005). By nature of its small size, Wilcannia has strong social networks and connections. The Wilcannia community has a strong connection to place and extended family histories in the area. Seventy per cent of the population in 2016 had lived at the same address five years prior, compared to 61 percent in the Central Darling local government area.

16.7 Assessment of impacts

16.7.1 Construction

Business, employment and training

The proposal is likely to generate direct and indirect benefits for local and regional businesses, in industries that provide goods and services to support construction activities. Benefits for businesses could include improved business outcome and direct employment opportunities, and businesses in hospitality, accommodation and trades are the mostly like to benefit. Local businesses with income generating facilities such as gaming and recreational could also see a short term beneficial impact with increased revenue from construction workforce spending.

The Wilcannia Weir Local Business Register was established in November 2021 and local businesses engaged in activities relevant to construction were encouraged to register their interest in the proposal. The details of businesses on the register will be shared with the principal contractors who tender for the construction of the new weir so that they can select and partner with registered businesses as part of their commercial offer. Registered businesses would also be notified of project tenders and expressions of interest.

A workforce of about 10 people is expected during the construction phase of the proposal, increasing for short periods when specialist contractors attend the work site. The workforce would likely include a construction site supervisor, site engineer, plant operators and labourers. Employment could also extend to the broader Far West Region, including nearby townships of Cobar and Broken Hill where there are larger number of construction and trade service providers.

It is likely that some or most of the workforce would need to be sourced from outside Wilcannia, due to the technical requirements of the construction and the specific skills and experience required, and the availability of local workers with the necessary skills. Temporary increases in the local workforce are not uncommon in Wilcannia due to its remote location, and it is expected that the community would be able to accept this change. This non-resident workforce would contribute to increased spending locally while they are in Wilcannia.

In October 2020 a TAFE program delivered in partnership with the Regional Enterprise Development Institute and Murdi Paaki Regional Assembly commenced to upskill local residents to be job ready for employment opportunities when construction planning commences. The program comprised eight-week training courses in construction, hospitality and tourism that were delivered over a 12-month period (WaterNSW, 2020). As of December 2021, eight students had completed a Certificate II in Construction, six students had completed a Certificate II in Hospitality and four students had completed a Certificate II in Tourism. Potential contractors will be encouraged to consider local hiring, including the local trainees, if suitable and appropriate.

Social infrastructure

Construction of the proposal is not expected to negatively impact on social infrastructure in Wilcannia. The temporary local workforce has the potential to increase demand for community services and recreational facilities. It is expected that most local facilities such as the golf club or swimming pool, would have the capacity to meet increased demand, and the additional revenue for income generating facilities would be a short-term beneficial impact.

Local health services in regional areas often have challenges in delivering services, such as long wait times for general practitioners. The Wilcannia Multi-Purpose Service Centre provides emergency services and other health care and is expected to be able to provide treatment in the case of a workplace incident during the construction period. However, it is not expected that the temporary local workforce would exacerbate existing health services challenges or significantly increase demand on such services due to the low numbers of staff proposed.

Recreation and river use

While access to Union Bend Road and the local access track to the river would be maintained during construction, the local community would not have access to the new weir site, including the section of the existing access track in the vicinity of the new weir, for recreational activities such as fishing and swimming.

Access to other parts of the Darling River (Baaka) would not be affected during construction of the new weir.

During partial removal and decommissioning of the existing weir, swimming and fishing in the vicinity would be restricted for public safety reasons. It is proposed that the partial removal and decommissioning works are undertaken during a period of low flow, for safety and water quality reasons, which would result in the temporary swimming and fishing restriction to be less of a concern for local residents.

Tourism

The remoteness of Wilcannia means that any temporary workforce would need to be accommodated locally. Due to insufficient rental housing supply, there would not be any housing available to rent to the construction workforce. It will be essential for the contractor to independently manage accommodation requirements for the temporary workforce.

Over the summer months when local tourism experiences a low season, the non-resident workforce would be easily accommodated within the existing tourist accommodation in town which offers about 45 rooms excluding caravan sites (refer to **Section 16.6.6**). However, there could potentially be some competition for accommodation with the travelling public outside of summer months. Potential impacts on temporary accommodation during peak tourist period could lead to limited availability and this would be managed by the contractor during the construction period through a temporary workforce accommodation plan (refer to mitigation and management measures in **Table 16-12**).

Apart from than the partial removal and decommissioning of the existing weir (expected to take about 10 weeks), construction activities would not be visible to the general public, and are therefore not expected to detract from visitor's experience of the town. During decommissioning activities, the Victory Park Caravan Park would be leased by Water Infrastructure NSW and would not be open to the public or visitors. This impact is expected to be temporary in nature as the closure of the caravan park would only be for 10 weeks, and mitigation and management measure would be implemented to minimise impacts (refer to **Table 16-2**).

Land use and property

No property acquisition is required for the proposal. A lease agreement has been established with the Wilcannia Local Aboriginal Land Council who own the parcels of land on the left bank of the river in the vicinity of the new weir to allow construction access and activity. For safety reasons, it would be necessary to exclude the public from the leased premises during construction. This may also require requesting that some cultural practices are not conducted in the vicinity of the construction site. Consultation with Wilcannia Local Aboriginal Land Council representatives has indicated that this would be acceptable.

At the request of the Wilcannia Local Aboriginal Land Council, the upgraded access track across their land would be retained following construction, leaving a permanent improved asset for them to use. The remainder of the construction compound areas and riverbank access tracks would be rehabilitated at the end of construction.

As discussed in **Table 3-2** and **Section 16.1.1**, the other land on which construction work is proposed is Crown land and the Water Administration Ministerial Corporation would use its powers under the *Public Works and Procurement Act 1912* to enter and occupy this land to construct the proposal.

As stated in **Section 3.6.5**, Water Infrastructure NSW intends to lease the Victory Park Caravan Park for the duration of the decommissioning activities at the existing weir site. This will enable the safe and efficient movement of vehicles and materials within the site, as well as avoid amenity concerns such as noise and vibration for guests of the caravan park. Any disturbed areas would be rehabilitated prior to the completion of the lease.

As detailed in **Section 16.6.7**, native title has been granted over all parcels of land where construction is proposed. Formal engagement with the Barkandji Native Title Group Aboriginal Corporation has commenced to ensure the appropriate rights, obligations and commitments are met.

A small section of the access track upgrade on the southern (left bank) of the river would fall within the declared the Wilcannia Mission Camps and Cultural Places Aboriginal Place. Consultation with Heritage NSW has confirmed that the draft management plan for the Aboriginal Place acknowledges the presence and usage of the access track and allows for maintenance work to be completed and no negative impact to this land use is expected. Further discussion on the Aboriginal Place is provided in **Section 14.6.2**.

Community values, wellbeing and amenity

Any construction project that causes changes or disruption in a community has the potential to cause uncertainty or anxiety to residents and business owners. Concerns can be raised about timing of activities, noise and disruption to traffic, employment or procurement opportunities. Providing a consistent and transparent point of contact for all concerns and enquiries would hopefully serve to alleviate some community concerns.

The design of the proposal has sought to minimise impact on the large trees, including River Red Gums, to the fullest extent possible, although the proposal would require the removal of some large River Red Gum trees at the new weir site.

As indicated in **Section 5**, discussions with the community on site have indicated that they understand that it is unavoidable that some large trees would need to be removed. Up to 28 large trees are proposed to be removed at the new weir site and one large tree is proposed to be removed at the existing weir site. Twelve new River Red Gum (*Eucalyptus camaldulensis*) trees, and four new trees (mix of *Eucalyptus coolabah* and *E. camaldulensis*) are proposed to replace those removed during construction. Further discussion on the value of the large trees and the work done to minimise impacts on them is provided in **Sections 14.4**, **Section 17.4** and **Technical Report 6**.

As indicated in **Section 16.6.8**, it is important to the local community that cultural heritage is protected. The construction footprint has been shaped to avoid and protect as much of the identified cultural heritage as possible. As per mitigation and management measure AH5 (refer to **Table 14-5**), it is intended that items that are required to be collected and removed from site would be stored for later display in the Baaka Cultural Centre, which is expected to be completed prior to the completion of the proposal. Rocks removed as part of the partial demolition of the existing weir will be reused locally where possible, including at the community river place since the rocks at the existing weir hold cultural and social values. These measures would hopefully serve to increase pride and understanding of cultural heritage.

The training program and local employment opportunities through the construction phase of the proposal is likely to be considered a positive benefit by the Wilcannia community, where the courses being offered are not solely focused on employment in the construction industry, but are aimed to provide long term employment opportunities in tourism and hospitality industries as well. The high levels of unemployment in the town are a source of frustration and disappointment to many in the town. Positive opportunities to gain experience are expected to bolster the community's sense of hope for the future.

Community values have also been reflected and enhanced through the consultation carried out for the proposal, where the local Aboriginal and non-Aboriginal community members have been engaged in art production that would become a design component for the new weir. Community members, and in particular students, have provided input into videos and drawings that have become part of the proposal. As detailed in **Technical Report 6**, a selection of the drawings that have been created would be incorporated into the fishway wall, and also would potentially be used in the interpretive signage proposed for the community river place. This very tangible connection to place will be a positive contribution to community wellbeing.

Construction would generate some changes in amenity for residents and visitors to the town. The new weir site would not be visible to the general public, however minor increases in construction traffic and some temporary construction noise would be audible to some residents at times, which may cause a minor disturbance to everyday activities. Some activities associated with the partial removal and decommissioning of the existing weir would also be audible at nearby sensitive receivers.

16.7.2 Operation

The key social outcome of the new weir is that it would improve liveability by securing the town's water supply and providing readily available water for consumption. The proposal also has the potential to provide opportunities for new recreational and tourism offerings to be developed in the community. By creating an extended weir pool through the town centre where it is most visible, the proposal would enhance cultural connections to the Darling River (Baaka) for residents and visitors alike.

Business, employment and training

Securing the town's water supply is expected to benefit local businesses through greater certainty over supplies and less reliance on bore water or imported water. The operation of the new weir itself is not expected to have a direct impact on businesses or employment. However, local business would benefit if the proposal were to result in an increase in tourists stopping in the town.

As noted above, the training program implemented as part of the proposal (refer to **Section16.7.1**) has provided valuable new skills to enable Wilcannia community members to gain skilled employment in a number of industries, take on entrepreneurial ventures or kickstart their own local tourism businesses.

Social infrastructure

Operation of the proposal is not expected to directly impact on social infrastructure, however the securing of town water supplies will indirectly benefit users and operators of these facilities. The visual amenity and existing recreational values of Baker Park in the town centre would also be improved by increased water level in the river.

Recreation and river use

Recreational opportunities such as swimming and fishing would increase in the Darling River (Baaka) during operation. The new town pool between the new and existing weirs would extend past Baker Park. The deep water of the weir pool would create a different environment to the current (sometimes shallow) flowing water and sandbar environment that the community is accustomed to. Deeper water could provide benefits for recreation and river use, including for swimmers, however this may present some safety risks for children or people who are not strong swimmers. It would also potentially change or improve the fishing environment for locals, creating new and deeper pools of water.

The community river place would provide a space where cultural teachings could be conducted, a place for relaxation and recreational activities and also offers opportunities to celebrate cultural connections to the Darling River (Baaka). There would be limited amenities at the community river place, which is consistent with engagement of Central Darling Shire Council, which is responsible for maintenance of the area as the land manager of Union Bend Reserve. There is adequate space at the community river place for the future inclusion of toilets or other amenities if Council decided to add them.

The partial removal and decommissioning of the existing weir would avoid directly impacting most of the area on the rock embankment on the downstream side of the weir crest that the local Aboriginal community uses for fish trapping. However, this rock embankment would be inundated by the new town pool, so future use of this area for fish trapping would not be possible.

Tourism

There is the potential that increased visibility of the new town pool from the Barrier Highway at Wilcannia Bridge could encourage more tourists to stop in Wilcannia and visit Baker Park. Any increase in foot traffic in Wilcannia as a result of more tourists stopping in the town would create greater trading opportunities for retail businesses.

The new weir and community river place have the potential to be a local tourist attraction, particularly if the local community pursues opportunities such as incorporating these sites into an Aboriginal cultural heritage walk, for example.

Land use and property

Central Darling Shire Council would remain the owner of the land on which the community river place is proposed. Central Darling Shire would continue to be responsible for the area as the land manager of Union Bend Reserve.

Community values, wellbeing and amenity

The proposal is expected to make a positive contribution to supporting the cultural and spiritual values of the Barkandji by providing a secure supply of water and extending the weir pool through the town so that there would nearly always be some water visible in this section of the river. Furthermore, while there is a unique cultural and spiritual link between the Aboriginal population of Wilcannia and the Darling River (Baaka), the entire community has strong cultural and heritage links to the river. The new town pool would enhance civic amenity and pride, and engender a 'feel good factor' in the local community.

The social capital that would be generated through improved recreational amenity and new tourism opportunities, would be a positive boost for the entire community.

16.7.3 Evaluation of social impacts

The likely significance of potential positive and negative social impacts associated with the construction and operation of the proposal have been rated using an evaluation matrix that assigns likelihood and magnitude levels to each impact. The evaluation of significance and residual impacts of social impacts is shown in **Table 16-11**.

Table 16-11 Evaluation of social impacts during construction and operation of the proposal

Social impact	Likelihood	Magnitude	Significance	Proposed mitigation measures	Residual impact and significance
Upskilling and training opportunities during design development and construction	Almost certain	Moderate	High (positive)	S2	High (positive)
Local employment opportunities during construction	Likely	Minor	Medium (positive)	S2	Medium (positive)
Construction workforce accommodation requirements could compete with locals and visitors during peak tourism seasons outside summer	Possible	Moderate	High (negative)	S3	Low (negative)

Social impact	Likelihood	Magnitude	Significance	Proposed mitigation measures	Residual impact and significance
Potentially increased demand for social infrastructure, including health services during construction	Possible	Minor	Low (negative)	S1, S4, S6, S7	Negligible to low (negative)
Temporary loss of access to certain parts of the Darling River (Baaka) at the new weir site and existing weir site during construction	Likely	Minor	Medium (negative)	S1, S6, S7	Low (negative)
Legacy upgrades of local access infrastructure for local use	Almost certain	Moderate	High (positive)	S1, S2	High (positive)
Temporary closure (through leasing) of Victory Park Caravan Park during partial removal and decommissioning of the existing weir	Almost certain	Moderate	Medium (negative)	S1, S2, S7	Low (negative)
Community's perceived impacts to cultural heritage sites or values, and impacts to important features such as large River Red Gum trees during construction	Likely	Moderate	High (negative)	S1, AH5	Low (negative)
Recreational opportunities such as swimming and fishing would increase in the Darling River (Baaka) during operation	Almost certain	Major	Very High (positive)	S2, S6	Very High (positive)
Opening up of increased tourism opportunities associated with Aboriginal cultural heritage or the Darling River (Baaka) once operational	Possible	Moderate	Medium (positive)	S2	Medium (positive)
Reduced access to fish trapping locations along the river during operation	Almost certain	Major	Very High (negative)	S2	Very High (negative)
Improved water security and clean water availability for the township of Wilcannia, and enhanced cultural connections to the Darling River (Baaka) once operational	Almost certain	Major	Very High (positive)	S2	Very High (positive)

16.8 Mitigation and management measures

Mitigation and management measures for social, land use and property impacts are provided in **Table 16-12**.

Table 16-12 Mitigation and management measures for social, land use and property impacts

Ref	Impacts	Mitigation and management measures	Timing
S1	Community uncertainty	A community communication strategy will be prepared for the proposal to facilitate communication with the local community including relevant government agencies, Central Darling Shire Council, adjoining affected landowners and businesses, and other relevant stakeholders that may be affected by the proposal. The strategy will:	Pre-construction Construction

Ref	Impacts	Mitigation and management measures	Timing
		▪ Identify people or organisations to be consulted during the delivery of the proposal ▪ Set out procedures and mechanisms for the regular distribution of information about the proposal ▪ Outline mechanisms to keep relevant stakeholders updated on site construction activities, schedules and milestones ▪ Outline avenues for the community to provide feedback (including a 24 hour, toll free project information and complaints line) or to register complaints and through which Water Infrastructure NSW will respond to community feedback ▪ Outline a process to resolve complaints and issues raised.	
S2	Delivery of proposal benefits	A social impact management plan will be prepared in consultation with key stakeholders to support the proposed engagement activities through to the completion of construction. The social impact management plan will outline: ▪ Roles and responsibilities for stakeholders involved in the implementation of the plan ▪ How any local employment opportunities would be planned, communicated and managed ▪ How any local procurement and supply opportunities would be planned, communicated and managed ▪ Ongoing employment, training and development opportunities ▪ Monitoring and reporting requirements and responsibilities.	Detailed design Construction
S3	Temporary workforce accommodation	A temporary workforce accommodation plan will be developed and will include: ▪ Requirements for consultation and early notification to local providers ▪ Measures to ensure no negative impacts to local rental accommodation are incurred ▪ Consideration of mobile accommodation facilities within existing campgrounds, in consultation with the owners and any local approval requirements ▪ Procedures to monitor and measure performance against the plan.	Pre-construction Construction
S4	Local health services	The contractor will monitor workforce demand for local health services as part of the construction health and safety plan, and consult with local health authorities on alternative arrangements should the need arise.	Construction
S5	Drinking water supplies	Water Infrastructure NSW will continue to liaise closely with Central Darling Shire Council during construction to manage the township's water supplies.	Detailed design Pre-construction Construction

Ref	Impacts	Mitigation and management measures	Timing
S6	Recreational swimming, fishing and boating	Water Infrastructure NSW in partnership with local stakeholders will conduct water safety and awareness workshops with the community following completion of construction of the new weir and partial removal and decommissioning of the existing weir, The workshops will aim to make the community aware of the changed conditions for swimming, fishing and boating.	Construction Operation
S7	Victory Park Caravan Park	Water Infrastructure NSW will notify Central Darling Shire Council at least six months prior to the need to access Victory Park Caravan Park to decommissioning the existing weir to allow sufficient time for leasing and notification to potential travellers. Water Infrastructure NSW will consult with Central Darling Shire Council about the rehabilitation of disturbed areas at Victory Park Caravan Park.	Construction

17. Visual amenity

This section provides a landscape and visual impact assessment of the proposal, and recommends mitigation and management measures to address these impacts.

SEAR no. 16 includes requirements for the assessment of the design of the proposal which are relevant to this landscape and visual impact assessment. The requirements of SEAR no. 16 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

17.1 Legislative and policy context

There is currently no standard guidance on landscape and visual impact assessment within Australia. As such the methods used in this environmental impact statement for visual impact assessment are from the Transport for NSW *Guideline for Landscape Character and Visual Impact Assessment – Environmental Impact Assessment Practice Note EIA-N04 Version 2.2* (Transport for NSW visual impact guidelines) (Transport for NSW, 2020).

The Transport for NSW visual impact guidelines are based on principles from, and references:

- *Guidelines for Landscape and Visual Impact Assessment*, 3rd Edition (Landscape Institute and Institute of Environmental Management & Assessment, 2013)
- Better Placed: An Integrated Design Policy for the Built Environment of New South Wales (DPIE, 2017)

Other policies and guidelines that have been considered as part of the assessment include:

- Crown Land 2031- State Strategic Plan for Crown Land (DPIE, 2021c)
- Crime Prevention and the Assessment of Development Applications (Department of Urban Affairs and Planning, 2001)
- Crime Prevention through Environmental Design – Guidelines for Queensland (Queensland Police Service, 2021).

17.2 Assessment methodology

The methodology for the landscape and visual impact assessment involved:

- Identifying a study area for the assessment and understanding the relative physical differences between the current visual environment and that of the proposed new weir
- Contextualising and describing the full range of natural and cultural components that make up the local landscape through:
  - Desktop studies of aerial photography, satellite imagery and topographic maps
  - Visual inspection during a site visit (completed on 16 October 2020)
- Identifying viewsheds and key views of the proposal and potential sensitive visual receivers
- Selecting representative viewpoints for the visual impact assessment
- Assessing potential negative or positive impacts that would affect the existing landscape and any inherent visual values
- Determining the potential significance of impacts through a combined qualitative assessment of sensitivity and magnitude
- Recommending mitigation and management measures to address potential landscape and visual impacts.

17.2.1 Study area

A study area for the visual assessment was defined that included the construction footprint of the proposal plus a 10-metre buffer zone, as well as the extent of the Darling River (Baaka) from the new weir to the upstream extent of the new weir pool when the new weir is in drought security operation mode.

The proposed construction and operation of the new weir, partial removal and decommissioning of the existing weir, the new community river place, as well as the new weir pool are the key physical changes anticipated to impact the landscape character and views of the area due to their scale. Other physical changes would be of an appearance and scale that is visually absorbed into the existing landscape. The visual impact assessment considered the Darling River (Baaka) inundation area at the drought full supply level, to provide a likely worst-case visual envelope associated with the proposal.

17.2.2 Landscape and visual impact assessment

An assessment of the broad landscape character and visual impact was carried out to assess potential impact on the overall study area's built, natural and cultural character and to assess the impact of the proposal on views and visual amenity. Visual amenity impacts refer to the visual effect of the proposal on people's views when they observe the proposal in its location.

The overall impact of the proposal on the study area's sense of place refers to what people may think and feel about a place, how the community may value it, regardless of whether they are physically present in this place. Given that the topography of the river channel conceals views of the proposal, a broader geographical extent has been included to understand landscape character to assess potential impacts.

The potential visual impacts were assessed based on the sensitivity of the viewpoint and the magnitude of the proposed changes:

- Sensitivity refers to how easily the existing character of the land can absorb the impacts of the proposal. Sensitivity depends on the location of visual receivers, the importance of their view and land uses nearby
- Magnitude refers to the physical size and scale of the proposal and the proximity to the viewer. Magnitude also considers cumulative impacts and the contrast between the existing area and the design of the proposal as an addition to the landscape.

The combination of the sensitivity of the landscape and the magnitude of the impacts determines the overall visual impact on viewpoints, from negligible to high, as shown in the landscape character and visual impact rating matrix in **Figure 17-1**.

The key viewpoints are shown in **Figure 17-2** and discussed further below.

		Magnitude of visual impacts			
		High	**Moderate**	**Low**	**Negligible**
Sensitivity of landscape	**High**	High	Moderate to High	Moderate	Negligible
	Moderate	Moderate to High	Moderate	Moderate to Low	Negligible
	Low	Moderate	Moderate to Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 17-1 Landscape character and visual impact rating matrix

17.3 Risk

The proposal would result in a permanent change to the visual landscape at Wilcannia, particularly at the new weir site and at the new town pool between the new and existing weirs. There would also be temporary visual changes around the construction sites for the proposal. The potential risks associated with these permanent and temporary changes to the visual landscape include:

- A temporary reduction in visual amenity for sensitive receivers near the new and existing weir sites and community river place during construction
- A permanent change to the appearance of the Darling River (Baaka) at the new town pool, from a flowing river to a permanent weir pool
- Permanent changes to the visual character of the Darling River (Baaka) at the new weir site and particularly on the right riverbank, as well as a general increase in human activity at Union Bend including at the community river place.

17.4 Avoidance and minimisation of impacts

Potential visual amenity impacts have been avoided and minimised by:

- Locating the new weir away from sensitive receivers
- Locating laydown areas for construction on already cleared land where possible to minimise vegetation clearing
- Engaging extensively with the local community during planning for the proposal and incorporating the community's feedback into the design of the proposal where possible, so that there is widespread awareness of the visual changes that would occur during the construction and operational phases of the proposal and a sense of ownership of the proposed new infrastructure.

17.5 Existing environment

The topography of the study area is characterised by a predominantly flat river plain and undulating bush land associated with the Darling River (Baaka) in the Upper Barwon-Darling catchment. The new weir is proposed in a natural setting south of the Wilcannia township. The Darling River (Baaka) channel between the new and existing weirs including through Wilcannia township is steep with slopes of 15 to 22 degrees and riverbanks with a local relief of about 10 metres (64 to 74 metres AHD). Views of this section of the Darling River (Baaka) are generally confined to the tops of the riverbanks due to the large River Red Gums and other vegetation that line the tops of the riverbanks and the flat landscape (refer to **Photo 17-1** and **Photo 17-2**). The river is most visible within the township at Baker Park and from the Barrier Highway crossing of the river at Wilcannia Bridge. The Darling River (Baaka) holds high aesthetic and cultural significance within the local and regional landscape and is an important visual element of the Murray-Darling Basin environment.

Upstream of the existing weir, the Darling River (Baaka) is the key landscape feature of the study area. The river is surrounded by a mostly flat rural landscape that is mostly used for grazing. The odd rural residential structure dots the landscape, which is occasionally crossed by unsealed roads and access tracks. The river meanders through this landscape, surrounded by the same type of vegetation that lines the river through Wilcannia. The confluences of the Darling River (Baaka) with Kallyanka Creek and the Paroo River occur within the study area.

Photo 17-1 Darling River (Baaka) viewed from Baker Park at Wilcannia facing downstream

Photo 17-2 Darling River (Baaka) about 50 kilometres upstream of the existing weir at Wilcannia

17.5.1 Key viewsheds and landscapes

New weir site

The landscape around the proposed new weir site consists mostly of sparse bush land with medium to dense vegetation and no dwellings or structures immediately to the north and south of the Darling River (Baaka). The river at this location is only visible when standing close to the riverbanks.

Community river place

The areas surrounding the proposed community river place at the end of Union Bend Road also consists of bush land however there are two occupied dwellings on the left riverbank, across the river from the proposed community river place. These two dwellings have views of the community river place, although these views are filtered by existing trees and vegetation.

Existing weir site and Victory Park Caravan Park

The existing weir is located within Wilcannia township between Victory Park Caravan Park on the left bank of the Darling River (Baaka) and the Wilcannia Hospital on the right riverbank. Private dwellings at the cul-de-sac ends of Field Street and Byrnes Street are also located on the right riverbank downstream of the existing weir.

At Victory Park Caravan Park, vegetation along the top of the left riverbank prevents views of the existing weir from the caravan parking area. Visitors to Victory Park Caravan Park are able to view the existing weir by following a short informal walking track through this vegetation to the top of the left riverbank (refer to **Photo 17-3**).

Vegetation along the top of the right riverbank is also expected to at least partially obscure views of the existing weir from Wilcannia Hospital and private dwellings. An informal walking track from the cul-de-sac end of Field Street to the top of the right riverbank provides direct views of the existing weir (refer to **Photo 17-4**).

Photo 17-3 Existing weir viewed from the left riverbank at Victory Park Caravan Park

Photo 17-4 Existing weir viewed from the right riverbank at the cul-de-sac end of Field Street

Baker Park and Ray Hunter Memorial Park

Baker Park and Ray Hunter Memorial Park are located on the right riverbank either side of the Wilcannia Bridge at the southern end of the Wilcannia township. The parks flank the bridge and the Barrier Highway. Baker Park includes interpretive signs and displays of information, Wilcannia War memorial and a playground. Ray Hunter Memorial Park consists of decorative tree carvings, a locomotive statue and seating areas. Both parks have important recreational values for the local community and visitors. At Baker Park, there is an access track which leads down to the river edge, which was once the location of a public wharf.

Upstream location

The weir pool that extends upstream from the existing weir is not be visible from the established roads in the area, including East Tilpa Road and West Tilpa Road. Private access tracks from properties do extend to the river's edge however these are not generally used by the public. Upstream from the existing weir there are many private property land parcels however there are only a few (up to 15) properties with dwellings that are close to the riverbanks and have the potential to view the Darling River (Baaka). Due to the tall trees lining the top of the banks of both sides of the river and the topography of the incised and steep river channel, the views from many of these private dwellings would be mostly obstructed. There are however five private dwellings in the study area that are located on the riverbanks along the weir pool and these are likely to have broad views over the river channel.

17.5.2 Representative viewpoints

Five representative viewpoints were selected to illustrate the visual effects of the proposal when viewed from different locations in Wilcannia. Sensitive visual receivers within the study area include residents, workers and visitors in the township of Wilcannia, staff and guests at the Victory Park Caravan Park and residents of rural properties along the weir pool extent.

The viewpoints were selected to represent views from sensitive receivers and public buildings and spaces as follows:

- VP1 The new weir site
- VP2 The community river place
- VP3 The existing weir site
- VP4 Baker Park
- VP5 Private property on the right riverbank about 750 metres downstream of the proposed weir pool extent.

Figure 17-2 shows the located of the five representative viewpoints within the study area. **Table 17-1** shows the sensitivity ratings and describes the existing view from these viewpoints.

Figure 17-2 Location of selected viewpoints

Figure 17-2 Location of selected viewpoints

Table 17-1 Key viewpoints and sensitivity ratings

Viewpoint	Location	Description	Visual sensitivity	Existing view
VP1 The new weir site	Darling River (Baaka), about 4.5 river kilometres downstream of Wilcannia Bridge	This view looks south-west towards the proposed new weir site and the left riverbank from the right riverbank and includes the riverbank slopes and Darling River in the foreground. Tall trees that line the top of the riverbanks are visually dominant in this view. Fallen tree branches and logs and riparian vegetation also feature in this view. The new weir would be located in the middle of this view extending across the river channel, and the fishway would be perpendicular to the weir along the near side of the river channel in this view. This viewpoint represents the views experienced by people accessing this part of the Darling River (Baaka) from the right riverbank. This view would generally be experienced by current recreational users of the river and future visitors to the new weir site including both locals and tourists.	Moderate	

Viewpoint	Location	Description	Visual sensitivity	Existing view
VP2 Community river place	End of Union Bend Road on the Darling River (Baaka) right riverbank, about 1.2 river kilometres upstream of the new weir site	This view looks south-west towards the Darling River (Baaka), with the right riverbank in the foreground. The community river place is proposed at this location. Minor changes are proposed to the existing viewshed as part of the development of the community river place including recreational amenity items such as benches, signage and landscaping. This viewpoint represents views experienced by the local community who would typically access this area for fishing, swimming or other recreational activities.	Low	

Viewpoint	Location	Description	Visual sensitivity	Existing view
VP3 The existing weir site	Darling River (Baaka), about 500 metres upstream of Wilcannia Bridge at Barrier Highway	This view looks towards the existing weir from the southern end of the weir crest at the top of the left riverbank. This view includes steep riverbanks and tall vegetation in the background, the existing weir in the middle ground and a park bench surrounded by riparian vegetation in the foreground. The foreground shows an existing access track which connects the caravan park roadway to the edge of the existing weir. At this location some gaps in trees and vegetation allow unimpeded views to the river below the banks. This view would be experienced by visitors to Victory Park Caravan Park.	Low	

Viewpoint	Location	Description	Visual sensitivity	Existing view
VP4 Baker Park	Darling River (Baaka) right riverbank, about150 metres west of Wilcannia Bridge	This view includes the edge of Baker Park in the foreground and the Wilcannia Bridge in the background, with the Darling River (Baaka) in the middle ground. Baker Park has access down to the edge of the river through low lying vegetation and views from Baker Park looking south or south-east towards the Darling River (Baaka) are generally filtered by trees along the top of the riverbank. This viewpoint represents typical views experienced by visitors to Baker Park, including local residents and tourists.	Low	

Viewpoint	Location	Description	Visual sensitivity	Existing view
VP5 Between the existing weir pool extent and the new weir pool extent	Private property about 750 metres downstream of proposed weir pool extent	This view is located at the edge of the private property near the weir pool extent, looking south over the Darling River (Baaka) from the top of the right riverbank. Tall vegetation that lines the left riverbank forms the backdrop in this view, where the riverbanks are less steep than downstream areas. The Darling River (Baaka) is visible in the middle and foreground. The river at this location curves around a bend. The river at the time of this photo was at low flow. This viewpoint is representative of views from the nearby private residence, with broadly spanning views across the river, filtered by some vegetation.	Low	

17.6 Assessment of impacts

There are a few key physical changes associated with the proposal that would influence the existing landscape and visual character of the study area. Most of the proposal (the new weir and existing weir) is located within the steep river channel, surrounded by tall vegetation on both riverbanks. Due to the steep river channel, the weir pool would only be visible in the immediate vicinity of the river or from higher viewpoints, as shown in **Table 17-1**. The weir pool would not be visible from publicly accessible roads in the study area upstream of the existing weir and is expected to be visible only from a few private properties located close to the riverbanks. The proposal would consist of temporary visual impacts during construction and introduce permanent structures and visual amenity changes once operational, as described below.

17.6.1 Construction impacts

The proposal would result in temporary changes to visual amenity during the construction period. These changes would be experienced by sensitive visual receivers, such as residents, motorists, workers and visitors to recreational areas in the vicinity of the proposal site, particularly those at viewpoints listed in **Table 17-1.**

Impacts on visual amenity would generally only be experienced within a relatively short distance from the proposal area and would be due to the clearing of vegetation, generation of waste and construction activities. Visible elements during construction of the new weir and the partial removal and decommissioning of the existing weir would include work sites, machinery and equipment, site fencing, storage areas or compounds, stockpiles, waste materials and partially constructed structures. The construction activities proposed at the community river place would involve fairly minor works and no vegetation clearing.

Other construction activities that may result in changes to visual amenity include:

- Removal of vegetation at the new weir site only
- Trimming of tree cover for construction access at the new and existing weir sites
- Installation of temporary cofferdams and silt curtains
- Construction of the new weir and fishway
- Partial removal and decommissioning of the existing weir
- Upgrades of an existing access track on the left riverbank and construction of a new unsealed access track on the right riverbank at the new weir site
- Increase in heavy vehicle movements on the road network that would be visible to some receivers.

Visual impacts would occur throughout the construction period but the nature of the impact would change based on the types of works being caried out.

17.6.1.1 VP1 The new weir site

During construction at the new weir site, the site would be fenced off in an exclusion zone, and since there are no private residential dwellings nearby, the construction works in the river channel are not expected to affect visual amenity for any sensitive receivers. The impacts are therefore expected to be negligible as the construction work would be temporary and recreation activities in the immediate surrounding areas would be paused. Larger construction plant and machinery or tall equipment may be visible from Union Bend Road and an increase in heavy vehicle traffic through the Wilcannia township would also be visible on local roads.

The clearance of vegetation is likely to be the largest visual impact caused during the construction period at the new weir site. The specific trees to be removed are shown in **Figure 17-3**.

17.6.1.2 VP3 The existing weir site

Partial removal and decommissioning of the existing weir would involve works within the river channel at the existing weir and the use of Victory Park Caravan Park for plant and equipment laydown and materials storage and to access the river. The caravan park would be closed during the works, which would distance sensitive receivers from the construction site and minimise visual impacts to sensitive receivers. However, construction vehicles, equipment and plant would be visible from the right riverbank such as the informal walking track that extends from the cul-de-sac end of Field Street.

It is expected that due to the temporary nature of the construction works at the existing weir, with a construction period of about 10 weeks, the construction impacts would not be significant on the local visual amenity and landscape. All construction sites would be restored and rehabilitated at the end of the construction period.

17.6.1.3 Other viewpoints

The construction works proposed at VP2 (community river place) are minor and the visual impact of these works would be minimal.

No construction work is proposed at viewpoints VP4 (Baker Park) and VP5 (upstream location).

17.6.1.4 Vegetation clearing and landscaping

Vegetation clearing is proposed at the new weir site to enable construction of the new weir and fishway. Trees that line the tops of the riverbanks are proposed to be removed on both sides of the new weir to enable plant and equipment to access the riverbed and cranes to move materials between the banks and the riverbed. Vegetation clearing is also required on the right riverbank at the new weir site to create space for the fishway maintenance track, controls rooms and switch room. Trees proposed for removal are identified in **Figure 17-3**.

Vegetation clearing is also proposed away from the tops of the riverbanks on both sides of the new weir to accommodate construction compounds, plant, equipment and material laydown areas, stockpiles areas, a concrete batching plant, and vehicle parking.

17.6.1.5 Site rehabilitation

The new weir site would be progressively rehabilitated as construction work areas are no longer needed. A preliminary rehabilitation plan for the new weir site has been prepared and is provided in Appendix A of **Technical Report 6**.

The existing weir site would be rehabilitated once the partial removal and decommissioning of the existing weir is completed. A preliminary rehabilitation plan for the existing weir site has been prepared and is provided in Appendix C of **Technical Report 6**.

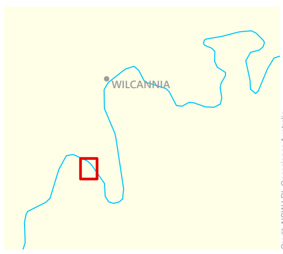


Figure 17-3: Trees to be removed as part of the proposal

Figure 17-3: Trees to be removed as part of the proposal

17.6.2 Operation impacts

Visual changes during the operation of the proposal would include:

- A permanent weir structure and fishway within the river channel downstream of Union Bend in what is currently a mostly natural setting
- About 4.92 river kilometres of the Darling River (Baaka) between the new and existing weirs would be transformed from a flowing water and sandbar environment to a weir pool with deep standing water
- Power poles and overhead powerlines crossing the landscape between Union Bend Road and the new weir
- A new access track between Union Bend Road and the new weir site
- The retained portion of the existing weir would be inundated by the new town pool, with only the top of retained portion of the weir crest visible when the water level in the weir pool is low
- The use of land at Union Bend for public recreation would be more visually apparent due to informal car parking, picnic tables, and seating and an expected increase in usage by the local community.

The extent to which the proposal would be visible from the identified viewpoints would vary depending on existing topography, vegetation, land use and the form of the proposal when viewed from each viewpoint. General visual impacts would occur as a result of vegetation loss, introduction of a new weir and fishway, construction of a community river place, partial removal of the existing weir and upgrades to existing access tracks in a typically rural landscape setting.

Low visual sensitivity was predicted at viewpoints 2, 3, 4 and 5, while moderate visual sensitivity was predicted at viewpoint 1. The proposal during detailed design would seek to minimise the potential visual amenity impacts as far as practicable, through siting of infrastructure elements and minimising clearing in areas with significant vegetation cover. Mitigation measures developed to further reduce visual impacts of the proposal are outlined in **Table 17-3**.

17.6.3 Summary of construction and operation visual impacts

Table 17-2 provides a summary of changes and the significance of potential impacts at representative viewpoints during construction and operation. Overall impact significance ratings at key viewpoints ranged from negligible to moderate to high.

Table 17-2 Summary of proposal visual impacts during construction and operation

Viewpoint	Construction/ operation	Description of change	Visual sensitivity	Magnitude of visual change	Significance of impact
VP1 The new weir site	Construction	During construction of the proposal, native vegetation clearing would be required on both banks of the river at the new weir site. The retained vegetation would provide some screening of the proposal site. However when viewed in close proximity, the proposal would be fully visible and temporary structures such as in-stream work sites and cofferdams would reduce views of water flowing in the river. Site fencing, compound areas and the movement of machinery associated with the construction of the new weir, fishway and community river place would be visible from this viewpoint during the construction period.	Moderate	High	Moderate to High
	Operation	The community river place and construction compounds on the right riverbank would be filtered by the remaining riverbank vegetation. The proposal would introduce permanent structures into the river and this viewpoint would experience visual amenity changes during operation.		Moderate The proposal would result in loss of trees and the new weir and fishway would become new features in this view. Vegetation would be retained where feasible and the dense riverbank trees would screen views to the proposal site.	Moderate

Viewpoint	Construction/ operation	Description of change	Visual sensitivity	Magnitude of visual change	Significance of impact
VP2 Community river place	Construction	There may be some minor construction activities at the community river place related to truck movements dropping off rocks taken from the existing weir as part of the decommission works. No other construction activities would be visible from this viewpoint	Low	Low	Low
	Operation	During operation of the proposal in both normal and drought security operation modes this viewpoint would likely experience higher water levels than in the existing view. Visual amenity from this viewpoint is likely to be improved as a result of the proposal.		Low The proposed changes to visual amenity as a result of increased river levels would fit into the existing open space and waterway view.	
VP3 The existing weir site	Construction	Construction vehicles, plant and equipment would traverse through the caravan park for the duration of the construction period at the existing weir, and would be visible from this viewpoint. Construction activities that would be visible include demolition works, site fencing, silt curtains, machinery and vegetation removal.	Low	High	Moderate
	Operation	The proposal would permanently remove part of the existing weir. The new town pool would inundate the river downstream of the existing weir resulting in water levels being higher than in this existing view. During operation the proposal would likely add to the existing aesthetics of the riverside landscape and improve visual amenity with a more continuous river flow.		Moderate The anticipated visual changes from the removal of the existing weir would be visible and noticeable from this viewpoint. Existing vegetation would screen views to the proposal site.	Moderate to Low
VP4 Baker Park	Construction	Construction works at the new and existing weir sites would not be visible from this location. However construction vehicles crossing the Darling River (Baaka) at the Barrier Highway would be visible from Baker Park.	Low	Moderate	Moderate to Low
	Operation	During operation of the proposal in both normal and drought security operation modes this viewpoint would likely experience higher water levels than in the existing view. Visual amenity from this viewpoint is likely to be improved as a result of the proposal.		Low The proposed changes to visual amenity as a result of increased river levels would fit into the existing open rural and waterway view.	Low

Viewpoint	Construction/ operation	Description of change	Visual sensitivity	Magnitude of visual change	Significance of impact
VP5 Between the existing weir pool extent and the new weir pool extent	Construction	Construction activities would not be visible from this location.	Low	Negligible	Negligible
	Operation	The only change to the existing viewpoint would be a rise in the water level in the river when the new weir transitions from normal operation mode to drought security operation mode and this section of the river becomes a temporary weir pool. The water level in the temporary weir pool would rise when the new weir is in the filling phase. Once filling of the weir pool to the drought full supply level is complete and the new weir enters drought security operation mode the temporary weir pool would gradually fall due to evaporation and consumption. If the new weir remains in drought security operation mode for an extended period of time the temporary weir pool would reduce to isolated pools or a dry riverbed until flows from upstream resume.		Negligible The proposed visual changes would be similar in character to the existing view. The water level increase would be minor and temporary and would be screened by tall riverbank vegetation.	Negligible

17.7 Mitigation and management measures

Mitigation measures for visual impacts are provided in **Table 17-3**.

Table 17-3 Mitigation and management measures for visual impacts

Ref	Impacts	Mitigation measures	Timing
LV1	Rehabilitation of the new weir site	The rehabilitation plan for the new weir site will be further developed in consultation with Wilcannia Local Aboriginal Land Council (for areas on the left side of the river) and the Wilcannia local community (for areas on the right side of the river).	Pre-construction Construction
LV2	Riverbank appearance at the new weir site	The disturbed riverbanks at the new weir site will be reinstated with materials that provide stability while also presenting as natural an appearance as possible.	Pre-construction Construction
LV3	Landscaping of the community river place	The concept landscape plan for the community river place will be further developed in consultation with Central Darling Shire Council and the local community. This will include identifying opportunities to reuse waste materials from the construction of the new weir and partial removal of the existing weir such as logs and rocks.	Pre-construction Construction
LV4	Rehabilitation of the existing weir site	The rehabilitation plan for the existing weir site including disturbed areas within Victory Park Caravan Park will be further developed in consultation with Central Darling Shire Council.	Pre-construction Construction

18. Geology, soils and contamination

This section provides a geology, soils and contamination impact assessment of the proposal, and recommends mitigation and management measures to address these impacts.

SEAR nos. 8, 9 and 11 include requirements for the assessment of the proposal's potential impacts to land, contamination and soils respectively. The requirements of SEAR nos. 8, 9 and 11 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

18.1 Assessment methodology

A preliminary site investigation was undertaken to assess historical and current contaminating activities, soil and any geological limitations, and to identify and manage potential impacts to the construction and operation of the proposal.

As part of the investigation, Land Insight Resources was engaged to conduct a historical review and an assessment of the current environment of both the new and existing weir sites. Land Insight Resources carried out a desktop assessment using publicly available information and government databases and documented the results in due diligence reports for each site that formed a key input to the investigation.

The history of land use within and next to the new and existing weir sites was investigated, which included reviewing historical aerial images of the sites for the years 1961, 1977, 1988, 1995, 2006, and 2016. The NSW Environment Protection Authority's contaminated land record of notices that it maintains under section 58 of the *Contaminated Land Management Act 1997* and the list of contaminated sites notified to the NSW Environment Protection Authority under section 60 of the *Contaminated Land Management Act 1997* were also checked.

The investigation was also informed by an inspection of the new and existing weir sites.

18.2 Risk

Broadly, contamination, soil and geological risks are a result of activities carried out on land over time within or next to a subject site. Additionally, geological risks encompass natural hazards caused by geological conditions which can be naturally initiated or induced by human impact. Areas of land with the correct geological conditions may be at risk of becoming acid forming, erosional or saline.

Specific contamination, soil and geological risk at the new and existing weir sites include:

- Erosion as a result of the disturbance of soils during construction
- Contamination of soils/groundwater due to spills and leaks during construction
- Exposure of saline soils and subsequent erosion
- Potential to disturb hazardous materials during the partial removal and decommissioning of the existing weir
- Erosion of soils during operation and maintenance works
- The transport and storage of dangerous goods (including flammables) could pose risks to health and safety and the surrounding environment if not appropriately managed.

18.3 Avoidance and minimisation of impacts

The risk of encountering contaminated soil has been minimised by locating the new weir at a greenfield site. This risk has been further reduced by selecting a site for the new weir that can be partly accessed from existing tracks and where there are level sites on either side of the river suitable for construction compounds and laydown areas.

18.4 Existing environment

Topography

The topography Wilcannia is flat to gently undulating terrain with a local relief of typically up to 10 metres or 64 – 74 metres AHD. The Darling River (Baaka) runs through the landscape with moderate to steep riverbanks with slopes of about 15 to 22 degrees and are in relatively good condition.

At the proposed new weir site, the lowest riverbed level is 61.57 metres AHD, and the heights of the left and right riverbanks are estimated to be about 9.85 metres and 11.56 metres, respectively.

Geology

The Wilcannia 1:250,000 Geological Series Sheet SH/54-16 maps the overall geological formation of the Darling River (Baaka) and floodplain as Cainozoic Quaternary (Qrs) (Frenda, 1965). **Table 18-1** provides a description of the underlying geological units at the new and existing weir sites.

Table 18-1 Geological units underlying the new and existing weir sites

Locations	Geological unit	Code	Formation	Description
Existing weir site	Quaternary aeolian deposits	Q_ds	Aeolian sand plain	Flat to low undulating or hummocky fossil sand plain, red-brown to brown and humic, clayey, silty to fine-grained sand, silty clay at depth; abundant regolithic and pedogenic carbonate, extensively modified by pedogenesis.
New and existing weir sites	Quaternary alluvium	Q_acw	Alluvial channel deposits, subaqueous	Fluvially deposited sand, gravel, silt, clay.
		Q_acm	Alluvial channel deposits, meander plain facies	Unconsolidated grey humic, clayey very fine-grained sand, typically overlying light brown clayey silt.

Source: Frenda G.A. (1965) and Land Insight Resources (2020a and 2020b)

Hydrogeology

The aquifer underlying Wilcannia is described in **Section 9.5.1**. In summary, the aquifer below and surrounding the proposal is considered porous with extensive aquifers of low to moderate productivity.

Existing water quality in the Darling River (Baaka) at Wilcannia is described in detail in **Section 10.5.1** and is assessed as poor because:

- High flows result in higher turbidity, and higher concentrations of nutrients and possibly pesticides and pathogens

- There is also a general trend towards increasing turbidity and nutrient concentration with distance down the catchment as cumulative impacts increase
- During increasingly extended periods when there is no tributary inflow, the river can dry to a series of standing pools. The quality of the water in these remnant pools is generally poor with high nutrients, suspended sediments and salinity. Water in stagnant pools can have high nutrient concentrations, triggering potentially toxic blue-green algal blooms.

Groundwater

Groundwater levels and quality at the new and existing weir sites are described in **Section 9.5.2**. Groundwater levels at both sites are in line with the elevation of the riverbed, however, are subject to seasonal variation and by fluctuations in the level of the river. Groundwater quality within the wider regional area is generally saline apart from narrow shallow lenses of freshwater along the Darling River (Baaka) and its tributaries.

Soil land system

A description of the soil land systems and soils at the new and existing weir sites is provided in **Table 18-2** and shown in **Figure 18-1**.

Table 18-2 Soil land system the new and existing weir sites

Location	Soil land system	Characteristics
New weir site	Mid-Darling land system (LSMy)	Darling-Barwon River (Baaka) and fringing River Red Gum forests. Sinuous perennial stream incised into grey Quaternary alluvium; bed to 15 metres deep. Grey cracking clays; dense forests of River Red Gum, Black Box and Coolibah, scattered lignum; annual forbs, Warrego summer grass and other grasses. Minor erosion in areas of sloping scalds near banks.
	Grey-brown and red clays (CG, BC, RC) of the soil group Vertosols	These form a broad group of soils whose common properties are determined by their high clay contents. Typically, they are moderately deep to very deep soils with uniform colour and texture profiles, weak horizonation mostly related to structure differentiation and some carbonates and/or gypsum in their subsoils. They crack deeply on drying.
Existing weir site	Denian land system (LSDe)	Slightly undulating plains with bluebush and dunes, adjacent to lower Darling floodplain. Slightly undulating Quaternary alluvial plains, outwash plains and dunes' transitional between active floodplain and sandplain; relief to 7m. Plains with texture-contrast soils, red earths, solonized brown soils, sands and cracking clays; sparse to moderate prickly wattle, rosewood, belah and black box; locally dense narrow-leaf hopbush on sandy areas, moderate to dense black bluebush on lighter soils; grasses, copper burrs, annual saltbushes and forbs. Minor erosion from windsheeting and scalding.
	Red-brown earths (RBE) of the soil group Chromosols	The characteristic features of these soils are grey-brown to red-brown loamy A horizons, weakly structured to massive, an abrupt to clear boundary between A and B horizons, and brighter brown to red clay B horizons with well-developed medium prismatic to blocky structure.

Source: Office of Environment and Heritage (2018) and Walker (1991)

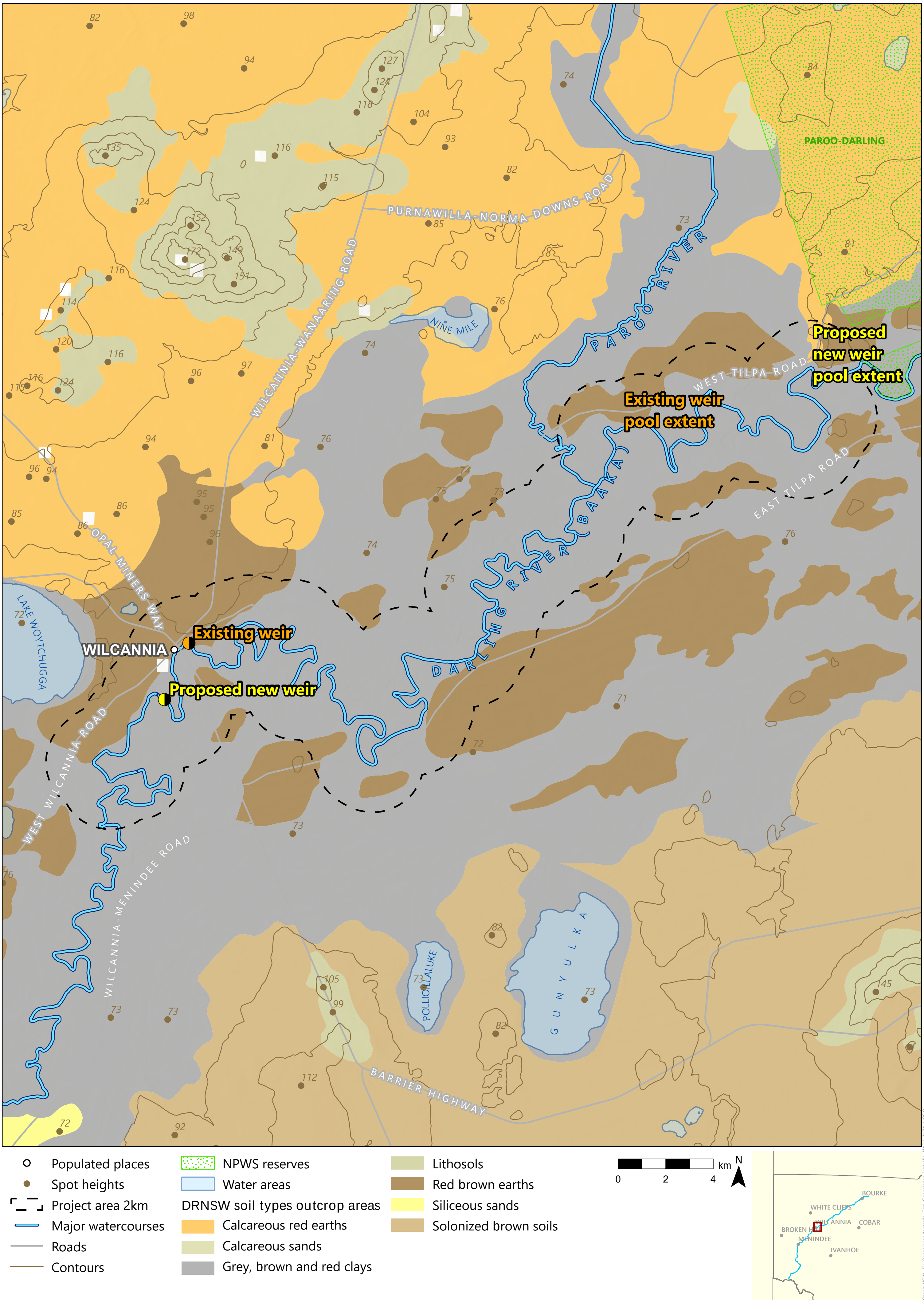


Figure 18-1 Geography and topography

Landforms

Geotechnical

Geotechnical investigations undertaken to inform the design development and the selection of the proposed new weir location identified the subsurface conditions as thick deposits of alluvial soil. Consistent with the geological formation of the Mid-Darling and Denian land systems, alluvial soil samples were determined to comprise low plasticity silty clay/clayey silt of stiff to hard consistency, with minor to moderate portions of sand, overlying fine grained alluvial sands of dense to very dense consistency with minor proportions of silt clay with a low to moderate dispersal potential (Greywacke Geotechnics, 2020). The exposure classification as per Australian Standard AS2159-2009 (6.4.2c and 6.5.2 c) for underlying soils was assessed as generally nonaggressive for buried steel and one occasion of mild and generally mild for buried concrete (Greywacke Geotechnics, 2020).

Seismicity

The National Seismic Hazard Assessment defines the level of earthquake ground shaking across Australia that has a likelihood of being exceeded at a given time. By understanding how the ground-shaking hazard varies across Australia higher hazard areas can be identified and mitigation strategies can be prepared so that communities can be more resilient to earthquake events (Geoscience Australia, 2018). Seismic hazard is calculated as the ground motion level, on engineering rock, that has a given probability of being exceeded within a given period: 10 per cent in 50-year exceedance in the Australian Standard AS1170.4 -2007 (Geoscience Australia 2018).

The 2018 National Seismic Hazard Assessment contains uniform probability hazard maps for a 10 per cent and two per cent chance of exceedance in 50 years. These maps are calculated for peak ground acceleration and a range of response spectral periods. Under the 2018 National Seismic Hazard Assessment, Wilcannia is mapped as having a spectral acceleration of 0.00 to 0.02 in a 50-year period. A spectral assessment of zero to two per cent is the lowest low rate of potential seismicity risk within Australia. Therefore, the potential for ground motion in a seismic event would be rare at the new and existing weir sites.

Acid sulfate soils

The Australian Soil Resource Information System (CSIRO, 2020) classifies the proposal and surrounding area as C4 Extremely Low Probability of Occurrence of containing acid sulfate soils. Additionally, the absence of potential acid sulfate soil or actual acid sulfate soil risk mapping within the Central Darling Local Environmental Plan 2012 suggests that there is no known or expected occurrence of acid sulfate soils at Wilcannia.

Furthermore, the elevated terrain of the proposal is inconsistent with typical acid sulfate soil environments. Therefore, development and construction activities are not likely to be affected by acid sulfate soils and are not considered further in this assessment.

Salinity

The saline water conditions at Wilcannia are discussed in **Section 10.5**. In summary, the water in the river systems of the Murray–Darling Basin naturally carries salt from the ground and surface water sources as they flows from southern Queensland and eastern highlands of NSW and Victoria to South Australia. The Murray-Darling Basin has a naturally salty landscape, particularly in the southern and western parts resulting from millions of years of rainfall. Salt has become part of the landscape from wind and dust, the natural breakdown of rocks and ancient ocean sediments (MDBA, 2020).

Contamination

Historical land use

Historically, the Darling River (Baaka) in Wilcannia was a busy, functioning port between the 1880s and 1920s as discussed in **Section 15.5.1**. Due to this historical use of the river at Wilcannia as a port, there is potential for the sediments of the Darling River (Baaka) to contain heavy metals and hydrocarbons from operation of boats and machinery.

The existing Wilcannia Weir was constructed in 1942 and a major refurbishment to the weir was carried out in 1987. There is the potential for hazardous materials to exist that are associated with the existing weir, such as polycyclic aromatic hydrocarbons associated with creosote dipped wooded piles; copper, chromium and arsenic treated timber and the possible (but unlikely) use of asbestos containing materials for concrete cap formwork.

Land use surrounding the proposal is primarily for agriculture and grazing. Agriculture presents a risk of contaminants of concern which have the potential to affect sediments and soils within the proposal, such as heavy metals, pesticides and herbicides.

Given the proximity of the proposal to the town of Wilcannia, the most likely potential contaminants of concern at the new and existing weir sites and the reach of the Darling River (Baaka) through the town are considered to be fly-tipped illegal waste and demolition waste. This type of waste stream can typically include bricks, timber, used chemical drums, scrap metal and possibly asbestos containing material.

Historical aerial photography of the new and existing weir sites since 1961 has been reviewed and is described in **Table 18-3**. There was no visible land uses at the new and existing weir sites in these images of activities associated with contamination.

Table 18-3 Historical aerial photography review, 1961 to 2016

Date	Site description	Surrounding area
New weir site		
1961	A vacant section of the Darling River (Baaka), with moderately vegetated riverbanks. Vegetation density decreased with increasing distance from the riverbanks.	Very sparse vegetation and the Wilcannia Cemetery.
1977	The site remains vacant of permanent human activity. Vegetation density along the riverbanks appears to have increased. A bush track has become defined along the right riverbank.	Vegetation density has increased. Land clearing/disturbance on the right riverbank to the north of the new weir site has increased including several access tracks. The Wilcannia Cemetery appears more defined.
1988	Largely unchanged.	The land to the north of the new weir site on the right riverbank remains largely unchanged. Land to the south of the new weir site on the right riverbank appears to be subdivided for agricultural land use. The southern access track to the new weir site appears, along with other tracks through this area.
1995	The proposal was largely unchanged. The bush track along the right riverbank appears to be well used due to its clear definition.	Union Bend Road appears.
2006	Largely unchanged. A bush track has become defined along the left riverbank.	Largely unchanged.

Date	Site description	Surrounding area
2016	Largely unchanged.	Largely unchanged other than Union Bend Road being widened and straightened.
Existing weir site		
1961	The right and left riverbanks appear to be undeveloped. The left riverbank appears to be moderately vegetated, while the right riverbank appears to be predominately bare land.	The town appears to consist of residential and commercial land use. There appears to be an orchard or other agricultural activity to the north-east of the proposal. The left riverbank and surrounding land to the south of the existing weir appears undeveloped and unused.
1977	Largely unchanged except for the increased vegetation density on the right riverbank.	The town had extended further north and west on the right riverbank. The orchard/agricultural land to the north-east is no longer apparent. A cricket pitch/sports field appears to have been established nearby, on the southern side of Bourke Street. Victory Park Caravan Park appears to have become established on the left riverbank with the current road layout visible. Land south of the caravan park has been cleared for use (land use is unclear) with small unsealed tracks leading to the cleared land. Small buildings in this area also appeared to have been established.
1988	Largely unchanged.	Land surrounding the proposal appears largely unchanged except for the return of vegetation/land cover to the previously cleared land to the south of Victory Park Caravan Park. Additionally, tennis courts have been developed on the southern side of Bourke Street, next to the sports field, to the north-west of the existing weir.
1995	Largely unchanged.	Largely unchanged.
2006	Largely unchanged.	Largely unchanged.
2016	Largely unchanged.	Largely unchanged.

Source: Office of Environment and Heritage (2018) and Walker (1991)

Contaminated sites

The NSW Environment Protection Authority maintains a contaminated land record of notices under section 58 of the *Contaminated Land Management Act 1997*. It also publishes a list of contaminated sites notified to it under section 60 of the *Contaminated Land Management Act 1997*. Both of these were checked for entries relating to land within 500 metres of the proposal and no sites were identified.

The search identified one surrendered licence still regulated by the Environment Protection Authority under the POEO Act. Details of the licence are summarised in **Table 18-4**.

Table 18-4 Surrendered EPA licence within 500 metres of the proposal

Licence number	Licence holder	Location name	Premise address	Fee-based activity	Status
13419	Forestry Corporation of NSW	IFOA Area "South Western Cypress Region"	State Forests and other Crown Timber Lands within the South-western Area, Dubbo, NSW 2830	Logging operations	No longer in force

Additionally, a search was carried out for nearby land uses with potential for contaminating activities, such as power stations, cattle dips sites, substations, service stations etc. within a one-kilometre radius of the proposal. Only one site was identified: a BP service station located about 900 metres from the existing weir. This service station is located hydraulically down gradient of the existing weir and poses a low risk to the proposal.

18.5 Assessment of impacts

18.5.1 Construction impacts

Stability

Most of the excavation works for the construction of the new weir wall would be advanced through stiff to hard alluvial clays and possibly into dense to very dense alluvial sands. Excavations are expected to be stable up to 1.5 metres below ground level, however stability would depend on the strength/cohesion of the strata forming the excavation sidewalls, soil moisture conditions at the time of construction, and the presence of groundwater. Structural stability will be further considered during detailed design and monitored during construction as required, particularly following rain events.

The partial removal of the existing weir may also have impacts to the riverbed and riverbank formation at that location. However, being within a weir pool rather than a flowing section of the river, these changes are likely to be contained and localised. The remediation of the existing weir site will be inspected and signed off by an appropriately qualified engineer.

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 associated with the removal of deep-rooted vegetation or other activities which could raise the groundwater table above normal seasonal levels.

Given that waters of the Murray-Darling catchment and the Darling River (Baaka) are generally considered saline, there is the potential for saline soils to be present at the new and existing weir sites, although none have been identified from the publicly available data or the geotechnical investigations completed to date. Should saline soils exist within the proposal site, they have the potential to impact on surface water and/or groundwater, soil erosion, and structures associated with the proposal if not correctly managed. This risks are addressed in **Sections 9.6.1** and **10.6.1**.

Soil erosion and sedimentation

Soil landscapes near the proposal have not been identified as highly erosive, however given the moderate to steep slopes of the riverbanks, the variation in river flows and flooding potential of the river, and the generally dry conditions, construction of the proposal could impact upon erosion of soils and increased sedimentation.

During construction, there would be potential for sediment and nutrient laden runoff from areas disturbed by construction to impact water quality in downstream waterways through increased turbidity if this risk is not suitably managed. Areas which would present a high risk of soil erosion include locations where both surface gradients and slope lengths combined would increase the erosive potential of runoff.

Activities that have the highest risk of causing erosion and sedimentation impacts include:

- Works within and around the Darling River (Baaka)
- General earthworks, including stripping of topsoil, excavation of material or filling of material
- Stockpiling of topsoil and vegetation
- Transportation of materials
- Movement of heavy vehicles across exposed earth
- Removal of terrestrial or riparian vegetation.

As described in **Section 3.6.5**, the new weir and fishway would be built sequentially, each surrounded by a cofferdam which would be dewatered prior to works commencing within the area. This approach would minimise the opportunity for the transportation of soils and sediments into the river. Stockpiling and storage of all materials would be located within the designated ancillary sites (refer to **Figure 3-2** and **Figure 3-3**) away from the riverbanks. It is noted that the main ancillary site adjacent to the left riverbank (about 200 metres south of the new weir) is located on the floodplain, however as discussed in **Section 11.5.2**, the river only overtops the banks infrequently so the risk of sediment transport is considered to be low.

Additionally, an erosion and sediment control plan will be prepared in accordance with the principles and practices detailed in *Managing Urban Stormwater: Soils and Construction* (the Bluebook) (Landcom, 2004) and all other relevant policies and guidelines. The erosion and sediment control plan will form part of the construction environmental management plan and would be supported by qualified personnel.

Contamination

If not managed appropriately, contamination (that is disturbed as part of construction activities) has the potential to impact upon the environment, human health, time and the cost of constructing the new infrastructure.

The historical aerial photography review indicated that the proposal and the surrounding land use has changed little between the 1960s and 2016. Surrounding land use has remained rural residential and agricultural up to the present day, while the existing weir has remained largely unchanged (despite degradation). Small areas of land clearing surrounding the new and existing weirs could potentially indicate unregulated waste disposal.

The BP service station at 4 Martin Street in Wilcannia near the right riverbank poses a low risk to the construction of the proposal given its distance from the new and existing weir sites. It is also hydraulically down gradient of the existing weir.

Contamination within soils and sediments based on the historical agricultural and industrial (port) land use surrounding the existing weir poses a low risk to the proposal given the diffuse nature of potential pesticide and herbicide use. Additionally, the scouring nature of any flood events means the soils and sediments of the proposal are dynamic and therefore contaminated soils may have migrated further downstream or have been diluted.

Based on the assessment of groundwater within and surrounding the proposal in **Section 9.6.1**, if contamination exists at the new and existing weir sites and was to be released during construction, the risk of contaminated groundwater affecting the emergency town water supply bores would be low because the bores screen the deeper alluvium aquifer and not the shallow alluvium aquifer and are not directly connected to the Darling River (Baaka),

Decommissioning of the existing weir would involve the removal of building materials that have the potential to contain contaminating materials such as creosote dipped wooded piles; copper, chromium and arsenic treated timber and the possible use of asbestos containing materials for concrete cap formwork.

Similarly, fly-tipped and illegally dumped waste poses a risk during construction, if uncovered, given the potential to include bricks, metals and asbestos. Recent drought periods when there is no water in the river have not revealed any evidence of such locations at either the new or existing weir sites.

There is the potential for the generation of odours to occur during excavation in deeper sediments within the Darling River (Baaka) at the new weir site from the exposure of sulphides. This possibility is unlikely but would be included in the construction environmental management plan under risks to human receptors.

Fill (earth and rock) materials would need to be brought onto site for construction of the new weir and access tracks. Fill materials would be tested for suitability prior to use during construction. 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. Waste disposal will occur in accordance with environmental management measure W2 (refer to **Table 21-4**).

Overall, potential contaminates within soils and groundwater from historical and existing land use, pose a low risk to human health and the environment from construction activities. The land is considered suitable for the proposed use. The implementation of mitigation and management measures would minimise the risk of contaminants being introduced into the environment including the Darling River (Baaka) during construction. Contamination risks would be managed under the construction environmental management plan and controls established to manage any unforeseen contamination encounters.

Dangerous goods

Minor quantities of dangerous goods and hazardous substances are expected to be used during construction of the proposal. The types of dangerous goods and hazardous substances that would be transported to the construction site and used during construction may include, but are not limited to:

- Diesel fuels
- Oils, greases and lubricants.

Dangerous goods and hazardous substances would be appropriately and temporarily stored in the construction laydown areas.

The quantity and type of dangerous goods and hazardous substances that would be stored and used during construction would be confirmed by the construction contractor and addressed in the construction environmental management plan.

18.5.2 Operation impacts

Stability

Provided the construction of the proposed weir is undertaken in accordance with the design, the new weir is not expected to impact the stability of the soils at the new weir site once operational.

Soil erosion and sedimentation

There is potential for soil erosion and sediment build up due to changes in the level of water stored in the weir pool during operation of the new weir. This risk would be minimised by maintaining vegetation where possible, stabilising the embankments and ongoing maintenance inspections undertaken by WaterNSW to manage water storage levels (refer to **Section 3.5.5**).

Contamination

As noted in **Section 18.5.1,** there is a low risk of encountering contaminated soils or contaminated groundwater during construction of the proposal, and this would also be the case during operation of the proposal. Following rehabilitation of the construction sites, and with the correct disposal of any contaminated waste generated or encountered during construction, contamination is not expected to impact on the operation of the proposal.

No dangerous goods and hazardous substances would be held or stored in the proposal area during operation.

18.6 Mitigation and management measures

Mitigation and management measures for geology, soils and contamination impacts are provided in **Table 18-5**.

Table 18-5 Mitigation and management measures for geology, soils and contamination impacts

Ref	Impacts	Mitigation and management measures	Timing
GS1	Salinity	The construction soil and water management plan will include specific measures to manage construction within potentially saline soils, should they be identified, in accordance with the *Salinity Training Handbook* (NSW Department of Primary Industries, 2014). Specific measures will include, but are not limited to: ▪ Identification and management of saline discharge sites ▪ Testing to confirm the presence of saline soils in areas of salinity potential prior to disturbance ▪ Controls to manage soil erosion and offsite water migration for saline discharge sites ▪ Progressive stabilisation and revegetation of exposed areas following disturbance as soon as is practicable ▪ Ongoing groundwater monitoring for groundwater levels and salinity.	▪ Pre-construction ▪ Construction
GS2	Soil and groundwater contamination	The construction environmental management plan will include a procedure for managing unexpected contamination finds. The procedure will include: ▪ Requirements for the excavation, handling, storage and management of contamination soil or water. This will include requirements for segregating and signposting contaminated soil and water ▪ Requirements for the disposal of contaminated waste in accordance with the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2014*.	▪ Pre-construction ▪ Construction
GS3	Partial removal and decommissioning of the existing weir	Prior to partially removing and decommissioning the existing weir, a hazardous materials audit will be carried out in accordance with Australian Standard (AS 2601-2001) *The demolition of structures*. Where hazardous materials are present, they will be managed to reduce the potential for contamination in accordance with the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2014.*	▪ Pre-construction ▪ Construction

Ref	Impacts	Mitigation and management measures	Timing
GS4	Spills and leaks	The soil and water management plan will include measures to ensure that: ▪ Vehicles and machinery are properly maintained to minimise the risk of fuel/oil leaks ▪ Routine inspections of all construction vehicles and equipment will be undertaken for evidence of fuel/oil leaks ▪ All fuels, chemicals and hazardous liquids will be stored within an impervious bunded area in accordance with Australian standards and NSW Environment Protection Authority guidelines ▪ Any on-site refuelling will occur in a designated area with impervious surfaces.	▪ Pre-construction ▪ Construction
GS5	Dangerous goods and hazardous materials	The storage, handling and use of dangerous goods and hazardous substances will be carried out in accordance with the *Work Health and Safety Act 2011* and the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005) and relevant Australian Standards.	▪ Construction

19. Traffic and transport

The potential non-Aboriginal heritage impacts of the proposal are assessed in **Technical Report 7** and summarised in this section.

SEAR no. 13 include requirements for the assessment of the proposal's potential impacts to traffic and transport. The requirements of SEAR no. 13 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

19.1 Legislative and policy context

Roads Act 1993

The *Roads Act 1993* aims to establish the rights and procedures for using, opening and closing public roads. It also provides the classifications of roads and the declaration of Transport for NSW and other public authorities as roads authorities for classified and unclassified roads. A local council is the roads authority for all public roads within its local government area excluding classified roads, Crown roads or any public roads declared to be under the control of some other roads authority.

Under section 138 of the *Roads Act 1993*, consent of the roads authority is required to:

- Erect a structure or carry out a work in, on or over a public road
- Dig up or disturb the surface of a public road.

Section 5(1) of Schedule 2 exempts public authorities, such as the Department of Planning and Environment, from being required to obtain approval under section 138 to exercise the public authority's functions in, on or over an unclassified road other than a Crown road.

The proposal would be located on Crown land and includes the sites of the new weir and the existing weir, and access routes such as Reid Street and Union Bend Road.

The proposal includes upgrades to the southern access track between the Barrier Highway and the left riverbank at the new weir site and in this case consent from the road authority (Central Darling Shire Council) is not required as this private road is unclassified.

In the case of classified roads, the proposal would require minor upgrades to the intersection of the southern access track and the Barrier Highway, which is a classified State road. Approval from Transport for NSW would be required for the works. Section 5.24 of the EP&A Act requires that a consent under section 138 of the *Roads Act 1993* cannot be refused if it is necessary for carrying out approved State significant infrastructure and must be on terms which are substantially consistent with the planning approval. Water Infrastructure NSW has consulted with both Transport for NSW and Central Darling Shire Council on the proposed works. Further detail on consultation undertaken to inform the proposal and this environmental impact statement is provided in **Section 5**.

Maritime Safety Act 1998

Maritime activity in NSW is governed by the *Marine Safety Act 1998*, which includes an objective to ensure the safe operation of vessels in the State's waterways. Section 19 of the Act allows for the making of regulations for or with respect to the safety of navigation including provisions for navigation aids.

Part 2 of the Marine Safety Regulation 2016 addresses navigation safety. Part 2 Division 5 of the regulation contains provisions relating to obstruction of navigation. Clause 23 requires that the owner of any obstruction to navigation must ensure that the obstruction is marked and lit so that it does not cause a danger to navigation. Clause 24 allows for Transport for NSW to direct the owner of an obstruction to navigation to mark or light the obstruction to navigation and to maintain the marking or lighting in good condition.

Like the existing Wilcannia Weir, the proposed new weir would be a permanent obstruction to navigation and, accordingly, the proposal would need to comply with the requirements of the Marine Safety Regulation 2016 regarding the installation of navigation aids.

Road Safety Plan 2021

The *Road Safety Plan 2021* (Transport for NSW, 2018) features targeted and proven initiatives that will help to progress to reduce fatalities by 30 per cent by 2021, and address key trends, behaviours and the types of crashes occurring on NSW roads.

The proposal seeks to support the objectives of *Road Safety Plan 2021* by ensuring that road safety is prioritised at all times during construction and operation of the proposal. In particular, the proposal supports the following priority areas of the Road Safety Plan:

- Saving lives on country roads – as the proposal is located in rural NSW, consideration and management of road safety would contribute to reducing trauma on country roads
- Using the roads safely/building a safer community culture – construction and operation vehicle drivers would be trained and managed to ensure that they are sharing roads safely with others
- Building a safe future – access tracks on the proposed haulage routes would be assessed and upgraded (where required) to improve safety and facilitate safe access for construction and operation vehicles.

Roads and Maritime Guides

The *Guide to Traffic Management Part 12: Integrated Transport Assessments for Developments* (Austroads, 2020) aims to ensure consistency in the assessment and treatment of traffic impacts, including addressing the needs of all road users and the effect upon the broader community.

The *Guide to Traffic Generating Developments* (Version 2.2) (Roads and Traffic Authority, 2002) outlines the purpose for, and the process to complete traffic impact studies. It also includes the traffic generation rates for various surveyed land uses and their impacts, as well as parking requirements, design and access.

19.2 Assessment methodology

The traffic and transport impact assessment involved the following:

- Establishing the study area to include the transport network surrounding the proposal site and any roads that would form access routes for construction and operational vehicles
- Analysing the existing road network, parking, access public transport, cycleways and footpaths provisions in the study area
- Assessing the expected changes and potential impacts of the proposal construction and operation on the existing provisions in the study area
- Assessing potential impacts of the proposal to road safety, maritime traffic access and potential impacts from oversized and/or overmass (OSOM) vehicles and the transport of dangerous goods or hazardous substances
- Assessing potential cumulative impacts on the transport network from other projects, based on publicly available information.

19.3 Risk

The traffic and transport risks associated with the proposal include:

- Construction traffic impacts, including heavy vehicles turning onto and off the Barrier Highway in a 110 kilometres per hour speed zone
- Long haulage distances required for all construction materials.

19.4 Avoidance and minimisation of impacts

The preliminary concept design for the proposal includes widening of the southern access track at the Barrier Highway to facilitate safe truck turning. The proposed widening of the access track where it joins the Barrier Highway would provide truck drivers with adequate views along the highway to safely turn onto the highway. The widening would also enable simultaneous truck entry and exit from the access track.

Due to the remote location of the proposal and the small size of Wilcannia township, the long travel distances between the proposal area and material suppliers are unavoidable. The limited scope to avoid and minimise traffic and transport impacts within the design of the proposal means the focus for avoiding and minimising traffic and transport impacts is on the construction and operation phases of the proposal.

19.5 Existing environment

Access to the new weir site would be via the Barrier Highway, Reid Street and Union Bend Road, as well as the new northern access track and upgraded southern access track. Access to the existing weir site would be via the Barrier Highway and the road within Victory Park Caravan Park, as shown in **Figure 19-1.**

Figure 19-1 Local construction access routes

Road network

Key roads in the study area include:

- The Barrier Highway is a State highway (HW8) that forms part of Route A32 linking Sydney to South Australia via the Far West Region of NSW. Between townships the Barrier Highway has a speed limit of 110 kilometres per hour. The speed limit reduces to 50 kilometres per hour for about 1.3 kilometres through Wilcannia township. The Barrier Highway permits 25/26 metre B-double vehicles for heavy vehicle access to the proposal site
- Reid Street is a local road that extends perpendicular to the Barrier Highway at Wilcannia, on the northern side of the river. The road operates with a sign-posted speed limit of 50 kilometres per hour east of Adams Street and 100 kilometres per hour west of Adams Street and has one lane in each direction
- Union Bend Road is an unsealed road that provides access between Reid Street and the Central Darling Shire Council's emergency town water supply bores at Union Bend. The road has no sign-posted speed limit
- The southern access track from the Barrier Highway is located about 3.15 kilometres south of Warrali Avenue and travels across the land occupied by Wilcannia Local Aboriginal Land Council to the left bank of the Darling River (Baaka), near the location of the proposed new weir site. This road is an unsealed private road and about four metres wide
- The Victory Park Caravan Park access road is a sealed private road that connects the Barrier Highway to Victory Park Caravan Park. The intersection of the Barrier Highway and the Victory Park Caravan Park access road is give-way controlled with long sight distances along the Barrier Highway. The posted speed limit is 50 kilometres per hour.

The average number of vehicles travelling on the roads in the vicinity of the proposal are generally low due to the remoteness of the area. Average annual weekday traffic volumes for the Barrier Highway in 2020 were recorded at a traffic counter east of Broken Hill which showed:

- 325 vehicles eastbound
- 335 vehicles westbound.

Road safety

Thirty-nine crashes were recorded between 2014 and 2019 on Barrier Highway between Iodide Street/Argent Street, Broken Hill and the southern access track in Wilcannia. No crashes were recorded on Reid Street between Barrier Highway and Union Bend Road (Transport for NSW, 2020).

One fatal crash was recorded on the Barrier Highway between Broken Hill and Wilcannia and most of the recorded crashes occurred in dark lighting conditions and the most common crash type involved vehicles travelling off path on a straight section of road.

Public transport

There are no existing public transport train services in the study area. Coach services are operated by NSW TrainLink between Broken Hill to Dubbo via Wilcannia. The Broken Hill Bus Service also operates between Wilcannia and Broken Hill, with buses departing Wilcannia at Reid Street.

Active transport

Off-road shared path facilities are limited in the study area, with only one small section located between Reid Street and Warrali Avenue, utilising the local heritage listed Wilcannia Bridge, which then continues south-west to St Therese's Community Parish School. Footpaths are generally provided in Wilcannia township however there are no formal pedestrian facilities near the existing weir and new weir locations.

19.5.1 Maritime activities

The proposal is located on the Darling River (Baaka) and this section of the river does not carry any maritime traffic and does not provide access for marine vessels. However the river in the vicinity of the new weir and existing weir locations do provide for recreational activities including swimming and fishing.

19.6 Assessment of impacts

19.6.1 Construction impacts

The main contributors to construction traffic are expected to be the delivery of construction materials, equipment and plant components, and the construction workforce travelling to and from the proposal site. The construction workforce is expected to either relocate to Wilcannia for the direction of their involvement in the proposal or be residents from the township (refer to **Section 16** for more discussion on employment). During construction, workforce movements are expected to generate up to 20 two-way light vehicle movements per day.

It is expected that most construction equipment and materials would need to come from Broken Hill or Cobar via the Barrier Highway, depending on the construction contractor. Based on the preliminary concept design, peak heavy vehicle generation is expected to be up to 10 two-way movements per day.

A low number of local heavy vehicle movements would be generated from water tankers required to transport water to the concrete batching plant.

Proposal site access

As described in **Section 3.4**, there would be three construction access tracks established for the proposal, utilising existing roads and tracks where possible.

The primary construction access to the new weir site and construction compound would be from the existing southern access track from the Barrier Highway across land occupied by Wilcannia Local Aboriginal Land Council on the left riverbank. The southern access track would be upgraded and widened to improve access for construction vehicles.

Access to the right riverbank would be via Reid Street, Union Bend Road, and a new permanent access track which would provide construction access from the north. This new access track would be used by WaterNSW to access the right riverbank at the new weir site to operate and maintain the new weir.

Access to the existing weir would be through the Victory Park Caravan Park from the Barrier Highway via the existing sealed private road. A temporary access track would be constructed from the caravan park internal road to the edge of the existing weir wall, to allow heavy vehicle access for the decommissioning activities. Water Infrastructure NSW would lease the entire caravan park for the duration of decommissioning works, in order to manage traffic and safety risks. The temporary access track would be reinstated and rehabilitated after the proposed works are completed. Refer to **Section 17.6.1.5** and **Technical Report 6** for further details on the proposed rehabilitation plan.

19.6.2 Impact on road network

Road network performance

Additional construction light vehicle movements generated by the proposal are not expected to have a significant impact due to the existing low traffic volumes on the roads surrounding the proposal. The increase of construction traffic during peak volumes (prior to shift commencement and after shift end) would not disrupt existing operation of Barrier Highway, Reid Street and Union Bend Road. Access along Union Bend Road would be maintained for public access during construction.

OSOM vehicles may be required to transport large equipment and plant to and from the proposal site. The OSOM vehicle movements would occur at the start and end of the construction period and total movements are expected to be very low. Traffic management plans and appropriate permits would be sought and developed by the construction contractor to manage suitable routes and mitigate potential impacts. Impacts of OSOM vehicles on local traffic and road network would be minimal.

Road safety

Traffic generated during construction would not have a significant impact on the existing road use and traffic movements, however potential safety risks are associated with construction personnel commuting to and from the proposal site and heavy vehicle movements. Given the low crash rates and the relatively low number of vehicle movements expected during construction, no increase in road safety impacts is expected.

The proposed upgrade and widening of the southern access track would make it safer for use by construction vehicles.

Parking and access

During construction of the new weir, the existing 300 metre track along the right riverbank on the northern side would be restricted from public access to facilitate construction vehicle movements. Access to the construction site on the left riverbank would also be restricted from public access. However Union Bend Road and the access to the river or riverbanks upstream and downstream of the new weir site would be maintained for public access. Appropriate signage would be placed at access points from Union Bend Road to advise traffic of these restrictions.

Public transport

Construction activities would have a minor impact on the operation of public transport. Impacts to buses would be limited to a very minor increase in travel time due to additional construction vehicles on the road network

Active transport

Construction impacts to active transport would be limited to minor amenity impacts at Wilcannia town centre due to the addition of construction vehicles on the road network.

Transport of dangerous goods and hazardous substances

No significant quantities of hazardous or dangerous goods is expected to be transported during construction of the proposal. Assessment of hazards, risks and safety is further detailed in **Section 21.3**.

Maritime activities

During construction, a 50-metre signposted exclusion zone will be put in place both upstream and downstream of the new weir to restrict maritime activities and improve safety around the construction site. No impacts to maritime traffic are expected and impacts to recreational activities would be minimal.

19.6.3 Operation impacts

Operation of the new weir would be managed by WaterNSW and a small number of vehicles would be expected to travel to and from the new weir site for ongoing operation or maintenance works. Vehicles would access the new weir via Union Bend Road and the new access track. Parking for operation and maintenance vehicles is provided alongside the weir gate and fishway gate control rooms. The fishway access track would enable vehicles and plant to position themselves alongside the fishway to undertake fishway maintenance tasks. The new access track would operate as a shared zone between vehicles and pedestrians from Union Bend Road to the proposed community river place and car park.

Signage would be installed to direct visitors to the new weir site to park their vehicles at the community river place. Signage would be installed to direct visitors from the car park to the walking track along the top of the right riverbank that continues downstream to the new weir site.

As the operation of the proposal is expected to generate less traffic than during construction, the operational and cumulative impacts on the surrounding road network, public transport and active transport network and road safety would be minimal. No impacts to road access and maritime activities access are expected.

19.7 Mitigation and management measures

Mitigation and management measures for traffic and transport impacts are provided in **Table 19-1**.

Table 19-1 Mitigation and management measures to manage traffic and transport impacts

Ref	Impacts	Mitigation measures	Timing
T1	Construction traffic	A construction traffic management plan will be prepared and implemented as part of the construction environmental management plan. 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 ▪ Measures to minimise conflicts with pedestrians and cyclists ▪ Traffic control measures including signage at appropriate locations to notify road users of increased traffic volumes turning into and out of the southern access track from the Barrier Highway ▪ Management of oversized vehicles, including movements being undertaken outside of peak periods under police escort and in accordance with any OSOM permit conditions ▪ Requirements and methods to consult and inform the local community of impacts on the local road network due to construction and operation of the proposal ▪ Consultation with Transport for NSW, Central Darling Shire Council and Wilcannia Local Aboriginal Land Council to minimise traffic conflicts on roads surrounding the proposal ▪ Consultation with emergency services to ensure that procedures are in place to maintain safe, priority access for emergency vehicles ▪ A response plan for any construction-related traffic incident.	Pre-construction
T2	Construction traffic at the new weir site	Appropriate signage will be placed at the access points from Union Bend Road to the existing track along the northern bank of the Darling River (Baaka) to advise traffic of access restrictions during construction of the new weir.	Construction
T3	Maritime traffic during construction of the new weir	During construction of the new weir, a 50-metre signposted exclusion zone will be put in place both upstream and downstream of the new weir to restrict any maritime activities and improve safety around the construction site.	Construction

Ref	Impacts	Mitigation measures	Timing
T4	Construction traffic at Victory Park Caravan Park	Consultation with Central Darling Shire Council will be undertaken to minimise the impacts of the temporary closure of Victory Park Caravan Park during partial removal and decommissioning of the existing weir. Traffic management measures agreed in consultation with Central Darling Shire Council will be incorporated into the construction traffic management plan.	Pre-construction
T5	Operational traffic at the new weir	During operation of the proposal, appropriate signage will be placed along the existing track along the northern bank of the Darling River (Baaka) where it passes the new weir site to inform traffic of shared zone conditions.	Operation
T6	Maritime safety at the new weir	Water Infrastructure NSW will identify an appropriate exclusion zone for the proposed new weir as part of a safety in design process carried out during the detailed design phase of the proposal. Water Infrastructure NSW will involve relevant stakeholders in this process, including WaterNSW. Awareness of the exclusion zone and its location will be raised through signage. Fishing, swimming, canoeing, boating and other water-based recreational activities will be prohibited within the exclusion zone.	Pre-construction Operation

20. Noise and vibration

The potential noise and vibration impacts of the proposal are assessed in **Technical Report 8** and summarised in this section.

SEAR no. 14 include requirements for the assessment of the proposal's potential impacts to noise and vibration. The requirements of SEAR no. 14 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

20.1 Legislative and policy context

20.1.1 Protection of the Environment Operations Act 1997

The POEO Act requires that an environment protection licence be held to undertake a scheduled activity or scheduled development work. The proposal is not of a kind listed in Schedule 1 of the POEO Act and would not require an environment protection licence under this 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.

20.1.2 Regulatory policies and guidelines

20.1.2.1 Interim Construction Noise Guideline

The *Interim Construction Noise* Guideline (Department of Environment and Climate Change, 2009) (ICNG) was developed by a number of NSW state agencies along with extensive public consultation. The guideline was developed to apply a range of work practices suited to minimise the impacts of construction noise. The guideline covers the construction, maintenance or renewal activities carried out by a public authority (section 6 of the POEO Act), including public roads, rail and other urban infrastructure. The methodology provided by the guideline which has been applied to this assessment includes:

- Identifying sensitive land uses
- Identifying the hours of works for proposed construction works
- Identifying noise impacts at sensitive land uses
- Selecting and applying the best work practices to minimise noise impacts.

The guideline also sets out the method to determine noise level criteria for each sensitive land use types, including residential, commercial, educational, medical and others.

The *Draft Construction Noise Guideline* (Environment Protection Authority, 2020) is in the process of being published and is currently on display for public review and feedback. A review of this document has been undertaken and it is concluded that there are no changes to the methodology in the ICNG which would affect this assessment.

20.1.3 Noise Policy for Industry

The *Noise Policy for Industry* (Environment Protection Authority, 2017) provides guidance in minimising intrusive sound from operational industrial noise sources. The policy is non statutory and sets assessment noise levels and thresholds through consistent methods and best practice measures. The policy also sets out minimum rating background levels (RBLs), especially for rural areas where measured noise levels can be inconsistent (i.e. night-time background noise levels higher than daytime measured levels). These minimum RBLs are based on best practice measures, community consultation and research and have been adopted for this assessment, as detailed in **Section 20.2.1**.

20.1.4 Construction Noise and Vibration Guideline

The *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) outlines guidance for assessing and mitigating construction noise and vibration. The guideline can be applied to construction projects State-wide and used in conjunction with the ICNG to manage and mitigate noise and vibration impacts from construction projects. The mitigation measures detailed in the guideline has been applied in this assessment.

20.1.5 Assessing Vibration: A Technical Guideline

Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) is based on guidelines contained in *BS 6472–1992, Evaluation of human exposure to vibration in buildings (1–80 Hz)*. This guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. This vibration criteria set out in this guideline has been adopted for this assessment, as further detailed in **Section 20.2.6**.

20.1.6 Australian Standard AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives

Australian Standard AS2187.2 **–** 2006 *Explosives – Storage and use Part 2: Use of explosives* provides frequency-dependent guide levels for cosmetic damage to structures arising from vibration. These levels are adopted from British Standard BS7385: 1990 *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration* and are detailed further in **Section 20.2.7**.

20.2 Assessment methodology

The proposal is to be undertaken across two construction sites as presented in **Table 20-1** and **Figure 20-1**. The existing weir site is located within the Wilcannia township, with the nearest sensitive receivers located 100 metres to the east of the site, on Ross Street, Wilcannia. The new weir construction site is about five river kilometres downstream of the existing weir, and about two kilometres south of the Wilcannia township. **Figure 20-1** shows the location of the proposal relative to the closest sensitive receivers.

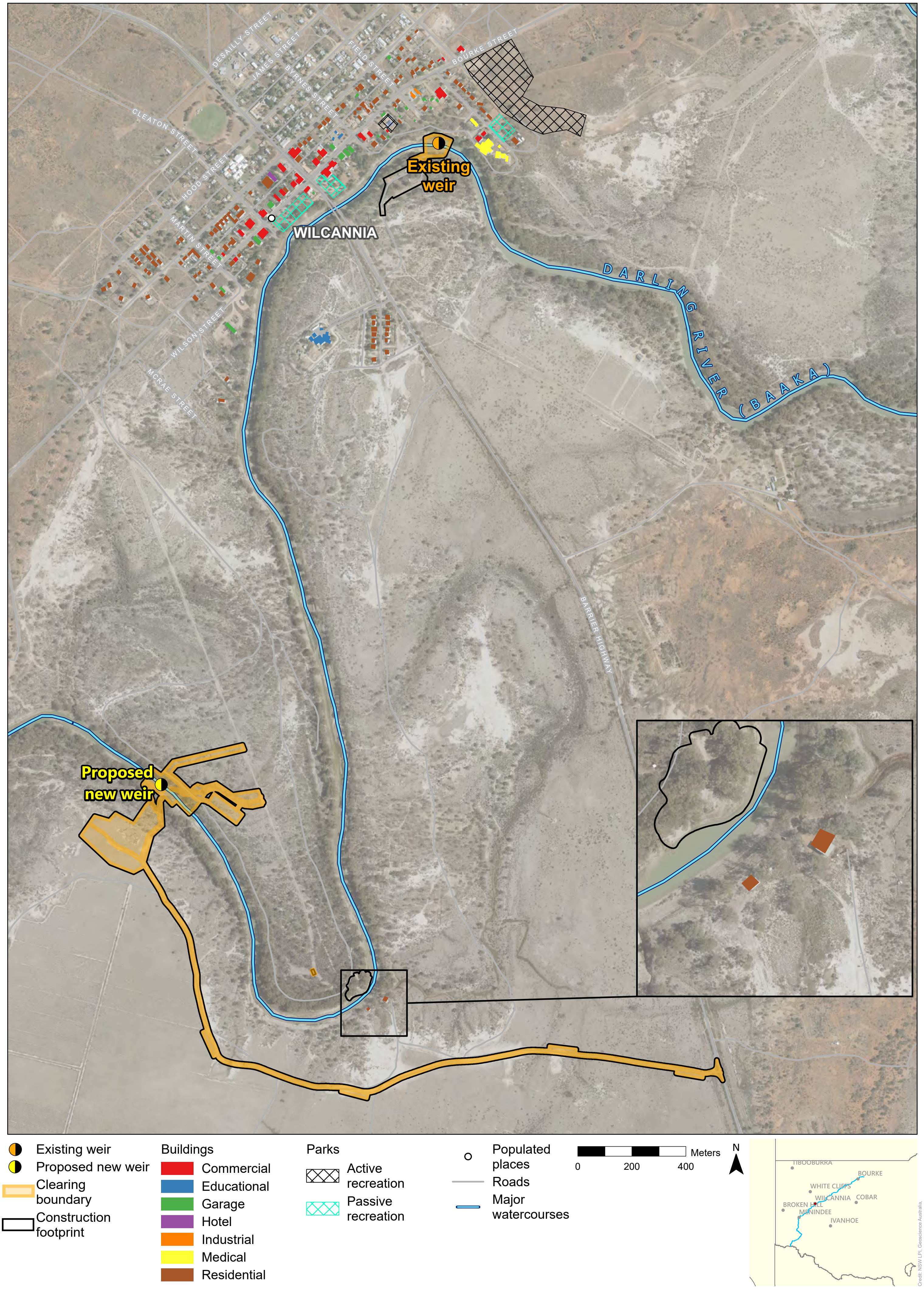


Figure 20-1 Proposal location and sensitive receivers

Table 20-1 Proposal setting

Site	Description	Location	Distance to nearest sensitive receivers in Wilcannia
Site 1	New weir construction area	Located on a reach of the Darling River (Baaka) downstream of Union Bend, about five river kilometres downstream of the existing weir, and about two kilometres south of the Wilcannia township.	1.5 kilometres
Site 2	Existing weir partial removal and decommissioning area	Darling River (Baaka), about 400 metres north-east of the Wilcannia Bridge crossing into Wilcannia. The site is about 120 metres southwest of Ross Street.	100 metres

The construction noise and vibration assessment involved the following tasks:

- Identifying and classifying sensitive receivers
- Characterising the existing noise environment based on RBLs
- Determining noise and vibration management levels/criteria in accordance with relevant guidelines
- Identifying potential noise sources during construction, including a list of likely construction activities and equipment/plant
- Defining construction scenarios and developing representative 'realistic worst-case' scenarios with indicative durations of impact, based on the assumption that several items of construction equipment would be used at the same time within individual construction scenarios
- Undertaking noise modelling using SoundPLAN software for the identified construction scenarios and likely equipment that would be operating
- Assessing the potential for traffic noise from construction traffic
- Assessing the potential for vibration from construction plant and equipment
- Identifying any structures within the minimum vibration distances
- Assessing the significance of predicted noise and vibration levels by comparing the modelling results to the management levels/criteria
- Identifying measures to mitigate predicted exceedances of management levels/criteria.

20.2.1 Background noise levels

The estimation of background noise levels is necessary to determine the noise sensitivity of an area. In the absence of monitored background noise levels, minimum background noise level guidance (presented below in **Table 20-2**) can be based on those provided in the *Noise Policy for Industry* (Environment Protection Authority, 2017).

Table 20-2 Adopted background noise levels (RBLs)

Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
35 dB(A)	30 dB(A)	30 dB(A)

Source: Environment Protection Authority (2017)

20.2.2 Noise management levels

The ICNG provides guidance for assessing noise from construction activities in NSW. It establishes noise management levels (NMLs) according to the hours in which construction may take place. Construction is considered to have the potential to cause a noise impact if the predicted noise exceeds the noise management levels. **Table 20-3** lists ICNG guidance for establishing construction NMLs at residential receivers.

Table 20-3 ICNG guidance for establishing construction NMLs at residential receivers

Time of day	Management level $L_{Aeq(15\ min)}$	Time of day
Recommended standard hours: ▪ Monday to Friday 7am to 6pm ▪ Saturday 8am to 1pm ▪ No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours – All other times including public holidays	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Source: Department of Environment and Climate Change (2009)

Considering the adopted RBLs presented in **Table 20-2** and the guidance from the ICNG in **Table 20-3**, the following NMLs listed in **Table 20-4** were established to assess potential construction noise impacts at the identified surrounding residential receiver locations.

Table 20-4 ICNG NMLs for residential receivers based on adopted RBLs

Day (during standard hours)		Day (outside standard hours)		Evening		Night	
L_{A90} (RBL) dB(A)	NML $L_{Aeq\ 15\ min}$ dB(A)	L_{A90} (RBL) dB(A)	NML $L_{Aeq\ 15\ min}$ dB(A)	L_{A90} (RBL) dB(A)	NML $L_{Aeq\ 15\ min}$ dB(A)	L_{A90} (RBL) dB(A)	NML $L_{Aeq\ 15\ min}$ dB(A)
35	45	35	40	30	35	30	35

Source: Department of Environment and Climate Change (2009)

Windows often allow the greatest amount of sound transmission from outside to inside across a building façade. Noting guidance presented in Australian Standard AS2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*, where bedrooms are ventilated by an opened window a transmission loss of 10 dB(A) would apply. Considering this, an external NML of 45 dB(A) was conservatively applied at surrounding educational and medical receivers.

For temporary accommodation type receivers (e.g. hotels) the ICNG refers to guidance presented in Australian / New Zealand Standard AS/NZS 2107:2016 *Acoustics: Recommended design sound levels and reverberation times for building interiors* (AS/NZS 2107:2016). For sleeping areas within temporary accommodation facilities AS/NZS 2107:2016 provides a maximum design target value of 35 dB(A).

20.2.3 Construction traffic noise impacts

Section 9 of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) provides guidance for the assessment of noise associated with additional traffic generated during construction. This guidance was adopted for this assessment as follows:

'For Roads and Maritime Services projects an initial screening test should first be applied by evaluating whether noise levels will increase by more than 2dB(A) due to construction traffic or a temporary reroute due to a road closure. Where increases are 2dB(A) or less no further assessment is required.

Where noise levels increase by more than 2dB(A), i.e. 2.1 dB(A), further assessment is required using Roads and Maritimes Criteria Guideline. This documents RMS' approach to implementing the Road Noise Policy. Consideration should be given under the Noise Criteria Guideline as to whether construction traffic or temporary reroute triggers new road criteria due to changes in road category'.

This guidance was considered for the purpose of reviewing potential noise associated with additional traffic generated as a result of the proposal.

20.2.4 Sleep disturbance

For premises where night operations occur, the potential for noise levels to lead to sleep disturbance should be considered. Where noise levels from a construction (or industrial) source at a residential receptor at night exceeds the following, a maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the RBL + 5 dB(A), whichever is greater, and/or;
- L_{AFmax} 52 dB(A) or the RBL +15 dB(A), whichever is greater.

Based on this guidance, a sleep disturbance screening criterion of $L_{Aeq,15min}$ 40 dB(A) was applied.

20.2.5 Vibration

Vibration arising from construction activities can result in impacts on human comfort or the damage of physical structures such as dwellings. These two outcomes have different criteria levels, with the effects of vibration on human comfort having a lower threshold.

20.2.6 Human comfort

With respect to human comfort, vibration arising from construction activities must comply with criteria presented in *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006) and British Standard 6472-1: 2008 *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting.* The technical guideline identifies three different forms of vibration associated with construction activities:

- Continuous: uninterrupted vibration occurring over a defined period

- Impulsive: short-term (typically less than two seconds) bursts of vibration which occurs up to three times over an assessment period
- Intermittent: interrupted periods of continuous or repeated impulsive vibration, or continuous vibration that varies significantly in magnitude.

Continuous vibration may result from steady road traffic or steady use of construction equipment (e.g. a generator). Impulsive vibration may arise during the loading or unloading of heavy equipment or materials or infrequent use of hammering equipment. Intermittent vibration may arise from the varied use of construction equipment (i.e. a dump truck moving around a site, idling while being loaded with materials, and then dumping the materials) or repeated high-noise activities such as hammering, piling or cutting.

Preferred and maximum values of human exposure for continuous and impulsive vibrations are provided in **Table 20-5**.

Table 20-5 Preferred and maximum weighted root mean square values for continuous and impulsive vibration acceleration (m/s^2) 1-80 Hertz (Hz)

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x and y axis	z-axis	x and y axis
Continuous vibration					
Critical areas[2]	Day or night	0.0050	0.0036	0.010	0.0072
Residences	Day	0.010	0.0071	0.020	0.014
	Night	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night	0.020	0.014	0.040	0.028
Impulsive vibration					
Critical areas[2]	Day or night	0.0050	0.0036	0.010	0.0072
Residences	Day	0.30	0.21	0.60	0.42
	Night	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night	0.64	0.46	1.28	0.92
Workshops	Day or night	0.64	0.46	1.28	0.92

Notes:
[1] Daytime is 7am to 10pm. Night-time is 10pm to 7am.
[2] Includes hospital operating theatres or precision laboratories.
Source: DEC (2006)

Intermittent vibration is assessed differently using vibration dose values, Preferred and maximum vibration dose values for different types of receivers are listed in **Table 20-6**.

Table 20-6 Preferred and maximum vibration dose values for intermittent vibration

Location	Vibration dose values ($m/s^{1.75}$)			
	Day time (7 am to 10 pm)		Night-time (10 pm to 7 am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas[1]	0.10	0.20	0.10	0.2
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:
[1] Includes operating theatres, precision laboratories and other areas where vibration-sensitive activities may occur.
Source: DEC (2006)

20.2.7 Buildings and structures

Section J4.4.3 of Australian Standard AS2187.2 – 2006 *Explosives – Storage and use Part 2: Use of explosives* provides frequency-dependent guide levels for cosmetic damage to structures arising from vibration. These levels are adopted from British Standard BS7385-2:1993 *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration* and are presented in **Table 20-7**.

Table 20-7 Transient vibration guideline values for cosmetic damage

Type of building	Peak particle velocity (mm/s)		
	4 to 15 Hz	15 to 40 Hz	40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50		
Un-reinforced or light-framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

Source: AS2187.2 – 2006

Guidance for more sensitive structures is presented in the German standard DIN 4150-3: 2016 *Vibrations in buildings – Part 3: Effects on structures*. Vibration velocities not exceeding three millimetres per second at one to 10 Hz are recommended in this standard.

20.2.8 Construction noise and vibration guideline

Section 7 of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) provides guidance for safe working distances to achieve human comfort (*Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006)) and cosmetic damage (BS7385-2:1993 *Cosmetic building damage*) criteria for a range of different plant and equipment. These have been reproduced for the relevant vibration-generating plant intended to be used during the proposal in **Table 20-9**.

Table 20-8 Recommended safe setback distances

Plant	Rating / description	Safe working distance (meters)	
		Cosmetic damage (BS7385-2: 1993)	**Human response (Department of Environment and Conservation, 2006)**
Vibratory pile driver	Sheet piles	2 to 20 metres	20 metres
Large hydraulic hammer	(1600kg – 18-tonne to 34-tonne excavator)	22 metres	73 metres
Jackhammer	Hand held	1 metre (nominal)	2 metres

Source: Roads and Maritime Services (2016)

20.2.9 Noise assessment inputs

20.2.9.1 Construction staging and plant

Overall sound power levels were predicted for each phase of construction. Each construction stage is assumed to operate at independent times from other stages, and operations within construction compounds are assumed to be active throughout all construction stages after preconstruction works. Construction stages were determined based on sequencing and plant and equipment provided by Water Infrastructure NSW. The overall sound power levels were estimated with reference to individual plant and equipment levels presented in national and international standards and guidelines, as well as from a Jacobs measurement database.

20.2.9.2 Construction timing

Construction work at the new and existing weir sites would mostly occur during standard hours where possible. However, at the new weir site it is expected that the construction contractor may shift construction hours during the summer months (November to February) to work between 5:00am and 4:00pm to reduce work during the hotter parts of the day. Decommissioning work at the existing weir site would only be undertaken during standard hours to minimise the impact on nearby sensitive receivers. **Table 20-9** summarises estimated overall noise emissions for each construction stage.

The period between 5:00am and 7:00am is considered as night-time works for this assessment as a conservative approach. Therefore, an NML criteria of 35 dB(A) has been considered for this assessment, for when construction works will be undertaken at the new weir site.

Table 20-9 Estimated noise emissions during construction

Construction stage	Task(s)	Plant/equipment	No. of plant/ equipment	Sound power level dB(A)
New weir site				
1. Site preparation	Establish proposed construction compound and material laydown areas	▪ Excavators ▪ Excavator with tree shear attachment ▪ Tub grinder* ▪ A-double truck ▪ Bulldozer ▪ Grader ▪ Mechanical roller ▪ Watercart	2 1 1 1 1 1 1 1	118
2. Early works	Upgrade access roads – entire access length from Barrier Highway to proposed work area	▪ Transporter to deliver heavy plant (low loader) ▪ Excavators ▪ Grader ▪ Mechanical roller ▪ Watercart ▪ A-double truck ▪ Utes and other site vehicles	1 2 1 1 1 1 3	120
	Install cofferdam for fishway on the right side of the new weir	▪ Excavator with sheet pile driver (piling rig)* ▪ 50 to 70 tonne crane ▪ Excavators ▪ Water pumps ▪ Generators	1 1 2 2 2	123
3a Fishway construction – sheet piling	Sheet piling for the fishway side wall	▪ 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack* ▪ Excavator with a vibratory attachment ▪ Flat-bed truck (sheet piling delivery) ▪ Franna crane (unloading sheet piling)	1 1 1 1	127
3b. Fishway construction – excluding sheet piling	Construction of fishway on the right side of the new weir	▪ Excavators ▪ Flat-bed trucks for crane delivery and removal ▪ 250 to 300-tonne crane ▪ Franna crane ▪ A-double trucks ▪ Utes and other site vehicles ▪ Generator	2 2 1 1 2 2 1	116

Construction stage	Task(s)	Plant/equipment	No. of plant/ equipment	Sound power level dB(A)
		▪ 6-inch pump for dewatering	1	
4. Remove fishway cofferdams, reinstate the right embankment	Remove cofferdams	▪ Dump trucks ▪ Excavators	2 2	116
	Reinstate the right embankment	▪ Rigid trucks ▪ Rock crushing screening plant* ▪ Tip trucks ▪ Front end loader ▪ Excavator	2 1 2 1 1	122
5a. Install cofferdam downstream of the new weir	Install cofferdam	▪ Excavator ▪ Dump trucks ▪ Water pumps ▪ Generators	1 2 2 2	120
5b. Install cofferdam upstream of new weir	Install cofferdam	▪ Excavator ▪ Dump trucks ▪ Water pumps ▪ Generators	1 2 2 2	120
6. Piling works for the new weir	Sheet piling for the weir wall	▪ 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack* ▪ Excavator with a vibratory attachment ▪ Flat-bed truck (sheet piling delivery) ▪ Franna crane (unloading sheet piling)	1 1 1 1	127
7. Concreting works for the new weir	Concreting	▪ Mobile concrete plant ▪ A-double truck ▪ Cement delivery truck ▪ Front end loader ▪ Flat-bed delivery truck ▪ Franna crane ▪ Forklift ▪ Concrete agitator trucks ▪ Mobile concrete pump ▪ Utes and other site vehicles such as tipper trucks ▪ Generator ▪ 6-inch pump for dewatering ▪ Hammer drills (hand tool) ▪ Jackhammers* (hand tool) ▪ Scabbing guns (hand tool)	1 1 1 1 1 1 1 2 1 3 1 1 3 3 3	120

Construction stage	Task(s)	Plant/equipment	No. of plant/ equipment	Sound power level dB(A)
8. Weir gates and fishway gates installation	Install the weir gates and the fishway gates	▪ Flat-bed truck ▪ Franna crane ▪ 120 to 150-tonne crane ▪ Elevated work platforms ▪ Utes and other site vehicles ▪ 3-inch pump for dewatering	1 1 1 2 2 6	118
9. Install overhead powerlines, remove cofferdams, reinstate left embankment – new weir site	Install overhead powerlines from Union Bend Road	▪ Flat-bed truck ▪ Transporter to deliver prefabricated components ▪ Excavator with auger attachment/piling rig* ▪ Pole holding truck ▪ Elevated work platform ▪ Franna crane ▪ 120 to 150-tonne crane ▪ Concrete agitator truck	1 1 1 1 1 1 1 1	116
	Remove cofferdams	▪ Dump truck ▪ Excavator	2 1	121
	Reinstate left embankment	▪ Rigid truck ▪ Rock crushing and screening plant* ▪ Front end loader ▪ Excavator	2 1 1 1	121
10. Site rehabilitation	Finishing works and site rehabilitation	▪ Excavator with rock grab ▪ A-double truck	1 1	119
Existing weir site				
11. Site preparation	Establish temporary access track, and install crane pad and pump hardstand area	▪ Transporter to deliver heavy machinery ▪ Excavator ▪ Articulated dump truck	1 1 1	120
	Install cofferdam	▪ 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack ▪ Small aluminium, boat with outboard motor	1 1	128
	Dewatering	▪ Skid-mounted pump (daytime use) ▪ Electric pump (night-time use) ▪ Generator	1 1 1	102

Construction stage	Task(s)	Plant/equipment	No. of plant/ equipment	Sound power level dB(A)
12. Partial removal and decommissioning	Partial removal and decommissioning of the existing weir	▪ Excavator with rock breaking or vibrator attachments* ▪ Dump truck ▪ A-double trucks ▪ Skid-mounted pump (daytime use) ▪ Electric pump (night-time use) ▪ Generator ▪ Concrete saw (hand tool)*	2 1 2 1 1 1 1	130
13. Site rehabilitation	Remove cofferdam	▪ 160 to 200-tonne crawler crane with vibrating hammer and hydraulic power pack* ▪ Small aluminium boat with outboard motor	1 1	128
	Finishing works and site rehabilitation	▪ Excavator with rock grab ▪ A-double truck	1 1	121
Operations in construction compounds	Operations in construction compounds (assumed to operate between stage 2 and stage 8 and during stage 10)	▪ Flatbed trucks ▪ Franna crane ▪ Generator	2 1 1	109

*5 dB(A) annoyance penalty included

20.2.10 Noise model

To evaluate potential noise impacts during construction, a site noise model was developed using the SoundPlan acoustic software package. Predictions were compared against the noise management levels. Setup details for the site noise model are provided in **Table 20-10**.

Table 20-10 Noise model setup details

Model input	Details
Topography	One metre resolution contour lines derived from SRTM LiDAR data.
Buildings	Footprints for receiver and other ancillary buildings were determined from aerial photography. Heights were estimated from Google Street view, or otherwise, assuming a building floor height of three metres per level.
Non-building receivers	Set at a height of 1.5 metres around the worst affected areas of these locations.
Ground absorption	Water and barren areas – 0.0 Residential areas – 0.5 Open grassland and vegetation areas – 0.75
Noise sound power levels	As listed in **Table 20-9**
Meteorology	Standard (construction)

Model input	Details
Prediction method	CONCAWE algorithm

20.2.11 Vibration-generating plant and equipment

Of the plant and equipment expected to be used during construction listed in **Table 20-9**, the piling rig, rock hammer and jackhammer have the potential for vibration impacts at nearby sensitive receivers and heritage items.

20.2.12 Primary noise and vibration-related risks

Noise and vibration-related impacts can arise when industry or construction activities result in unacceptable noise and vibration levels at surrounding sensitive receivers. The key activities with the potential to generate noise and vibration during the construction phase of the proposal include:

- Installation of the cofferdam and removal of the cofferdam using a vibrating hammer at the existing weir site
- Rock breaking and concrete sawing works associated with the partial removal of the existing weir
- All piling and concreting works at the new weir site.

Noise and vibration impacts may also arise during the operation of the proposal, such as opening the weir gate. However, given the expected low noise levels of operational activities and the setback distances to the nearest sensitive receivers, operational noise has not been considered further in this assessment. This is consistent with the requirement of the SEARs which focused on the assessment of potential for noise and vibration impacts during construction.

20.3 Risk

The existing weir is located on the edge of Wilcannia township and, therefore, there is potential for the construction works required for the partial removal and decommissioning of the existing weir to cause noise and vibration impacts to nearby sensitive receivers.

20.4 Avoidance and minimisation of impacts

Locating the new weir on the outskirts of Wilcannia away from sensitive receivers reduces the potential for the local community to experience noise and vibration impacts from the construction and operation of the new weir.

Noise impacts at the existing weir site would be minimised by restricting works at this site to standard construction hours were feasible.

20.5 Existing environment

20.5.1 Surrounding land uses and receivers

The proposed new weir site is surrounded by bushland in all directions. Land on the left riverbank at the new weir site is occupied by Wilcannia Local Aboriginal Land Council and land on the right riverbank is Crown land. Development that has occurred on this land includes vehicle access tracks and, on the Crown land only, town emergency water supply boreholes at the south-eastern end of Union Bend Road and powerlines alongside this road that connect to these boreholes. The nearest sensitive receivers to the new weir site are located on the land occupied by Wilcannia Local Aboriginal Land Council about one kilometre to the south-east of the new weir site, on the southern (left) riverbank where the river starts bending to head north. The next nearest sensitive receivers are on the southern edge of the town on Reid Street.

The existing weir is located on the north-eastern side of the town. The nearest sensitive receiver to the proposal work areas is Wilcannia Hospital, located on the right riverbank about 100 metres east of the existing weir site.

The nearest residential receivers are located on Field Street on the right riverbank and are about 100 metres north of the existing weir site. Other residential receivers are located on Reid Street and Ross Street to the west, north and east. There are also industrial, commercial and recreational receiver locations near the proposal on the right riverbank including Wilcannia Golf Club and Reconciliation Park, both on Ross Street.

Victory Park Caravan Park is located on the left riverbank to the south of the existing weir. Water Infrastructure NSW proposes to lease the caravan park during the works required to partially remove and decommission the existing weir. As a result, there would be no sensitive receivers at the caravan park during the works to partially remove and decommission the existing weir. Therefore, the caravan park has not been considered as a sensitive receiver for the works proposed at the existing weir.

In addition to the above sensitive receivers that are nearest to the works, other sensitive receiver potentially impacted by the works are occupants of buildings along the routes used by construction traffic.

Appendix A of **Technical Report 8** lists individual receiver identifiers for each receiver shown in **Figure 20-1**.

20.5.2 Vibration-sensitive receivers

Whilst all receivers and surrounding structures are sensitive to vibration impacts, heritage items and precision industries[2] are typically more susceptible and are subject to more stringent criteria. The Aboriginal Cultural Heritage Assessment Report (refer to **Technical Report 4**) and Statement of Heritage Impact (non-Aboriginal heritage, refer to **Technical Report 5**) identify several heritage items near the existing weir site and proposed new weir site. The Aboriginal Cultural Heritage Assessment Report found that most Aboriginal heritage items identified were scattered artefacts, which are not vibration sensitive items.

The closest non-Aboriginal heritage item is Wilcannia Hospital, which is about 100 metres east of the existing weir site, on Ross Street. Other nearby non-Aboriginal heritage items are Wilcannia Golf Club and Reconciliation Park, also both on Ross Street. Beyond these items, the next nearest heritage items are all more than 240 metres away and mostly towards the centre of Wilcannia, to the south-west of the existing weir.

20.6 Assessment of impacts

20.6.1 Construction impacts

New weir site

Noise levels from all construction stages at the new weir site except for fishway construction, cofferdam removal (for fishway construction), installation of downstream cofferdam and installation of weir and fishway are predicted to be above the standard hour NML at nearby sensitive receivers. All construction stages at the new weir site are predicted to produce noise levels at sensitive receivers, which are above the night-time NML, representing the work period between 5:00am and 7:00am.

During standard hours, only the construction stages involving the preparation of the laydown areas and upgrading of the southern access track from the Barrier Highway result in noise levels over 10 dB(A) above the standard hours NML at sensitive receivers. Only two receivers are impacted by these works, located on the left bank of the river bend, about 280 metres north of the access road from the Barrier Highway.

During night-time works, noise levels from site preparation, upgrading site access tracks, piling works, reinstating the right riverbank, concreting and site rehabilitation works are predicted to be above the night-time NML, representing the period between 5:00am and 7:00am. Noise levels were predicted to be up to 15 dB(A) over the night-time NML at most receivers. Only two receivers were predicted to experience noise levels over 15 dB(A) above the night-time NML, which were those two receivers located on the left riverbank at Union Bend.

[2] Precision industries are those that use equipment that is sensitive to vibration, such as some medical laboratories and scientific measurement laboratories.

Noise levels were not predicted to be above the NML at any non-residential receiver during any construction stage at the new weir site.

The number of receivers exceeding the relative NML as a result of construction works at the new weir site during standard daytime construction hours and night time construction hours are presented in **Table 20-11**.

Appendix C of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) provides guidance for evaluating the significance of noise exceedances for construction during standard hours and for out of hours work. Exceedances less than 10 dB(A) during standard hours are at a level that is 'clearly audible', but not requiring additional measures beyond standard best-practice controls. Exceedances more than10 dB(A) and less than 20 dB(A) are considered clearly audible, and require additional mitigation measures, which are further discussed in **Section 20.7**. **Table 20-11** presents the number of receivers exceeding the relative NML by less than 10dB(A) and more than 10dB(A) during standard hours.

As per Appendix C of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016), noise level exceedances less than five dB(A) above the NML during night-time are classified as noticeable, and those between five and 15 dB(A) above the NML are considered to be clearly audible. In both cases, additional measures beyond standard practice controls are required to be implemented. These measures, as well as the standard noise controls for the proposal are presented in **Section 20.7**. **Table 20-11** presents the number of receivers exceeding the relative NML as per these exceedance bands.

Existing weir site

Noise levels were predicted to be above the standard hours NML of 45 dB(A) and the night-time NML of 35 dB(A) at a number of residential receivers during each construction stage at the existing weir site.

Noise levels from the construction stage involving the partial removal and decommissioning of the existing weir were predicted to be above the standard hour and night-time NMLs at most residential receivers, due to the proposed operation of two excavator mounted rock breakers and dump trucks.

Noise levels from the installation and removal of the cofferdam at the existing weir site were also predicted to be above the standard hours and night-time NMLs at a number of surrounding residential receivers, primarily due to the use of a large crane mounted vibrating hammer.

Noise levels from site preparation and site rehabilitation works were also predicted to be above the standard hours and night-time NMLs at some nearby residential receivers, mostly due to dump trucks and A-double trucks on site.

Noise levels at Wilcannia Hospital were predicted to be above the standard hour NML of 55 dB(A) during all construction stages at the existing weir, except for dewatering. Noise levels were predicted to be up to 25 dB(A) above the NML during the partial removal and decommissioning stage, due to the operation of two excavator mounted rock breakers.

Noise levels at commercial receivers at 9-11 Ross Street, the Central Darling Shire Council Chambers and the Wilcannia Golf Club were predicted to be above the NML of 70 dB(A) during the installation and removal of the cofferdam and the partial removal and decommissioning stage. However, noise levels were predicted to be up to 10 dB(A) above the NML which can be managed through standard mitigation practices on site.

Noise levels at educational receivers TAFE NSW Wilcannia campus and St Therese's Community School are predicted to be above the NML of 55 dB(A) during the partial removal and decommissioning stage. However, noise levels were predicted to be only zero to five dB(A) above the NML and therefore can be managed through standard on-site mitigation measures.

The number of receivers exceeding the relative NML as a result of construction works at the existing weir site during standard construction hours are presented in **Table 20-12**. The number of receivers exceeding the relative NML during proposed night-time works are also presented in **Table 20-12**, however, night-time works are not proposed to occur where feasible.

Table 20-11 Summary of predicted noise levels at residential receivers at the new weir site

Number of residential receivers:	116													
Predicted noise level range and bands above the NML at residential receivers	**Construction phase**													
	Site preparation	**Upgrade site access road**	**Install cofferdam**	**Sheet piling - fishway**	**Fishway construction**	**Remove cofferdam**	**Reinstate right riverbank**	**Install cofferdam downstream**	**Install cofferdam upstream**	**Piling**	**Concreting**	**Install weir and fishway gates**	**Install powerlines, remove cofferdams, reinstate left riverbank**	**Site rehabilitation**
Range of predicted noise levels	23-54	25-57	10-48	27-50	2-41	3-41	22-46	6-45	6-45	21-46	23-48	11-44	20-46	24-55
Daytime standard hours (NML = 45 dB(A)														
Total number of receivers above the NML	2	2	2	5	-	-	2	-	1	2	2	-	2	2
0-10 dB (A0 above the NML	2	-	2	5	-	-	2	-	1	2	2	-	2	1
10-20 dB(a) above the NML	-	2	-	-	-	-	-	-	-	-	-	-	-	1
>20 dB(A) above the NML	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Highly affected (>75 dB(A))	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Night-time hours (NML = 35 dB(A)														
Total number of receivers above the NML	23	60	2	102	2	2	73	2	2	67	78	2	65	46
0-5 dB (A0 above the NML	21	57	-	31	-	-	67	-	-	63	56	-	61	44
5-15 dB(a) above the NML	-	1	2	69	2	2	6	2	2	4	22	2	4	-
15-25 dB(A) above the NML	2	2	-	2	-	-	-	-	-	-	-	-	-	2
>25 dB(A) above the NML	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Highly affected (>75 dB(A))	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 20-12 Summary of predicted noise levels at residential receivers at the existing weir site

Number of residential receivers:	116					
Predicted noise level range and brands above the NML at residential receivers	**Construction phase**					
	Establish temporary access track and install crane pad and pump hardstand area	**Install cofferdam**	**Dewatering**	**Partial removal and decommissioning of the weir**	**Remove cofferdam**	**Finishing work and site rehabilitation**
Range of predicted noise levels	27-63	28-72	-3-47	36-78	28-72	28-64
Daytime standard hours (NML = 45 dB(A)						
Total number of receivers above the NML	59	90	1	106	90	70
0-10 dB (A0 above the NML	38	66	1	45	66	48
10-20 dB(a) above the NML	21	13	-	37	13	22
>20 dB(A) above the NML	-	11	-	24	11	-
Highly affected (>75 dB(A))	-	-	-	3	-	-
Night-time hours (NML = 35 dB(A)						
Total number of receivers above the NML	107	110	15	116	110	109
0-5 dB (A0 above the NML	8	10	10	4	10	7
5-15 dB(a) above the NML	57	49	5	16	49	59
15-25 dB(A) above the NML	38	29	0	65	29	36
>25 dB(A) above the NML	4	22	0	31	22	7
Highly affected (>75 dB(A))	-	-	-	3	-	-

20.6.2 Noise resulting from traffic generated during construction

Access to the existing weir site during construction would be via the Barrier Highway and through Victory Park Caravan Park, which would be closed during the construction period and parts of it used as a compound.

Traffic volumes on the Barrier Highway were obtained from the nearest Transport for NSW permanent count station (ID T0236) located to the west of the proposal, 3.26 kilometres east of Silver Peak Road, Broken Hill. The average annual weekday traffic volumes identified that very low volumes of traffic travel on the Barrier Highway between Broken Hill and Wilcannia.

During construction, peak light vehicle generation is expected to be 20 two-way movements per day to facilitate the transportation of a peak workforce of 20 personnel. The workforce is anticipated to travel from the local area and light vehicle movements would occur in the hour prior to shift commencement and after shift end.

Heavy vehicle construction traffic would mostly comprise delivery of quarry materials (e.g. rock and concrete batching inputs for the new weir) and graded rock to upgrade the tracks to the new weir site. These heavy vehicles would travel to and from the proposal site via the Barrier Highway, from either the direction of Broken Hill to the west or Cobar to the east. Other deliveries may include the weir and fishway gates, sheet piles for cofferdams (if used), power poles and other power supply equipment and construction plant and equipment. There would also be some local heavy vehicle traffic movements between the new weir site and the local waste management facility, to dispose of surplus spoil and other waste, and between the existing weir and the local council depot, to store about 50 of the larger rocks removed during the partial removal and decommissioning of the existing weir. During construction, peak heavy vehicle generation is expected to be up to 10 two-way movements per day, or approximately one truck per hour.

Considering worst-case estimate of 40 additional light and 20 additional heavy vehicle movements per day generated as a result of construction, using Transport for NSW's Construction Noise Estimator it was determined that noise from road traffic would increase by about 0.4 dB(A) during standard hours and by 1.5 dB(A) during night-time works.

This predicted increase in traffic noise is less than the 2 dB(A) used in the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) to determine whether further noise assessment is required (refer to **Section 20.2.3**). Consequently, the additional construction traffic is estimated to not cause a noticeable increase in road traffic noise.

20.6.3 Vibration

As identified in **Section 20.2.11**, a piling rig, rock hammer and jackhammers would be used during construction, which are considered to be vibration-generating items of plant and equipment. Considering the distance of the nearest sensitive receiver to the construction site (including the nearest heritage structures) is greater than the recommended safe setback distances, and therefore it was concluded that vibration impacts would be unlikely.

20.6.4 Operation impacts

No operational impacts are anticipated as a result of the proposal.

20.7 Mitigation and management measures

Standard techniques for controlling noise impacts during construction are presented in the ICNG. Controls relevant to the proposal have been reproduced below in **Table 20-13**. These measures, or similar, would be included in a construction noise and vibration management plan.

Table 20-13 Standard measures, noise during construction

Ref	Impact/issue	Mitigation measure	Timing
NV1	Management of construction noise	A construction noise and vibration management plan will be prepared as a sub-plan of the construction environmental management plan, in accordance with Water Infrastructure NSW guidelines and policies. The construction noise and vibration management plan will include measures, processes and responsibilities to manage noise and vibration and minimise the potential for impacts during construction. The construction noise and vibration management plan will: ▪ Identify nearby sensitive receivers ▪ Include a description of the construction activities, equipment and working hours ▪ Identify relevant noise and vibration performance criteria for the proposal and licence and approval requirements ▪ Outline standard and additional mitigation measures from the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) and information about when each will be applied ▪ Outline requirements for the development and implementation of an Out-of-hours Work Protocol ▪ Describe community consultation and complaints handling procedures in accordance with the community communication strategy to be developed for the proposal.	▪ Pre-construction
NV2	Time constraints and scheduling	▪ Wherever possible and safe, limit works to standard hours of construction ▪ If out of hours works occur, where possible, perform noisy work after 7:00am ▪ Limit the completion of out of hours works over consecutive nights.	▪ Construction
NV3	Equipment restrictions	Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner.	▪ Pre-construction ▪ Construction
NV4	Substitute methods	Where possible, use quieter and less vibration emitting construction methods.	▪ Construction
NV5	Limit equipment use	Only have necessary equipment on-site and turn off when not in use.	▪ Construction
NV6	Limit activity duration	Where possible, concentrate noisy activities at one location and move to another as quickly as possible.	▪ Construction
NV7	Site access	Vehicle movements including deliveries outside standard hours should be minimised and avoided where possible.	▪ Construction
NV8	Equipment maintenance	Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices.	▪ Pre-construction ▪ Construction

Ref	Impact/issue	Mitigation measure	Timing
NV9	Reduce equipment power	Use only the necessary size and powered equipment for tasks.	▪ Construction
NV10	Quieter working practices	Include in the work site induction training on noise sensitivities, such as switching off equipment that is not in use, minimising talking and radio use when near sensitive receivers and configuring work sites to minimise the need for reversing.	▪ Pre-construction ▪ Construction
NV11	Reversing alarms	Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms.	▪ Construction
NV12	Noise barriers	Consider the installation of temporary construction noise barriers for concentrated, noise-intensive activities.	▪ Construction
NV13	Enclosures	Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.	▪ Construction
NV14	Use and siting of plant	▪ Where possible, avoid simultaneous operation of two or more noisy plant close to receivers ▪ The offset distance between noisy plant and sensitive receivers should be maximised ▪ Switch off equipment that is not in use; avoid idling.	▪ Pre-construction ▪ Construction
NV15	Plan work sites and activities to minimise noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.	▪ Pre-construction ▪ Construction
NV16	Minimise disturbance arising from delivery of goods to construction sites	Delivery and loading / unloading of materials should occur as far as possible from sensitive receivers. Select site access points and roads as far as possible from sensitive receivers.	▪ Construction
NV17	Monitoring	Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision.	▪ Construction

In addition to these standard measures, the assessment indicated that additional mitigation may be considered for several residential receivers during proposed daytime standard construction hours, and night-time works. However, this assessment is based on the worst case $L_{Aeq(15\ mins)}$ noise levels at each sensitive receiver and can be considered conservative.

Additional mitigation for affected residents may include:

- Notification – Notifying the affected residents (through letterbox drops or equivalent) of works and potential disruptions. The notification should detail work activities, time periods over which the works will occur, impacts and mitigation measures. Notifications should be given a minimum of five days prior to works commencing

- Verification – Where specific noise impacting works are to be undertaken for more than three weeks, attended noise measurements are to be undertaken within a period of 14 days from the commencement of construction activities. The purpose of these measurements is to verify the noise levels predicted in this noise assessment are accurate and whether mitigation measures are appropriate. Attended noise measurements should also be undertaken to address any noise complaints raised as a result of the proposed works
- Respite offers – Respite offers should be considered where there are high noise generating activities near receivers, such as rock breaking. Work should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour in between. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers and should be considered in consultation with affected receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact
- Respite period 2 (night-time affected residents only) – Night-time construction should be limited to two consecutive nights only, except where there is a duration respite (see below). The health and safety of construction workers should be considered if respite period 2 measures are adopted, as two night shifts on and one night off can result in adverse impacts to sleep patterns if crews are on this pattern for an extended period. Appropriate programming to avoid these adverse impacts should be considered
- Duration respite – Respite offers and 'respite period 2' may be counterproductive in reducing the impact on the community for longer duration projects. Where it can be strongly justified, it may be beneficial to increase work duration or the number of nights (or in this case, early mornings), so that the proposal can be completed quickly. The community should be consulted where duration respite mitigation is considered.

Residential receivers that should be considered for the additional mitigation described above are highlighted in Appendix A of **Technical Report 8**.

Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) provides general guidance for limiting vibration impacts during construction. Relevant recommendations have been reproduced below and should be considered as appropriate in the construction noise and vibration management plan.

Table 20-14 Vibration management measures

Measure	Details
Controlling vibration levels from the source	▪ Choosing alternative, lower-impact equipment or methods wherever possible ▪ Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) ▪ Locating high vibration sources as far away from sensitive receiver areas as possible ▪ Sequencing operations so that vibration-causing activities do not occur simultaneously ▪ Keeping equipment well maintained ▪ Do not conduct vibration intensive works within the recommended safe setback distances ▪ Avoid the use of vibration intensive plant within the nominated human comfort distances ▪ Monitor any Aboriginal heritage items near vibration intensive works.
Consultation	Informing nearby receivers about the nature of construction stages and the vibration-generating activities.

Source: *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006)

21. Assessment of other key issues

This section provides an assessment of the proposal's potential impacts that were not identified as key issues by the environmental risk analysis (refer to **Section 23.1.2**).

The issues discussed in this section have been identified in the SEARs. The level of assessment reflects the fact that these are issues commonly associated with construction projects and are appropriately addressed through the design process or by implementing best practice management and mitigation measures.

21.1 Air quality

This section provides an air quality impact assessment of the proposal and recommends mitigation and management measures to address these impacts.

SEAR no. 11 include requirements for the assessment of the proposal's potential impacts to air quality. The requirements of SEAR no. 11 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

21.1.1 Legislative and policy context

The legislations the guidelines that apply to the assessment of air quality impacts include:

- POEO Act
- National Environment Protection (Ambient Air Quality) Measure (National Environment Protection Council, 2016)
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Environment Protection Authority, 2016).

The air quality assessment carried out for the proposal has considered the legislative guidance and frameworks that are relevant in NSW, and provides mitigation measures to manage potential air quality impacts accordingly.

21.1.2 Assessment methodology

The methodology for the air quality impact assessment involved:

- Characterising key features of the surrounding environment, including the location of surrounding receivers and sensitive land use areas and background air quality
- Identifying key air quality issues during construction and operation phases, as well as suitable criteria for the evaluation of these risks
- Identifying the potential for impacts to occur during construction and operation
- Recommending mitigation measures to effectively manage any risks to air quality based on the outcomes of the air quality impact assessment.

Air pollution typically refers to pollution from particle substances which can cause health impacts, nuisance and environmental effects when the concentration exceeds a certain level. The exposure to these pollutants can be determined by measuring the concentration level in ambient air at sensitive receivers such as residences, schools and hospitals.

Air quality impacts that can affect human health or the surrounding environment during construction of the proposal would come from emissions from excavation works, material handling, transport and vegetation clearing activities.

The Environment Protection Authority prescribes air quality impact assessment criteria for particulate matter as follows:

- Total suspended particulates, to protect against nuisance amenity impacts
- Particulate matter with equivalent aerodynamic diameter less than or equal to 10 microns (PM_{10}), to protect against health impacts
- Particulate matter with equivalent aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), to protect against health impacts
- Deposited dust, to protect against nuisance amenity impacts.

Most EPA criteria are drawn from national standards for air quality set by the National Environmental Protection Council of Australia as part of the National Environment Protection Measures (NEPM). The EPA air quality assessment criteria encompass the total concentration of air pollutants in the air from cumulative sources, and not just the contribution of pollutants from project-specific sources. The threshold concentrations used for categorising air quality are shown in **Table 21-1**. These criteria apply at sensitive receivers such as residences, schools and hospitals.

DPE and NSW Health use the Air Quality Index as an indicator scale to show difference categories of air quality.

Table 21-1 Relevant air quality index criteria

Substance	Averaging time	Air quality index category*	
		Very good	Good
Particulate matter (PM_{10})	1-hour	0-26 μg/m^3	27-53 μg/m^3
	24-hour	0-17 μg/m^3	17.1-33.5 μg/m^3
Particulate matter ($PM_{2.5}$)	1-hour	0-20 μg/m^3	21-41 μg/m^3
	24-hour	0-8.5 μg/m^3	8.6-16.7 μg/m^3

*Source: DPE and NSW Health (2020)

21.1.3 Existing environment

The existing air quality in the proposal area is characteristic of a rural bushland and riverine plains environment. The new weir site is not located close to any sensitive receivers as it is 1.5 kilometres south from the edge of the Wilcannia township. The existing weir site is located near sensitive receivers such as the Victory Park Caravan Park located about 80 metres to the south-west, and the Wilcannia Multi-Purpose Service Hospital 100 metres to the east. The nearest residential sensitive receivers are located on Field Street on the right riverbank and are about 100 metres north of the existing weir site.

The nearest sensitive receivers for the new weir and existing weir sites are shown in **Figure 20-1**.

A search of the National Pollutant Inventory carried out on 5 October 2020 for the 2018/2019 reporting period identified two air polluting substances (nitrogen and phosphorus) from five sources within the Central Darling Shire Council. There are no specific air pollution sources near the proposal area and the identified sources are in the general Murray-Darling Basin sub-catchment.

The nearest DPE air quality monitoring station is located at White Cliffs automatic weather station, operated by the Bureau of Meteorology (station No. 046129) about 80 kilometres north of Wilcannia. This station measures and reports hourly updates on particle concentrations for total suspended particulates, fine particles as $PM_{2.5}$ and fine particles as PM_{10}. The measurements taken for a five-day average in October 2020 indicates $PM_{2.5}$ had minimum 4 μg/m^3 and maximum 7 μg/m^3. PM_{10} ranges from minimum 1 μg/m^3 to maximum 4 μg/m^3.

The particulate matter measurements indicate air quality are within the 'very good' range of the Air Quality Index and particle matter concentrations are well below the 1-hour and 24-hour criteria. It is expected that the air quality measurements for Wilcannia would be similar.

There are no major industrial sources of air pollutants in Wilcannia. The proposal is well removed from industry and large population centres, meaning that the concentration of air pollutants in the ambient environment would likely be at baseline levels. Other contributors to air quality within and surrounding the proposal area would include emissions from motor vehicles and equipment used during construction activities. Operational and maintenance activities may also contribute to air quality in a localised area.

The proposal area is susceptible to bush fires. Air quality during bush fire events would temporarily decrease. Any combustion type, and smoke from fires and wood heaters are common sources of $PM_{2.5}$ particles. Common sources of PM_{10} particles include crushing or grinding operations, dust stirred up by winds over exposed soils, or vehicles on roads.

21.1.4 Assessment of impacts

Construction impacts

The main impacts to air quality as a result of the proposal are likely to come from dust generated by clearing works, construction, use of access tracks and vehicle and equipment exhausts.

Emission sources for construction activities are outlined in **Table 21-2** which captures the most likely and significant sources and is not shown as an exhaustive list of potential air quality impacts. Dust, particulate matter such as $PM_{2.5}$ and PM_{10} are considered the most significant air pollutants.

Table 21-2 Potential emission sources identified for the proposal

Emission source	Activity or process
Emissions from loading and unloading activities	▪ Loading and unloading soil and rocks, construction material ▪ Compound/laydown area usage
Emissions from unsealed roads and access track	▪ Construction for upgrade of access tracks ▪ Use of unsealed roads
Emissions from earthworks	▪ Vegetation clearing on construction footprint at new weir and existing weir sites ▪ Earthworks to reshape the riverbanks ▪ Construction of the new weir and decommissioning of the existing weir
Emissions from exhaust and/or combustion of vehicles and plants	▪ Emissions from trucks, construction personnel ▪ Emissions from plant and equipment ▪ Use of generators
Wind erosion	▪ Wind erosion from new weir site footprint ▪ Wind erosion from existing weir site footprint ▪ Wind erosion from access tracks during construction and use

Environmental factors that would influence the risk of dust generation include:

- Wind direction – Determines the direction in which dust particles may be transported
- Wind speed – Controls the potential suspension load and drift distance of dust particles
- Rainfall or dew – Controls the potential suspension load and drift distance of dust particles
- Soil structure – Degradation of soil structure can increase erosion potential
- Soil moisture – increased soil moisture can reduce erosion potential
- Soil clay – increased clay content leads to more stable soil structure and reduces erosion potential.

Dominant wind direction observed at two stations (No. 046043 and No. 046012 in Wilcannia is southerly winds, indicating winds blow from the south towards the north more commonly than any other direction (Bureau of Meteorology, 2020). This means that the residential and hospital receivers north of the existing weir site would more likely be impacted by dust from the prevailing wind conditions than the Victory Park Caravan Park. It is noted however that Water Infrastructure NSW intends to lease the caravan park during decommissioning of the existing weir, so no impacts to guests would be anticipated.

Impacts to air quality as a result of the proposal are anticipated to be minor and temporary in nature. The impact on air quality from engine emissions is considered negligible given the absence of nearby sensitive receivers at the new weir site. Emissions generated from the construction activities may lead to some temporary impacts to the sensitive receivers located next to the existing weir site unless appropriate mitigation measures are implemented.

The absence of other emission sources in the vicinity suggest that any impacts to the local sensitive receivers would not generate dust emissions to cause an exceedance of quality index criteria. The relatively short duration of the construction phase at the new and existing weir sites and the mobile, non-permanent nature of the emission sources also means that impacts on air quality would not be significant.

Dust has the potential to impact human health, vegetation, water quality and visual amenity. The implementation of mitigation measures identified in **Section 21.1.5** would reduce any potential impacts from the construction of the proposal.

All vehicles accessing the proposal area are expected to be maintained in a serviceable condition such that exhaust emissions meet manufacturer specified levels.

Operation impacts

During operation, the new weir and its gate component would have no impact on air quality for the surrounding environment.

Some dust could be generated during dry periods when the new weir is operational but the Darling River (Baaka) has ceased to flow. When the water levels are low larger areas of the river channel would be exposed to wind erosion, however this impact is not expected to be significant or more severe than existing conditions in Wilcannia.

The level of dust emissions generated by maintenance vehicles would be comparable to existing conditions, since the unsealed roads and access tracks to the new weir site would be upgraded as part of the proposal to provide a better road condition that is less prone to erosion or generation of fine particles.

21.1.5 Mitigation and management measures

Mitigation measures for air quality impacts are presented in **Table 21-3**. No operational mitigation measures are required.

Table 21-3 Mitigation and management measures for air quality impacts

Ref	Impacts	Mitigation measures	Timing
AQ1	Air quality	The construction environmental management plan will include: ▪ Air quality management objectives consistent with any relevant published Environment Protection Authority and/or DPE guidelines ▪ Methods to manage work during strong winds or other adverse weather conditions to minimise dust ▪ A progressive rehabilitation strategy for disturbed or cleared areas to reinstate the construction footprint as soon as possible.	Pre-construction
AQ2	Dust	▪ Dust suppression techniques will be implemented and incorporated into the construction environmental management plan, as outlined in the 'Blue Book' (Landcom, 2004), such as not carrying out dust generating works during high winds, water spraying of surfaces, covering stockpiles and covering surplus soils and materials during transportation ▪ Exposed and disturbed surfaces will be stabilised at construction sites that are not active.	Construction
AQ3	Exhaust	▪ Appropriate vehicle and plant maintenance will be carried out to avoid excessive engine exhaust emissions ▪ Plant and equipment will be switched off when not in use.	Construction
AQ4	Monitoring	▪ Regular inspections of construction sites will be carried out to ensure the air quality measures being implemented are effective ▪ Construction site induction or other training opportunities will be used to educate all site personnel on the importance of air quality management measures and their responsibilities to comply with such measures.	Construction

21.2 Waste

This section provides a waste impact assessment of the proposal, and recommends mitigation and management measures to address these impacts.

SEAR no. 10 include requirements for the assessment of the proposal's potential waste impacts. The requirements of SEAR no. 10 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

21.2.1 Legislative and policy context

Waste management and recycling in NSW is regulated through the POEO Act, the Protection of the Environment Operations (Waste) Regulation 2014 and the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021* (Environment Protection Authority, 2014b) provides key directions and guidance on waste classification, reducing waste to landfill and construction waste management.

Protection of the Environment Operations Act 1997

The POEO Act is the key piece of environment protection legislation administered by the NSW EPA, and sets the statutory framework for:

- Specification of requirements for licences and the regulation of various activities that have the potential to pollute or harm the environment. The proposal is not a scheduled activity and does not require an environment protection licence under Schedule 1 of the POEO Act. In accordance with section 43(d) of the POEO Act, environment protection licences may also be issued to control the carrying out of non-scheduled activities for the purpose of regulating water pollution

- Integration with NSW EPA licensing with the development approval procedures under the EP&A Act
- Provision for the issuing of clean-up notices, prevention notices and environment protection notices
- Classification of environment protection offences and penalties
- Allowance for mandatory audits and provision for authorised officers with the power to carry out investigations.

Protection of the Environment Operations (Waste) Regulation 2014

The Protection of the Environment Operations (Waste) Regulation 2014 (NSW) (Waste Regulation) sets out the provisions related to the following:

- Storage and transportation of waste
- Reporting and record-keeping requirements for waste facilities
- Special requirements for the management of certain special waste including asbestos
- Payment of waste contributions (referred to as a waste levy) by the occupiers of licensed waste facilities
- Exemption of certain occupiers or types of waste from paying waste contributions and from requiring an environment protection licence under Part 9 of the Waste Regulation.

Part 9 of the Waste Regulation provides for exemptions to some of the requirements of the POEO Act and Waste Regulation for certain activities where it can be demonstrated that waste reuse would not cause harm to human or environmental health.

There are a number of Resource Recovery Orders and Exemptions allowing specified reuse of waste streams that are relevant to construction projects, including:

- Excavated natural material
- Recovered aggregate
- Excavated public road material
- Treated drilling mud
- Mulch
- Pasteurised garden organics
- Stormwater.

Clause 71 of the Waste Regulation prohibits the transport of waste for disposal more than 150 kilometres from the place of generation. Further discussion on waste facilities that may be utilised for the proposal is provided in **Section 8.5.3**.

Waste Avoidance and Resource Recovery Act 2001

The WARR Act provides a waste management hierarchy which specifies waste avoidance is the highest priority, followed by recovery (including reuse, reprocessing and recycling), with disposal as a last resort.

NSW Waste Avoidance and Resource Recovery Strategy 2014-2021

The *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021* (Environment Protection Authority, 2014b) sets key directions for reducing waste generation in NSW. The strategy includes the following targets for 2021-2022:

- Avoiding and reducing the amount of waste generated per person in NSW
- Increasing recycling rates to 70 per cent for municipal solid waste, 70 per cent for commercial and industrial waste, 80 per cent for construction and demolition waste
- Increasing waste diverted from landfill to 75 per cent
- Managing problem wastes better, establishing 86 drop-off facilities and services across NSW
- Reducing litter, with 40 per cent fewer items by 2017
- Combatting illegal dumping, with 30 per cent fewer incidents by 2017.

The proposal would seek to reduce waste generation by seeking recycling opportunities wherever possible. To increase construction waste recycling and divert more waste from landfill, waste such as mulch and spoil would be reused on site where appropriate.

Guidelines

Guidelines which were considered for this assessment include:

- The *Waste Classification Guidelines: Part 1 Classifying Waste* (Environment Protection Authority, 2014a) prescribe the process for the classification of waste into groups that pose similar risks to the environment and human health
- NSW Sustainable Design Guidelines Version 4.0 (Transport for NSW, 2017), which includes targets to achieve waste diversion in accordance with the waste management hierarchy
- Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2 (A. Installation of Services; B. Waste Landfills; C. Unsealed Roads; D. Main Roads; E. Mines and Quarries) (Department of Environment and Climate Change, 2008b), which outline waste management practices that should be applied during the design and construction phases of a project.

21.2.2 Assessment methodology

Waste streams that would potentially be produced during the construction of the proposal have been assessed in relation to likely sources, volumes, classification and the timing of waste generation.

Potential waste streams have been classified in accordance with the *Waste Classification Guidelines* (Environment Protection Authority, 2014) and may include:

- Special waste (e.g. asbestos, waste tyres)
- Liquid waste (e.g. concrete slurry, sediment-laden water pumped out of in-stream construction work sites)
- Hazardous waste (e.g. contaminated material)
- Sewage from toilet and kitchen facilities at construction site offices
- Restricted solid waste
- General solid waste (putrescible) (e.g. from vegetation clearance and food waste from site offices)
- General solid waste (non-putrescible) (e.g. from construction and demolition as well as virgin excavated natural material and excavated natural material).

The assessment of waste impacts involved:

- Reviewing the likely resources requires for the construction and operation of the proposal, including materials used, water and power
- Reviewing the likely waste streams, volumes and classification
- Identifying opportunities for the avoidance, minimisation and reuse of waste
- Identifying the environmental impacts associated with resource use and generation (and subsequent disposal) of waste materials
- Recommending mitigation measures and waste management strategies for construction and operation phases of the proposal, including for wastewater and potentially contaminated materials.

Waste regulations and policies have informed the assessment of potential waste impacts and development of mitigation measures. To follow best practice waste management principles under the WARR Act, the preferred options for management of excess materials would be identify potential ways of beneficial reuse either within the construction footprint or off-site.

21.2.3 Existing environment

As the proposal is located in regional NSW within the Darling River (Baaka) channel and away from major industrial or population centres, there is little waste currently generated in the proposal area. Waste sources are currently limited to household waste, roadside litter, green waste, agricultural waste and commercial waste from local businesses and service providers. There are no known areas with contaminated sites located near the proposal area.

The two nearest waste disposal facilities that have been identified are:

- Wilcannia Waste Disposal Facility/Rubbish Depot Lot 107 DP 820452 (Hood St South, about 2.5 kilometres north-west of the new weir site by road)
- Sunset Strip Landfill Lot 4878 DP767618 (Menindee Lakes, about 142 kilometres south of the new weir site by road).

21.2.4 Assessment of impacts

Construction impacts

Waste streams likely to be generated during construction of the proposal include:

- Vegetation waste from clearing
- Excess spoil from excavation, ground disturbance works and the partial removal and decommissioning of the existing weir which are unsuitable for use as backfill, or are unsuitable or surplus for reuse on-site
- General construction and building material waste such as excess concrete, grout, redundant pieces of plastic and metals or timber
- Domestic waste including food scraps, aluminium cans, glass bottles, plastic and paper containers, putrescible waste generated by construction personnel at the construction site compounds
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping material
- Redundant sediment and erosion controls such as silt fences and geofabric
- Wastewater including concrete washdown
- Waste hydrocarbons including grease, oil and fuel from maintenance of construction plant and equipment.

Potential waste generated during proposal construction would be managed using the waste hierarchy approach; whereby avoiding the generation of waste and reusing materials are prioritised over waste disposal. All waste would be managed in accordance with the waste provisions contained within the POEO Act and the Waste Regulation. Where waste would be reused offsite, relevant NSW EPA Resource Recovery Orders and Exemptions would be followed.

Should waste be found to be unsuitable for reuse or recycling, disposal methods would be selected based on the classification of the waste material in accordance with *the Waste Classification Guidelines: Part 1 Classifying Waste* (Environment Protection Authority, 2014). The Waste Classification Guidelines provide direction on the classification of waste, specifying requirements for management, transportation and disposal of each waste category.

Resource recovery would be applied to the management of construction waste and would include:

- Recovery of resources for reuse - reusable materials generated by the proposal would be segregated for reuse onsite, or offsite where possible, including the reuse of the major waste streams
- Recovery of resources for recycling - recyclable resources (such as metals, plastics and other recyclable materials) generated during construction and demolition would be segregated for recycling and sent to an appropriate recycling facility for processing
- Recovery of resources for reprocessing - cleared vegetation would be mulched or chipped onsite and used for landscaping, in the absence of a higher beneficial use being identified.

The largest waste stream by volume during the construction would be spoil. A summary of the likely volume of the spoil that would be generated and the opportunities to reuse it on-site is provided in **Section 3.6.7**.

Green waste would be produced from the removal of vegetation at the construction sites. Most vegetation within the clearing boundary would be cleared and moved. Woody debris (e.g. logs and mulch) produced during vegetation clearing would be temporarily stockpiled and then spread over the construction footprint to protect the soil surface from erosion and to aid habitat restoration.

Mulch stockpiles would require appropriate management measures to prevent leachate from impacting water quality in the Darling River (Baaka). The water quality mitigation and management measures are provided in **Table 10-3**.

Excavated material (spoil) would be generated as part of earthworks, particularly at the new weir site. Spoil from the bank reshaping at the beginning of construction would be stockpiled on site for reuse in the rehabilitation and restoration at the end of construction.

Excess spoil that cannot be reused in the proposal area would be disposed off-site at a licenced waste facility.

As noted in **Section 5.3**, the community have requested the reuse of some of the large rocks from the existing weir. These would be temporarily stored, sorted and stockpiled at the construction compound adjacent to the existing weir site, and then stored at the Council depot until they can be installed in the community river place, or other selected locations.

Common domestic waste generated during construction at work sites such as food waste, plastic and paper containers and bottles would be managed on site and construction personnel would be required to dispose of the waste in designated general waste and recycling bins. Portable toilet facilities would be provided on site at the new weir location and would be maintained by the construction contractor during the construction period.

Construction materials being delivered to the proposal site during construction may include pallets and plastic material. Any packaging waste that is not recyclable would be disposed of at the local waste depot located on Hood Street, Wilcannia.

Operation impacts

Waste generated by the operation of the proposal would be limited. Waste generated during operation would come from maintenance works. Any waste produced during operation would be managed in accordance with the waste hierarchy under WARR Act, and classified according to the *Waste Classification Guidelines* (Environment Protection Authority, 2014) if required, and would be reused, recycled or disposed of at suitable facilities.

21.2.5 Mitigation and management measures

Mitigation measures for waste impacts are presented in **Table 21-4.** No operational mitigation measures are required.

Table 21-4 Mitigation and management measures for waste impacts

Ref	Impacts	Mitigation measures	Timing
W1	Handling and/or disposing of waste	A construction waste and resource management plan will be prepared for the proposal and will include, but not limited to the following: ▪ Identification of waste types and volumes that are likely to be generated by the proposal ▪ Adherence to the waste minimisation hierarchy principles ▪ Waste management procedures to manage the handling and disposal of waste, including unsuitable material or unexpected waste volumes ▪ Identification of reporting requirements and procedures for tracking of waste types and quantities ▪ A resource management strategy detailing the process to identify reuse options for surplus materials ▪ Procedures for handling and storing waste so that it does not cause pollution of the environment or pose a risk to water quality in the Darling River (Baaka) surrounds ▪ A procurement strategy to minimise unnecessary consumption of materials and waste generation in accordance with relevant legislation and guidelines.	Pre-construction
W2	Excess spoil and surplus unusable waste	▪ If waste is stored temporarily on-site, stockpiling will be managed to ensure that it poses no risk of polluting the environment including in adverse weather conditions ▪ All waste, including surplus soils that cannot be reused will be classified in accordance with the *Waste Classification Guidelines* (Environment Protection Authority, 2014). Waste that is unsuitable for reuse on-site will be transported to and disposed of at a facility that can lawfully accept the waste in accordance with the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2014*. Disposal dockets will be retained and records kept for audit purposes.	Construction

Ref	Impacts	Mitigation measures	Timing
W3	Vegetation	Vegetation and woody debris would be managed in accordance with the vegetation management plan prepared as a sub-plan to the construction environmental management plan. This plan would identify opportunities to reuse vegetation waste in the rehabilitation plan including: ▪ Placing logs in the new town pool to create aquatic habitat ▪ Reusing logs in in site rehabilitation works ▪ Reusing logs in landscaping the community river place including as informal seating ▪ Reusing mulch in site rehabilitation works and in landscaping at the community river place.	Construction
W4	Construction site	▪ The construction site induction or other training opportunities will be used to educate all site personnel on the importance of minimising waste ▪ Construction sites will be kept free of litter ▪ Self-contained portable ablution and toilet facilities will be provided at construction sites. These facilities will be located at least 20 metres from any drainage lines. Septic waste will be transported off-site by a suitably licensed waste transporter and disposed at a suitably licensed waste facility.	Construction

21.3 Bush fire

This section describes the potential bush fire and public safety risks that may be generated by the construction and operation of the proposal and presents a proposed approach to managing these impacts.

SEAR no. 15 include requirements for the assessment of the proposal's potential bush fire hazard. The requirements of SEAR no. 15 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

21.3.1 Legislative and policy context

Rural Fires Act 1997

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. Under section 3(d) of the Act, the protection of the environment through bush fire prevention activities are 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 take the notified steps 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.

The authority has the duty to prevent the occurrence of bush fires on any land under its ownership or occupancy.

Part 3A of the *Rural Fires Act 1997* provides for the designation of neighbourhood safer places, which may be suitable for people to shelter from a bush fire.

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

Planning for Bush Fire Protection

The *Planning for Bush Fire Protection – A Guide for Councils, Planners, Fire Authorities and Developers* (NSW Rural Fire Service, 2019) provides standards and guides for land use planning and development on bush fire prone land. The guide sets out principles to reduce the impact of bush fires and protect development and occupants from bush fire risks, which include:

- Control the types of development permissible in bush fire prone areas
- Minimise the impact of radiant heat and direct flame contact by separating development from bush fire hazards
- Minimise the vulnerability of buildings to ignition and fire spread from flames, radiation and embers
- Enable appropriate access and egress for the public and firefighters
- Provide adequate water supplies for bush fire suppression operations
- Focus on property preparedness, including emergency planning and property maintenance requirements
- Facilitate the maintenance of asset protection zones, fire trails, access for firefighting and on site equipment for fire suppression.

Bush fire protection measures are required to be considered for development in bush fire prone areas.

21.3.2 Assessment methodology

The bush fire assessment included:

- Identification of bush fire risk factors
- Reviewing bush fire prone land maps
- Identification of bush fire protection measures
- Outlining and emergency management procedures to be implemented during construction.

21.3.3 Existing environment

The statutory Bush Fire Danger Period in NSW generally starts on 1 October each year through to the following 31 March (NSW Rural Fire Service, 2020), although commencement can be declared as early as August. Wilcannia has not experienced any major bush fires in recent years, with the last major fire event near Wilcannia having occurred in 2012. During summer months, hot and dry weather conditions as well as human-caused ignition may lead to bush fires. The proposal area has not been burnt in recent years.

A review of NSW Bush Fire Prone Land mapping developed by the NSW Rural Fire Service (NSW Rural Fire Service, 2020) indicated that the proposal at the new and existing weir locations, and the wider Wilcannia region, comprise Category 3 lands. Category 3 is considered to be medium bush fire risk vegetation and generally consists of grasslands, freshwater wetlands, semi-arid woodlands, and arid shrublands.

Fire weather was assessed using the NSW and ACT Regional Climate Modelling (NARCLiM) climate projections for NSW, which predict an additional 1.5 days a year at Wilcannia would have a forest fire danger index above 50, which is considered a severe fire danger rating. Refer to **Section 21.4.3** for further information on climate projections.

The Wilcannia township is identified as an "asset" in the *Central Darling Bush Fire Risk Management Plan* (Central Darling Bush Fire Management Committee, 2011) and had been assessed as 'Low' risk level. Targeted treatments specified for Wilcannia include hazard reduction and community education, such as distributing newsletters and targeted activities.

21.3.4 Assessment of impacts

The proposal is vulnerable to bush fires due to vegetation cover surrounding the new and existing weir sites. Bush fires are more likely to occur during the Bush Fire Danger Period and their frequency may increase with warmer temperatures and more hot days. Bush fires remove vegetation cover and litter that protect the surrounding soil from erosion, provide filtration and a sediment buffer, and provide habitats for wildlife (Office of Environment and Heritage, 2016). The removal of vegetation cover could lead to an increase in sediment, organic matter and ash or coal run off into the river channel. This run off would impact water quality in the river and may lead to increased levels of suspended sediment, nutrients and metals, as well as potential eutrophication that creates algal blooms. Reduced water quality negatively impacts aquatic habitat and fish species, and may become hazardous to human health without appropriate treatment.

Fires can also damage culturally significant sites and areas such as trees and historic heritage features. Other consequences may involve damage to properties, although the new weir site is removed from the town and is not located near any built infrastructure.

Construction impacts

Construction activities pose risks of bush fire due to on site ignition sources such as hot works, or accidental bush fires due to poor management, that may result in a fire escaping to the surrounding bushland and scrubland. Such risks may arise from hot works that generate sparks, vegetation clearing and the use of vehicles and equipment on site. Fuel leaks and spills from plant and equipment could also provide a fuel source for bush fires if ignited. Small quantities of flammable materials, such as fuel, would be stored on site.

The proposed powerline connection to the new weir site would be established with an appropriate easement to meet Essential Energy clearance requirements.

The isolated nature of the proposed worksites at both sides of the new weir location, surrounded by bush, presents a safety risk for the construction workforce. This risk would be managed through the implementation of mitigation and management measures in the construction environmental management plan.

Operation impacts

Bush fire risks during operation of the proposal include the powerlines between Union Bend Road and the new weir site, and the switchroom and the control rooms for the weir gates and fishway gates at the new weir site. As noted in **Section 3.4.9**, Essential Energy would own the power infrastructure from Union Bend Road to the switchboard, including all overhead lines, poles, the pole substation and power supply cables and it would maintain these in accordance with its own standards and procedures. This would include maintaining the powerline easement to manage bushfire risk.

The switchroom and control rooms have been designed in accordance *Planning for Bush Fire Protection – A Guide for Councils, Planners, Fire Authorities and Developers* (NSW Rural Fire Service, 2019). Asset protection zones would surround this new infrastructure, as shown in the rehabilitation plan for the new weir site (refer to Appendix A of **Technical Report 6**).

The upgraded access tracks to both sides of the new weir would provide safe access for firefighting, if required.

21.3.5 Mitigation and management measures

Mitigation measures for bush fire risks and safety impacts are provided in **Table 21-5**.

Table 21-5 Mitigation and management measures to manage bush fire risks and safety impacts

Ref	Impacts	Mitigation measures	Timing
BF1	Construction in bush fire prone areas	A bush fire emergency management plan will be prepared in accordance with *Planning for Bush Fire Protection* (NSW Rural Fire Service, 2019) and in consultation with the NSW Rural Fire Service. The bush fire emergency management plan will include responsibilities associated with and details of: ▪ Site specific hazards and risks for the proposal area ▪ Hot works procedures ▪ Procedures to maintain bush fire awareness ▪ Bush fire mitigation measures ▪ Fire preparedness actions including evacuation triggers, evacuation routes, mustering points, neighbourhood safe places ▪ Instructions for sheltering in-vehicle if there are no other options. Construction and staff attendance on site will be suspended on days with severe or greater forecast fire danger ratings, and construction hours will be reduced or moved to an earlier time on hot days (days above 40 degrees) to avoid work being undertaken during the hottest time of the day.	Pre-construction Construction

21.4 Climate change and greenhouse gas emissions

This section provides an assessment of the greenhouse gas emissions and climate change impacts of the proposal. This section also presents mitigation measures for identified climate change risks, including actions to be implemented during detailed design, construction and operation to minimise greenhouse gas emissions.

21.4.1 Legislative and policy context

NSW Climate Change Policy Framework

The NSW Government has committed to achieving net zero emissions by 2050 under the *NSW Climate Change Policy Framework* (Office of Environment and Heritage, 2016b). This framework aims to maximise the economic, social and environmental wellbeing of NSW and increase resiliency to a changing climate. The framework establishes the long-term objective to achieve net-zero emissions by 2050. Key policy directions that the NSW Government would implement include:

- Reduce risks and damages to public and private assets in NSW arising from climate change
- Reduce climate change impacts on health and wellbeing
- Manage impacts on natural resources, ecosystems and communities.

The framework would also seek to develop additional climate change and energy plans and policy investigations for sectors with significant opportunities and risks.

The proposal objectives directly align with some of the policy directions of the *NSW Climate Change Policy Framework* as the proposal seeks to improve water management and water security for an area of regional NSW that has experienced, and is facing, increased risks of natural hazards from climate change. The proposal is intended to contribute to the management of the impact of climate change on natural water resources by improving water storage capacity and supply during times of drought. Improving water security will have widespread benefits for community health and wellbeing, both physically and culturally. As detailed in Section 4.1.2 of **Technical Report 1**, the preliminary concept design of the proposal allows for climate change and changing river conditions.

21.4.2 Assessment methodology

The methodology for the greenhouse gas and climate change assessment included:

- Using NARCliM modelling projections when considering climate factor changes in the proposal area in the near future (2020-2039) and in the far future (2060-2079)
- Considering potential impacts of climate change risks and hazards such as increased extreme weather events on the proposal
- Considering the potential impacts of the proposal on climate change through the release of greenhouse gases during construction and operation
- Determining which construction and operation activities would contribute to greenhouse gas emissions
- Recommending mitigation measures to manage any risks.

21.4.3 Existing environment

Based on the NSW and ACT Regional Climate Modelling (NARCliM) projections, key projections for Wilcannia, and the Far West Region include:

- On average, temperatures are projected to increase by 0.67 ºC between 2020 and 2039
- Average rainfall is projected to decrease by about two per cent between 2020 and 2039, with increased rainfall over summer and autumn, but decreased rainfall in winter and spring
- In Wilcannia, an additional 1.5 days a year are predicted to have a forest fire danger index above 50. Over 50 is considered a severe fire danger rating
- Along the Darling River (Baaka) within the extent of the study area, an additional 1.6 days a year forest fire danger index reaches above 50
- In Wilcannia, an additional 11 to 12 days per year where maximum temperatures are above 35 ºC.

These general projections for the Far West Region are similar to the trends projected for other regions of NSW. The climate of this region is influenced by its low-lying topography and distance from the coast, where the central and western parts are very dry, with increasing maximum temperatures towards the north during summer (Office of Environment and Heritage, 2014). The warming trend has occurred since about 1950, and the largest increase in temperature has been experienced in recent decades.

The Far West Region is semi-arid and receives 200 to 400 millimetres of rainfall per year on average. Wilcannia's average annual rainfall is 264.8 millimetres and projected to decrease by about 2 per cent in the near future.

21.4.4 Assessment of impacts

21.4.4.1 Climate change impacts

The projected increase in average number of hot days and decrease in annual rainfall have implications on demand for water, river flow conditions and weir operations. Decreases in rainfall, combined with increasing average temperature can exacerbate drought conditions and heatwave hazards.

These climate factors on a regional and local scale impacts human health, community wellbeing, and a lack of water impacts on biodiversity and habitats.

Increased maximum temperatures are known to impact human health through heat stress and increased heatwave events. The occurrence of heatwaves is projected to occur more frequently and last longer, where both temperatures and hot days are projected to increase. The longest heat waves have been concentrated in the Far West Region, where the region on average experiences 15 days per year with temperatures above 40 ºC (Argüeso et al., 2015)

Modelling of the secure yield and demand forecasting completed by Public Works Advisory and Water Infrastructure NSW have allowed for a 1ºC temperature rise.

The CSIRO Murray-Darling Basin Sustainable Yields Project (CSIRO, 2008) concluded that at the time, the best estimate of climate change by 2030 would reduce average surface water availability by eight per cent and increase surface water diversions by 2 per cent due to increased evaporation from water storages. The CSIRO project also found that likely future growth in farm dams would reduce average river inflows by three per cent, and future rainfall run-off in the Barwon-Darling region would decrease by two per cent. The modelled reduction in water availability suggests that a warming climate trend would impact the secure yield of the river system. At the same time, increased frequency of extreme weather events such as heatwaves, drought or flooding are also considered climate change-related hazards, which could affect the construction and operation of the proposal.

Due to the relatively short timeframe for construction, it is not anticipated that short term variations in temperature or rainfall patterns would impact on construction activities. Mitigation measures would be implemented to protect construction personnel against heat stress and any hazards caused by heavy rain. No long-term climate change mitigation measures are considered necessary for the proposal construction.

Climate change may impact the proposal during operation through broad regional climate variations such as temperature rise and drought events, and localised changes such as increased frequency and intensity of extreme weather events. Severe and more frequent storms would lead to more precipitation upstream of the Darling River (Baaka), and lead to increased flows in the river through Wilcannia. Prolonged drought events would lead to drier conditions and potentially higher evaporation rates, reducing the river flow or stopping it completely. Both increased and decreased water levels in the river as a result of climate variables would impact on the operation of the proposal, however these changes would be managed through the operation of the weir gate and have been considered as part of the proposal design.

The proposal design would perform its built-in function to control and manage the water storage at Wilcannia in response to any water availability changes.

Long-term impacts of climate change on the proposal are not anticipated to affect the weir infrastructure however maintenance to the structure would be carried out if the weir becomes damaged or if there is greater slope instability.

In adopting the precautionary principle, a number of adaptation measures are proposed to address potential risks and opportunities associated with climate change, including:

- Ongoing review of latest climate change scenario modelling for the Far West Region
- Ongoing monitoring of water quality in the Darling River (Baaka) at Wilcannia
- Monitoring and surveillance of the weir infrastructure.

21.4.4.2 Construction greenhouse gas impacts

Construction of the proposal would result in greenhouse gas emissions being produced at the new weir and existing weir sites, including any compound areas and access tracks.

Specific emission sources include:

- Land clearing (decomposition of cleared vegetation)
- Liquid fuel combustion from plant and vehicles during construction, and vehicles used in disposal and transport of materials
- Embodied energy in construction materials including concrete and steel
- Emissions associated with electricity use.

The largest source of greenhouse gas emissions during construction would be linked to fuel combustion. Due to the remoteness of the location, all materials, and most personnel would need to travel long distances to get to Wilcannia. These greenhouse gas emissions are unavoidable but can be minimised by implementing the mitigation measures identified in **Section 21.4.5**.

21.4.4.3 Operation greenhouse gas impacts

Only two potential sources of greenhouse gas emission production during operation have been identified.

Electricity usage associated with the operation of the weir gates would be occasional and relatively minor, consequently it is assumed that any greenhouse gas emissions associated with electricity during operation would have a minor to negligible impact.

Based on the anticipated light workforce and light vehicle trips required to maintain and operate the proposal (refer to **Section 19**), it is assumed that any greenhouse gas emissions associated with vehicles during operation would have a minor to negligible impact.

21.4.5 Mitigation and management measures

Mitigation measures for climate change and greenhouse impacts are provided in **Table 21-6**.

Table 21-6 Mitigation and management measures to manage climate change and greenhouse impacts

Ref	Impacts	Mitigation measures	Timing
CC1	Greenhouse gas emissions	The construction contractor will consider the following as a minimum to minimise potential greenhouse gas emissions: ▪ Preferential use of local materials (where feasible and available) to reduce quantities of fuel consumption associated with material transportation ▪ Delivery of materials with full loads where feasible ▪ All plant and vehicles will be maintained regularly to maintain fuel efficiency ▪ Where reasonable and feasible, recycle or reuse construction materials such as rocks ▪ Consider the greenhouse gas intensity and sustainability of the materials selected ▪ Consider fuel efficiency when selecting vehicles, plant and equipment to be used during construction work ▪ Switch off all vehicles, plant or equipment not in use for extended periods, e.g. switch of heavy vehicle engines during unloading ▪ Minimise the number of vehicle trips and distances travelled by making this an objective when planning the construction works including staging and sequencing of the works, managing spoil and materials delivery, and selecting locations for construction compounds and temporary materials laydown and storage areas.	Construction

21.5 Sustainability

This section presents an assessment of the proposal against the principles of sustainability and demonstrates how sustainability was integrated into the construction, operation, and design. It includes an assessment against the Infrastructure Sustainability Council of Australia (ISCA) sustainability rating scheme and identifies a minimum rating scheme target level.

Sustainability on infrastructure projects is often considered against the requirements and ratings system of ISCA, the peak body for sustainability in Australia. ISCA provides a definition specific to sustainable infrastructure development within the Australian context, being that which is "planned, designed and delivered to meet the needs of society whilst enhancing our environment and economy." (ISCA, 2018).

SEAR no. 12 includes requirements for the assessment of the proposal's ecologically sustainable development (ESD) performance. The requirements of SEAR no. 12 and where they are addressed in this environmental impact statement are provided in **Appendix A**.

21.5.1 Legislative and policy context

The following sections outline the relevant aims and objectives of key legislation, policies and guidelines that have directed the consideration and integration of sustainability into the project design and environmental assessment.

The following policies are relevant to sustainability considerations for the proposal:

- United Nations Sustainable Development Goals (United Nations, 2015)
- EP&A Act
- Infrastructure Sustainability Rating Tool v1.2 (ISCA, 2018)
- *NSW Climate Change Policy Framework* (Office of Environment and Heritage, 2016b)
- NSW Government Resource Efficiency Policy (Office of Environment and Heritage, 2019)
- NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (Environment Protection Authority, 2014b)
- Aboriginal Participation in Construction Policy (NSW Government, 2018)
- NSW Infrastructure Skills Legacy Program (NSW Government, 2017).

A discussion of the broader legislative and strategic framework relevant to the proposal is presented in **Section 4** and **Appendix C**. Specific objectives and aims of these plans in relation to sustainability are outlined below.

United Nations Sustainable Development Goals

World leaders adopted the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development at a historic United Nation summit in August 2015. The SDGs are global goals that address various social, environmental, and economic issues. The SDGs came into effect on 01 January 2016; with the aim of meeting each goal and target by 2030. The proposal would contribute directly to two of the SDGs:

- Goal 6 Clean Water and Sanitation: Goal 6 acknowledges that provision of clean drinking water services is essential to enable healthy livelihoods. The proposal would provide a long-term water supply for the township of Wilcannia and alleviate water insecurity issues
- Goal 9 Industry, Innovation and Infrastructure: Goal 9 acknowledges that investment in infrastructure is crucial to achieving sustainable development and empowering communities. The proposal is State significant infrastructure, identified as a priority infrastructure project intended to improve water security for an isolated regional community and improve the drought resiliency for the Wilcannia community.

EP&A Act

The concept of sustainable development has been introduced into the NSW planning and development legislation by the EP&A Act. One of the objectives outlined in section 1.3(b) of the EP&A Act is 'to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment'.

Through the development of environmental management measures in this environmental impact statement, the proposal has outlined how it would facilitate the ESD objectives of the NSW government by considering economic, environmental and social factors in the design, construction and operation of the proposal.

Infrastructure Sustainability Rating Tool v1.2

The Infrastructure Sustainability (IS) Rating Tool Version 1.2 was developed by ISCA as a comprehensive national sustainability rating tool for infrastructure. The IS Rating Tool v1.2 is voluntary and measures sustainability performance across the quadruple bottom line (environmental, social, economic and governance). The IS Rating Tool v1.2 is the current version of the rating scheme, however, IS Rating Tool v2.0 is currently in beta testing.

The IS Rating Tool establishes different categories for assessment, and each of the categories are divided into several credits which address a specific aspect of sustainability performance within each category. The score is calculated with points from each of the categories assessed and the project is awarded an IS Rating based on the total score:

- 25-49+ – commended
- 50-74+ – excellent
- 75+ – leading.

The aspects of sustainability that are considered in IS Rating Tool v1.2 are shown in **Table 21-7**.

Table 21-7 Sustainability categories in IS Rating Tool v1.2

Themes	Categories	Description
Management and Governance	Management Systems	Management systems aim to ensure consistent and efficient activities within an organisation, project or asset management.
	Procurement and Purchasing	Goods and services should be procured in a manner that optimises economic, social and environmental outcomes.
	Climate Change Adaptation	Infrastructure needs to be designed, constructed and operated to cope with projected hotter, drier and stormier climatic conditions, with higher sea levels.
Using Resources	Energy and Carbon	Energy and carbon monitoring and reduction, and the use of renewable energy.
	Water	Conserving water and managing runoff and wastewater to prevent pollution.
	Materials	Ensuring that materials such as aggregates, concrete, steel, oil and wood are responsibly sourced, and used efficiently.

Themes	Categories	Description
Emissions, Pollution and Waste	Discharges to Air, Land and Water	Concerned with pollution to waterways, noise and vibration, air pollution, and light pollution.
	Land	Ensuring that the land used is not of high environmental or social value.
	Waste	Construction should avoid the generation of waste, manage waste as a resource, and ensure that waste treatment, disposal, recovery and re-use is undertaken in a sound manner.
Ecology	Ecology	Considers local ecosystems (soil, water, air, biomass and wildlife).
People and Place	Community Health, Well-being and Safety	This relates to the concept of liveability, and that community well-being is considered in the construction of infrastructure.
	Heritage	This encompasses the conservation of Aboriginal, historic and natural heritage in a local area.
	Stakeholder Participation	Refers to the processes and mechanisms that enable stakeholders who have a direct or indirect interest in infrastructure development to be part of decision making.
	Urban and Landscape Design	Concerned with the arrangement, appearance and function of infrastructure within an area.
Innovation	Innovation	Innovation is the creation of more effective infrastructure, processes, services, technologies, or ideas.

NSW Climate Change Policy Framework

The *NSW Climate Change Policy Framework* (Office of Environment and Heritage, 2016b) aims to maximise the economic, social and environmental wellbeing of NSW in the context of a changing climate. The framework outlines policy directions for implementing the NSW government's long-term objectives of achieving net zero emissions by 2050 and improving the resilience of NSW to a changing climate, including:

- Creating a certain investment environment by working with the Commonwealth to manage transition
- Boosting energy productivity to put downward pressure on household and business energy bills
- Capturing co-benefits and manage unintended impacts of external policies
- Taking advantage of opportunities to grow new industries in NSW
- Reducing risks and damage to public and private assets in NSW arising from climate change
- Reducing climate change impact on health and wellbeing
- Managing impact on natural resources, ecosystems and communities.

The proposal objectives directly align with some of the policy directions of the *NSW Climate Change Policy Framework* as the proposal seeks to improve water management and water security for an area of regional NSW that has experienced, and is facing increased risks of natural hazards from climate change. The proposal is intended to contribute to the management of the impact of climate change on natural water resources by improve water storage capacity and supply during times of drought. Improving water security will have widespread benefits for community health and wellbeing, both physically and culturally. As detailed in **Section 2.1.3**, the preliminary concept design allows for climate change and changing river conditions, and management measures will be implemented to maximise the resilience of the proposal to climate change impacts (refer to **Table 21-8**).

NSW Government Resource Efficiency Policy

The *NSW Government Resource Efficiency Policy* (Office of Environment and Heritage, 2019) aims to drive resource efficiency, with a focus on energy, water and waste, and a reduction in harmful air emissions. The policy aims to ensure that NSW Government agencies show leadership by incorporating resource efficiency in decision-making. The policy includes specific measures, targets, and minimum standards to drive resource efficiency alignment to energy, waste, clean air and water.

Environmental management measures seeking to improve resource use efficiency are included in Section 10.7, Section 21.1.5, Section 21.2.5 and Section 21.4.5.

NSW Waste Avoidance and Resource Recovery Strategy 2014-2021

The *NSW Waste Avoidance and Resource Recovery Strategy 2014-21* (Environment Protection Authority, 2014) identifies objectives and targets for effective waste management across six key result areas. The key result areas are: avoid and reduce waste generation; increase recycling; divert more waste from landfill; manage problem wastes better; reduce litter; and reduce illegal dumping. The strategy includes long-term targets for each key result area.

Potential waste impacts related to the proposal are discussed in **Section 21.2.4**. Proposal specific objectives and initiatives that would be used to optimise resource efficiency and waste management are shown in **Table 21-8**.

Aboriginal Participation in Construction Policy

The *Aboriginal Participation in Construction Policy* (APIC Policy) (NSW Government, 2018) was developed to support greater participation and opportunities for Aboriginal people in government construction projects across NSW. It specifically aims to increase the number of Aboriginal people employed under the NSW Government plan for Aboriginal Affairs by encouraging Aboriginal training.

Water Infrastructure NSW's current funding deed for the proposal's planning phase requires that five per cent of the total spend go towards the APIC Policy. As the proposal's planning phase does not include construction activities, approval was sought from DPE to allocate the five per cent spend to local training and the arts. The funding was used to implement local skills training programs to ensure qualified applicants are available when construction starts and for the funding of a local art project for the new weir.

Water Infrastructure NSW would be provided with a new funding deed when the proposal enters the construction phase. The new deed is expected to require that five per cent of the total spend go towards the APIC Policy. During construction this spend would be met by the principal contractor engaging participants from the training programs to work on the proposal, as well as smaller packages of work which would be tendered to the local community. A portion of the spend would also be used to engage RAPs to witness and archive the project works.

Water Infrastructure NSW is committed to promoting Aboriginal participation, including engagement with Murdi Paaki Services, Regional Enterprise Development Institute and TAFE NSW Wilcannia campus to deliver training, workforce placement and job opportunities for the Aboriginal community, throughout the consultation, design, and construction phases of the proposal. Water Infrastructure NSW has already commenced active engagement with the Aboriginal community, as detailed above and in **Section 5.**

NSW Infrastructure Skills Legacy Program

The *Infrastructure Skills Legacy Program* (ISLP) (NSW Government, 2017) seeks to capitalise on the NSW Government's record levels of infrastructure investment to boost the number of skilled construction workers and create fresh pathways to employment across the state. The ISLP is a mandatory requirement for all major NSW Government infrastructure projects. The *Training Management Guidelines* (NSW Government, 2020) help government agencies and construction contractors meet the ISLP targets.

For construction contracts over $10 million and up to $100 million to establish skills, project objectives must:

- Embed an apprenticeship target of 20 per cent of the trade's workforce
- Include the above target in contract requirements and tender documentation provided to potential construction contractors
- Include in contract requirements that construction contractors consider the capacity of subcontractors to contribute to skills and training targets
- Consider the capacity of a potential construction contractor to meet these requirements when assessing proposals and awarding a contract, including a contractor's previous performance in meeting the requirements
- Ensure construction contractors contractually commit to reporting on a quarterly basis on their achievement against the targets
- Report on a quarterly basis to Training Services NSW in Department of Education against agreed targets
- Apply the relevant Aboriginal Procurement Policy.

All requirements for construction contracts over $10 million also apply to construction contracts over $100 million. The minimum ISLP targets for the proposal are:

- 20 per cent of the total project workforce is to be made up of learning workers, who are defined as trainees and workers who need to update their qualifications to meet the needs of the infrastructure project
- 20 per cent of all trades positions on a project to be made up of apprentices
- Apply the relevant Aboriginal Procurement Policy
- Doubling the number of women in trade-related work (up from the current NSW average of one per cent to two per cent)
- Ensuring at least eight per cent of the total project workforce is less than 25 years old.
- Reporting the employment and training outcomes for people from the local region (local region to be defined in the contract).

Water Infrastructure NSW would develop a project sustainable procurement plan and Aboriginal participation plan using the guidelines. The implementation of these plans in conjunction with the training and employment initiatives under the APIC Policy would enable the project to achieve the ISLP targets throughout the design and construction phases.

Water Infrastructure NSW Environmental and Sustainability Policy

Water Infrastructure NSW has developed an Environmental and Sustainability Policy that outlines its vision, purpose and approach to delivering water infrastructure. The key elements of the policy are:

- Vision – To deliver water infrastructure solutions that enhance cultural and socio-economic outcomes for the communities of NSW in an environmentally responsible and sustainable manner
- Purpose – To build resilience in regional water supplies by developing and delivering critical water infrastructure projects. Water Infrastructure NSW designs sustainable, innovative and integrated infrastructure that is effective to operate and maintain and adaptable to future requirements including those resulting from climate change
- Approach – Water Infrastructure NSW collaborates with industry partners and stakeholders across the water sector to deliver innovative infrastructure and water management solutions. It strives to ensure that sustainability and environmental management processes are applied consistently across its portfolio, from design through to procurement and delivery. Water Infrastructure NSW works to enhance its internal processes and project delivery through continuous improvement initiatives driven by qualitative and quantitative data sourced through research, feedback, consultation and audits (Water Infrastructure NSW, 2022).

Sustainability implementation

Most of the IS Rating Tool applies to future stages of a project, in construction and operation, however the requirements of the IS Rating Tool have been considered in the design development of the proposal. The assessment of environmental impacts and the identification of relevant environmental management measures (refer to **Appendix E**) have further integrated sustainability considerations into the proposal.

The outcomes from this environmental impact statement, including any relevant conditions that may be applied to the proposal by the Minister for Planning would be used to finalise the sustainability objectives and targets for the proposal.

Indicative objectives and targets for the current phase of the proposal and the ISCA sustainability theme/category (v1.2) which they align with are outlined in **Table 21-8**. While Water Infrastructure NSW has not yet registered with ISCA, it would aim for the proposal to achieve sustainability outcomes equivalent to an IS Rating of between 50-74+ - excellent.

Table 21-8 Indicative sustainability objectives and target themes

Sustainability objective	Initiative and targets	ISCA v1.2 sustainability theme/category
Maximise sustainability knowledge and awareness	▪ Sustainability commitments (including procurement commitments) ▪ Sharing of sustainability outcomes with the community/stakeholders and industry ▪ Integrate environmental and social principles into the project framework ▪ Document and evaluate environmental and social costs and benefits.	▪ Management and governance: procurement and purchasing, management systems ▪ People and place: community health, well-being and safety, stakeholder participation.
Minimise energy use and greenhouse gas emissions	▪ Use energy efficient equipment, methods, and practices ▪ Local sourcing of materials where feasible.	▪ Emissions, pollution and waste: discharges to air, land and water ▪ Using resources: materials, energy and carbon.
Optimise resource efficiency and waste management	▪ Reuse of topsoil ▪ Reuse site won material where possible ▪ Diversion of construction office waste from landfill ▪ Achieve efficient use and management of resources.	▪ Emissions, pollution and waste: waste ▪ Using resources: materials, water, land ▪ Management and governance: management systems.
Maximise resilience to climate change impacts	▪ Climate change risk mitigation and/or adaptation measures ▪ Fit-for-purpose infrastructure with different operating modes ▪ Ensure emergency procedures adequate address extreme weather events.	▪ Management and governance: climate change adaptation, management systems.

Sustainability objective	Initiative and targets	ISCA v1.2 sustainability theme/category
Enhance liveability and wellbeing of local communities	▪ Protecting and supporting heritage values ▪ Community benefit initiatives ▪ Enhance existing public open space ▪ Incorporate Crime Prevention Through Environmental Design principles ▪ Provide a community river place that is suitable for a range of uses by the community ▪ Ensure efficiency and durability of built infrastructure that requires minimum expenditure in maintenance and upkeep.	▪ People and place: community health, well-being and safety, stakeholder participation, heritage, urban and landscape design ▪ Innovation: innovation ▪ Emissions, pollution and waste: land ▪ Management and governance: management systems.
Maximise employment and training opportunities for young, local Aboriginal people	▪ Aboriginal apprenticeships ▪ Aboriginal training and development ▪ Aboriginal workforce participation ▪ Develop Aboriginal workforce skills which support skill shortages, transferable skills and new technologies ▪ Increase local Aboriginal employment and participation of small and medium enterprises including Recognised Aboriginal Businesses.	▪ Management and governance: procurement and purchasing ▪ People and place: community health, well-being and safety, stakeholder participation, heritage, urban and landscape design ▪ Innovation: innovation.
Efficiently manage water	▪ During construction, water collected within the instream work sites would be used for dust suppression and other on-site uses, or otherwise treated and returned to the river ▪ Operate the new weir to provide water security to Wilcannia while also aiming to maximise flows past the new weir to support downstream aquatic ecology.	▪ Using resources: water ▪ Ecology: ecology ▪ Management and governance: management systems.
Minimise pollution generated by the proposal	▪ Avoid generating dust emissions during construction ▪ Minimise noise and vibration during construction ▪ Protect surface water quality in the Darling River (Baaka) during construction ▪ Avoid contamination of soils, surface water and groundwater during construction.	▪ Emissions, pollution and waste: land, waste, discharge to air, land and water ▪ Using resources: water, materials ▪ Ecology: ecology ▪ Management and governance: management systems.

Sustainability objective	Initiative and targets	ISCA v1.2 sustainability theme/category
Minimise impacts on biodiversity and the environment	▪ Provide fish passage past the new weir to enable native fish migration upstream and downstream at Wilcannia.	▪ Ecology: ecology ▪ Emissions, pollution and waste: land, waste, discharge to air, land and water ▪ Management and governance: climate change adaptation, management systems ▪ Innovation: innovation ▪ Using resources: water, materials.
Protect and promote Aboriginal and non-Aboriginal heritage and culture	▪ Avoid or minimise impacts to heritage ▪ Identify and implement opportunities to enhance heritage and cultural values via design and interpretation ▪ Ensure key Aboriginal stakeholders are meaningfully engaged ▪ Create opportunities for archaeological interpretation.	▪ Management and governance: procurement and purchasing, management systems ▪ People and place: community health, well-being and safety, stakeholder participation, heritage, urban and landscape design ▪ Innovation: innovation ▪ Ecology: ecology.
Stakeholder engagement and deliver community benefits	▪ Collaborate with key stakeholders to drive a lasting legacy in workforce development and industry participation ▪ Establish collaborative working relationships with stakeholders ▪ Sustainable procurement along the supply chain ▪ Engage with local Aboriginal communities to integrate Aboriginal cultural values appropriately into design ▪ Ensure the community and local stakeholders are engaged and kept informed of construction activities ▪ Provide information in ways that are easily accessible for the local community ▪ Deliver initiatives that benefit local communities and provide positive social outcomes.	▪ Management and governance: procurement and purchasing, management systems ▪ People and place: community health, well-being and safety, stakeholder participation, heritage, urban and landscape design ▪ Innovation: innovation.

21.5.2 Management and mitigation measures

Mitigation and management measures for sustainability impacts are provided in **Table 21-9**.

Table 21-9 Mitigation and management measures to promote sustainability outcomes

Ref	Impacts	Mitigation and measures	Timing
SU1	Sustainability outcomes	A sustainability management plan will be prepared as a sub-plan of the construction environmental management plan. The sustainability management plan will include: ▪ sustainability objectives and targets ▪ details of sustainability initiatives to be implemented during planning and delivery of the proposal ▪ timing and responsibilities for implementing sustainability initiatives ▪ measures to determine the effectiveness of the sustainability initiatives in achieving the sustainability objectives and targets.	Pre-construction Construction
SU2	Local content	Local content will be considered during the procurement for the construction phase of the proposal. Water Infrastructure NSW will develop a sustainable procurement plan that will require construction contractors to demonstrate their local content as part of the tender process, to ensure that construction contractors are engaging local participants from the training programs under the APIC Policy and to achieve the ISLP targets through the design and construction phases. A participant resource list would be provided with the tender documents and the APIC Policy requirement will be written into the construction contract.	Pre-construction Construction

22. Cumulative impact assessment

This section provides an assessment of the potential cumulative impacts of the proposal when considered with other existing or proposed projects in the locality of Wilcannia. It describes other projects in the locality and identifies where there is the potential for cumulative impacts to occur. It addresses the SEARs general requirement for "consideration of the potential cumulative impacts due to other developments in the vicinity (completed, underway or proposed)". The assessment has been prepared in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2021e).

22.1 Overview

Cumulative benefits or impacts have the potential to occur when benefits or impacts from a project interact or overlap with benefits or impacts from other projects and can potentially result in a larger overall effect (positive or negative) on the environment, businesses or local communities.

Cumulative impacts may occur when projects are constructed concurrently or consecutively. Projects constructed consecutively (or sequentially) can have construction activities occurring over extended periods of time with little or no break in construction activities. This has the potential for increased impacts and construction fatigue for local communities.

The overall effect of cumulative benefits or impacts could be positive or negative, depending on the nature of the project and the nearby communities and environment. Once the new Wilcannia Weir is operational, other projects which interrelate may enhance the proposal and create positive cumulative benefits.

The extent to which another development or activity could interact with the construction and/or operation of the proposal would depend on its scale, location and/or timing of construction. Generally, cumulative impacts would be expected to occur where multiple long-duration construction activities are undertaken close to, and over a similar timescale of, construction activities for the proposal, or where consecutive construction activities occur in the same area. Additionally, operation of the proposal could cause cumulative benefits or impacts when it interrelates or possibly enhances the construction or operation of other projects.

22.2 Assessment methodology

The approach to assessing cumulative impacts focused on the proposal's interaction with other projects in the locality of the proposal, where construction or operational timeframes are likely to be concurrent, and where the potential impacts would be of a scale that could cause cumulative impacts.

Projects in the locality were identified using searches of the following data sources in January 2022:

- The major projects online database maintained by the DPE
- The Infrastructure Investment Program database maintained by the Australian Government's Department of Infrastructure, Transport, Regional Development and Communications
- Development consents on the Central Darling Shire's website and development applications placed on the NSW Planning Portal
- Proponent websites.

The following tasks were undertaken to assess the potential for cumulative impacts:

- Identifying potentially relevant projects in the study area (either proposed, with a known construction timeframe or approved) based on information available in the public domain
- Screening identified projects for the potential to interact with the proposal
- Identifying and assessing (quantitatively or qualitatively) the significance of potential cumulative impacts.

The projects identified were screened in relation to their potential for cumulative impacts that could compound the proposal's potential impacts. The projects were screened based on their nature, size and proximity to the proposal area and the cumulative impact assessment draws on the findings of **Section 7** to **Section 21.5.1**. The assessment has been limited to desktop review of the predicted impacts of external projects and consideration of where these impacts may overlap with the proposal. These potential cumulative impacts have been described in general terms in **Section 22.5**.

22.3 Other projects near the proposal

The projects in the locality that were considered to have the potential for cumulative impacts with the proposal are listed in **Table 22-1**.

Table 22-1 Projects with the potential for cumulative impacts with the proposal

Project and proponent	Description	Status	Timing	Location in relation to the proposal
New Wilcannia Water Treatment Plant – Central Darling Shire Council	Upgrade and replacement of current water treatments works.	Pre-construction	A contract for construction of the new water treatment plant was awarded in July 2021. The start of construction is yet to be confirmed, but could potentially be in late 2022. Construction would take 12 to 24 months.	16-34 Hood Street, Wilcannia
Wilcannia Township Gravity Sewer Scheme – Central Darling Shire Council	New gravity sewerage system to replace the existing pumped common effluent drainage system.	Scoping study	The DPE are currently developing a proposal for funding approval. It is expected that work would not commence until after the new weir is completed.	Throughout Wilcannia
Wilcannia Stormwater Mitigation Works – Water Infrastructure NSW	Installation of diesel-powered back-up pumps at pumping stations numbers 1 and 2.	Detailed design	Construction is scheduled to occur from late 2022.	Pumping station number 1 – Corner of Hood Street and Field Street, Wilcannia Pumping station number 2 – Martin Street, midblock between Hood Street and Woore Street, Wilcannia

Project and proponent	Description	Status	Timing	Location in relation to the proposal
Victory Park Caravan Park Amenities Block Refurbishment – Central Darling Shire Council	Refurbishment of the existing amenities block including installing a new sewage pumping station and storage tank.	Pre-construction	Construction is expected to start in about mid-2023 and would take up to about six months to complete, weather permitting.	Victory Park Caravan Park, on the left bank of the Darling River (Baaka) at the existing weir
Baaka Cultural Centre Wilcannia – National Indigenous Australians Agency	A new cultural centre in Wilcannia for the Barkandji people to practise their living culture, including their art, recorded history and tradition.	Construction	The Baaka Cultural Centre is expected to be completed and operational in early 2023.	Corner of the Barrier Highway and Reid Street

New Wilcannia Water Treatment Plant

A new water treatment plant is proposed to be built in Wilcannia as the existing plant has reached the end of its service life. The project is funded by the NSW State Government's Safe and Secure Water Program. A contract for construction of the project was awarded in July 2021 (Central Darling Shire Council, 2021).

The new water treatment plant would produce treated water of a consistent quality in accordance with the ADWG. The plant would be designed to treat raw water from the weir pool, which can be subject to algal blooms due to stagnation of water, and high colour and turbidity, which is exacerbated during wet weather events and prolonged dry periods.

Wilcannia Township Gravity Sewer Scheme

The existing Wilcannia township sewerage scheme is mostly a pumped common effluent drainage system comprising a septic tank arrangement on each property with a pump and pipework connecting the effluent tank/chamber to the low pressure sewerage reticulation network, which discharges to standard wet well submersible sewage pumping stations. There are several disadvantages associated with this system including the need for residential management of what is essentially an on-site sewage management system with the knowledge and resources to fulfil this task, surcharge of sewage from septic tanks, the cost of effluent pump replacement, and the shallow depth of installation of the low-pressure sewage reticulation network results in frequent damage from heavy vehicles such as garbage trucks.

In contrast to the common effluent drainage system in the township, septic tank infrastructure at the Mallee and Warrali Aboriginal estates was replaced with full gravity sewerage reticulation networks and sewage pumping stations in 2014-15 with funding from the NSW Government's Aboriginal Communities Water and Sewerage Program and the Australian Government's Remote Communities Program. The Mallee Aboriginal Estate comprises 28 residences on a single lot in the north-west of the township, and the Warrali Aboriginal Estate comprises 10 residences east of the Darling River (Baaka).

Central Darling Shire Council proposes to construct a gravity sewerage system for the Wilcannia township to avoid the problems associated with the current common effluent drainage system and to bring the level of sewerage services to the town's residents and businesses to the same standard as is now provided to the residents of Malle and Warrali Aboriginal estates. The Wilcannia Township Gravity Sewer Scheme project will be funded by the NSW State Government's Safe and Secure Water Program.

Wilcannia Stormwater Mitigation Works

As noted in **Section 2.2.2**, Water Infrastructure NSW proposes to minimise the risk of sewage entering the new town pool due to sewage overflows. Diesel-powered back-up pumps are proposed to be installed at pumping stations numbers 1 and 2 to provide continuity of pumping in the event of power or mechanical failures of these sewage pumping stations. The works are proposed to be carried out from late 2022 so that they are completed prior to the start of construction of the new weir.

Victory Park Caravan Park Amenities Block Refurbishment

Central Darling Shire Council proposes to replace the amenities block located at the centre of Victory Park Caravan Park. The proposed works include building a new amenities block alongside the existing amenities block, demolishing the existing amenities block, replacing perimeter drainage and sewerage services including installing a new sewage pumping station and storage tank, and installing disabled facilities next to the amenities block. The works also include new landscaping and paving. The works are expected to start in about mid-2023 and would take up to about six months to complete, weather permitting.

Baaka Cultural Heritage Centre

Work has commenced in Wilcannia on a new cultural centre for the Barkandji people to practise their living culture, including their art, recorded history and tradition. The Baaka Cultural Heritage Centre will provide a keeping place for Barkandji artifacts, language, and memories. It will also support inter-generational and inter-cultural teaching through the keeping place and language lab that has partnerships with local schools and research institutions.

The new cultural centre is being constructed on the site of the derelict heritage 'Knox and Downs' store building. It is expected to be completed and operational in early 2023.

22.4 Western Weirs Program

The Western Weirs Program is a study by Water Infrastructure NSW to investigate a whole-of-river system approach to the management of the Barwon-Darling and Lower Darling systems and their river infrastructure.

Water Infrastructure NSW has developed a strategic business case for the program. The program seeks to improve water security for towns in the Far West Region, including Aboriginal communities supplied by those towns, by evaluating infrastructure options to improve water security for towns and improve river flows along the Barwon-Darling and Lower Darling rivers (Baaka). The strategic business case also assesses alternative non-weir options that could have similar benefits for improving town water security.

A key driver of the study is to improve system flows, so any future improvements to the volume or quality of inflows to Wilcannia that are identified would be beneficial.

The strategic business case for the Western Weirs Program is being considered by Infrastructure NSW. Infrastructure NSW will determine if the program receives further funding to proceed to a more detailed analysis in a final business case.

Implementation of the Western Weirs Program may include all or some of the following:

- Construction of either new or upgraded weirs at towns incorporating gates and fishways
- Possible removal or lowering of some weirs that do not supply water for towns
- Alternative options to weirs to improve town water security.

Within Water Infrastructure NSW, the Wilcannia Weir Replacement project team has consulted regularly with the Western Weirs Program team to ensure that it is informed of the proposal's construction and operation, so that there is overarching consistency between the proposal and the various hydraulic modelling studies being undertaken for the Western Weirs Program.

22.5 Cumulative impacts with other projects

The proposal has been developed in liaison with Central Darling Shire Council and relevant teams within Water Infrastructure NSW to minimise the potential for adverse cumulative impacts due to the nearby projects discussed in **Section 22.3**.

The operation of the proposed new Wilcannia water treatment plant and upgrades to the town's sewerage system would, together with the operation of the proposal, have the potential for cumulative surface water quality and social impacts. There is also the potential for cumulative social, traffic, noise and vibration and air quality impacts if the construction phases of the projects discussed in **Section 22.3** and the proposal overlap. The following sections discuss these potential cumulative impacts.

22.5.1 Surface water quality

The stormwater mitigation works are proposed by Water Infrastructure NSW specifically to reduce the risk to surface water quality in the new town pool as a result of overflows from the town's sewerage system. The works would target the two sewage pumping stations in the town's sewerage system that have the greatest likelihood of overflowing and causing sewage to flow into the new town pool via the stormwater system. As the proponent of both the proposal and these works, Water Infrastructure NSW would schedule the stormwater mitigation works ahead of the proposal to ensure it is operational prior to construction of the proposal starting.

The proposed Wilcannia Township Gravity Sewer Scheme project and Victory Park Caravan Park Amenities Block Refurbishment project would also reduce the likelihood of sewage overflows occurring and therefore the risk of sewage entering the new town pool.

22.5.2 Social

The reduced risk of sewage overflows occurring as a result of the proposed Wilcannia Stormwater Mitigation Works, Wilcannia Township Gravity Sewer Scheme project and Victory Park Caravan Park Amenities Block Refurbishment project would minimise the health risks of recreational swimming in the new town pool. This would make swimming in the new town pool a more attractive recreational activity for the local community. These projects would therefore be supportive of the social benefits of the proposal.

The proposed New Wilcannia Water Treatment Plant project would improve the quality of Wilcannia's town water supply. This project, together with the improvement in the security of the town's water supply provided by the proposal, would make the supply of drinking water less of a concern for the local community and thereby improve the liveability of Wilcannia.

The proposal aims to deliver tourism benefits by encouraging more tourists to stop in Wilcannia. as detailed in **Sections 2.2.7** and **16.7.2**. The proposed Baaka Cultural Heritage Centre project would also encourage tourists to stop in Wilcannia. The combination of this project and the proposal would deliver a cumulative benefit to tourism because more tourists are likely to stop in the town if there are more attractions to view or visit.

22.5.3 Aboriginal heritage

The proposed Baaka Cultural Heritage Centre project would provide a place for the display of Barkandji cultural heritage items and would be used for the display of Aboriginal cultural heritage items salvaged during ground disturbance works for the proposal in accordance with management and mitigation measure AH5. It could also potentially by used to display Aboriginal cultural heritage items that would be disturbed by the proposal, such as Union Bend Canoe Tree 7(24-5-208). The combination of the Baaka Cultural Heritage Centre project and the proposal would therefore provide a cumulative benefit to Aboriginal heritage by providing an appropriate and convenient location for the safe storage and display of local Aboriginal cultural heritage items that would be directly impacted by the proposal.

22.5.4 Construction impacts

There is the potential for adverse social, traffic, noise and vibration and air quality impacts if the construction phases of the projects identified in **Section 22.3** overlap. It is currently expected that the Victory Park Caravan Park Amenities Block Refurbishment project would be completed prior to the commencement of construction of the proposal. As the proponent of both the proposal and the proposed Wilcannia Stormwater Mitigation Works, Water Infrastructure NSW would schedule the stormwater mitigation works to conclude prior to construction of the proposal starting.

A key potential impact of any construction works that occurs in Wilcannia at the same time as construction of the proposal is higher demand for temporary accommodation and local health services in the township compared to if all the proposed projects were constructed sequentially. Mitigation and management measures S3 and S4 are proposed to manage this potential impact (refer to Table 16-12).

Other potential cumulative impacts from construction of nearby projects and the proposal occurring at the same time would include greater traffic, noise and vibration and air quality (dust) impacts than if the projects occurred at different times. However, these cumulative impacts would be minor because much of the construction work for the proposal would be at the new weir site which is located just outside the township and the sensitive receivers most impacted by the proposal are not those most impacted by the other projects proposed in the town. Construction vehicles travelling to the work sites for the proposal could experience minor delays when travelling through the township if they pass work sites for other projects, particularly any work sites for the Wilcannia Township Gravity Sewer Scheme project that require road opening. (i.e. works within road reserves). However, any traffic delays are likely to be minimal and the grid layout of Wilcannia's road network enables easy detours around any such work sites.

22.6 Summary of results

Overall, the proposal and nearby projects would benefit the local Wilcannia community by improving the quality and security of the town's water supply and therefore its liveability, making it a more attractive location for tourists to stop at, and reducing the potential health risks of recreational swimming in the new town pool.

There are some potential adverse cumulative impacts if construction of the proposal and other local projects occur at the same time. Water Infrastructure NSW is working closely with the proponents of nearby projects including Central Darling Shire Council to minimise the potential for cumulative construction impacts. The proposal also included mitigation and management measures to avoid or minimise potential adverse cumulative impacts to local demand for temporary accommodation and health services.

23. Environmental risk analysis

The environmental risk analysis and residual risks were identified through the risk analysis process described in **Section 6.2** and provided in **Table 23-1**. The analysis has considered all key issues identified by the SEARs, as well as other environmental issues identified through the preparation of the environmental impact statement that have the potential to be impacted by the proposal.

The management approaches for residual impacts are discussed in **Section 23.1**.

Table 23-1 Environmental risk analysis summary

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Hydrology								
Permanent inundation of about 4.92 kilometres of the Darling River (Baaka) between the new and existing weirs (the new town pool)	Operation	Almost certain	Major	Very high	The permanent inundation of the river between the new and existing weirs to create the new town pool is an unavoidable consequence of locating the new weir downstream of the existing weir. Habitat in this section of the would be altered as a result of the change from flowing water habitat to weir pool. The new town pool is expected to provide social benefits as discussed in **Section 16.7.2**.	Almost certain	Major	Very high
Temporary inundation of about 18.81 kilometres of the Darling River (Baaka) upstream of the existing weir pool when the new weir is in drought security operation mode	Operation	Almost certain	Major	Very high	The temporary inundation of the river for about 18.81 river kilometres upstream of the existing weir pool when the new weir is in drought security operation mode is an unavoidable consequence of the drought full supply level being one metre higher than the existing full supply level to provide water security to Wilcannia for the longest drought on record. The new weir would typically be in drought security operation mode when there are no flows in the river and would keep this section of the river wetter for longer during dry periods than if it were not subject to temporary inundation.	Almost certain	Major	Very high
A temporary increase in the depth of the existing weir pool of one metre when the new weir is in drought security operation mode	Operation	Almost certain	Moderate	High	A temporary increase in the full supply level of the weir pool is required to provide water security to Wilcannia through the longest drought on record. Mitigation measure HY2 is proposed to refine the trigger for the new weir entering drought security operation mode, which would reduce the instances of the weir pool level being raised to the drought full supply level unnecessarily.	Almost certain	Moderate	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Changes to flows downstream of the new weir	Operation	Almost certain	Moderate	High	The new weir would reduce downstream flows, mostly when it enters the filling phase. This impact is a consequence of the new weir being maintained at the existing full supply level during normal operation mode and only being increased when the drought security operation mode is triggered. Flows downstream of the new weir need to cease during the filling phase to ensure that the weir pool fills to the drought full supply level to provide water security to Wilcannia before inflows to the weir pool cease. When the weir pool is at the drought full supply level it stores sufficient water to sustain Wilcannia through the longest drought on record. As a result, any inflows to the new town pool and Pool 1 after it has been filled to the drought full supply level can be discharged downstream as translucency flows. This would result in some flows downstream of the new weir when it is in drought security operation mode that would not have occurred downstream of the existing weir in the same circumstances.	Almost certain	Moderate	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Changes to water velocities upstream of the new weir	Operation	Almost certain	Moderate	High	The new weir would be a larger obstruction in the waterway than the existing weir and as a consequence would have a larger backwater effect at lower flows than the existing weir, as discussed in **Section 7.6.2**. The new weir is a large obstruction than the existing weir at low flows because flows would pass it through the weir gates and fishway, rather than overtopping the weir crest as occurs at the existing weir. The greater backwater effect of the new weir at low flows compared to the existing weir would result in a small reduction in water velocities upstream of the new weir. This impact is unavoidable.	Almost certain	Moderate	High
Geomorphology								
Erosion of the reformed and trimmed riverbanks at the new weir site	Operation	Likely	Moderate	High	Mitigation measure GE1 will be implemented to reduce the risk of erosion of the reformed and trimmed riverbanks at the new weir site occurring after completion of construction.	Very unlikely	Moderate	Low
Undercutting/notching of the riverbanks within the weir pool due to ponding of water against the riverbanks.	Operation	Likely	Moderate	Medium	Mitigation measure GE2 will be implemented during the reset phase to lower the weir pool gradually to reduce the potential for riverbank erosion within the weir pool.	Unlikely	Moderate	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Sedimentation is likely to occur in the about 18.81 river kilometre section of additional weir pool at the upstream end of the existing weir pool when it is inundated. It is also expected that these sediments may be remobilised and transported further downstream into the existing weir pool	Operation	Very likely	Moderate	High	No specific mitigation is proposed for this impact. As a large proportion of the sediment is fine grained and forms 'wash load' it is expected that mobilised sediment may still be transferred beyond the extent of the new weir, particularly during larger flood events. This would reduce the potential for sediment starvation downstream of the new weir.	Very likely	Moderate	High
Groundwater								
Spills or leaks of hydrocarbons or other hazardous materials onto the ground being drawn down into groundwater	Construction	Unlikely	Moderate	Medium	Mitigation measure GW1 will be implemented to avoid and manage risk to groundwater from spills or leaks.	Very unlikely	Moderate	Low

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
The groundwater level within 100 metres of either side of the Darling River (Baaka) at the new town pool is expected to rise to within five metres of the ground surface as a consequence of the inundation of this section of the river.	Operation	Almost certain	Moderate	High	This impact is unavoidable. Mitigation measure GW2 will be implemented to monitor groundwater levels and whether they rise more than predicted.	Almost certain	Moderate	High
Shallow groundwater (less than three metres below ground level) within 100 metres of either side of the Darling River (Baaka) has the potential to become saline through evapo-concentration over time	Operation	Likely	Moderate	Medium	Mitigation measure BIO14 will be implemented to monitor groundwater dependent ecosystems near to the new town pool for salinisation impacts.	Likely	Moderate	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Surface water quality								
Reduction in surface water quality due to ground disturbance works that result in erosion and sedimentation	Construction	Likely	Minor	Medium	Mitigation measure SW2 will be implemented to address erosion and sedimentation risks during the construction phase of the proposal.	Unlikely	Minor	Low
Reduction in river water quality due to dewatering activities from in-stream construction work sites	Construction	Likely	Moderate	Medium	Mitigation measures SW3 and SW4 will be implemented to address surface water quality risks from in-stream work sites.	Unlikely	Moderate	Medium
Reduction in river water quality due to disturbance of saline soils or release of oils, fuels, concrete waste, or dust and litter	Construction	Unlikely	Minor	Low	Mitigation measures SW5, SW6, SW7, SW8, SW9, GS1 and GS4 will be implemented to protect surface water quality during the construction phase. Surface water quality monitoring in accordance with mitigation measure SW10 will provide a check on the effectiveness of these controls.	Very unlikely	Minor	Low
Reduction in surface water quality during the initial filling of the new town pool	Operation	Unlikely	Insignificant	Low	As noted in **Section 10.6.2**, while some reduction in water quality may occur during filling of the new town pool, it is likely that this would be no different to a significant rainfall event in the catchment.	Unlikely	Insignificant	Low

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Mobilisation of sediment behind the existing weir wall	Operation	Unlikely	Minor	Low	As noted in **Section 10.6.2**, there is potential for sediment collected behind the existing weir to remobilise and be carried downstream into the new town pool and resulting in reduced water quality. The new weir would reduce the risk of any remobilised sediment from travelling further downstream. The proposed partial removal of the existing weir would reduce the risk of this sediment remobilising compared to removal of the entire existing weir.	Very unlikely	Minor	Low
Thermal stratification of the weir pool	Operation	Very likely	Major	High	Dissolved oxygen, temperature and electrical conductivity would be measured at an existing gauging station at Rock Bar located between the new weir and the existing weir, which would assist in monitoring water quality and identifying whether passing translucency flows when the new weir is in drought security operation mode prevents or minimises thermal stratification and deterioration in water quality.	Likely	Major	High
Erosion downstream of the new weir due to the discharge from the weir gates	Operation	Likely	Minor	Medium	The design of the new weir includes rockfill at the discharge location to protect against scouring.	Very unlikely	Minor	Low
Flooding								
Localised flooding due to in-stream construction activities	Construction	Unlikely	Minor	Low	Mitigation measures F1 and F2 will be implemented to reduce the potential for the in-stream construction works to cause localised flooding.	Very unlikely	Minor	Low

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Terrestrial biodiversity								
Vegetation clearing including threatened flora and endangered ecological communities listed on both the BC Act and the EPBC Act	Construction	Almost certain	Moderate	High	Mitigation measures BIO1, BIO3, BIO4 and BIO8 will be implemented to minimise the extent and impacts of vegetation clearing.	Almost certain	Moderate	High
Fauna injury or death	Construction and operation	Unlikely	Minor	Low	Mitigation measures BIO3, BIO6, BIO7, BIO9, BIO10 and BIO13 will be implemented to avoid fauna injury and death.	Very unlikely	Minor	Low
Introduction and spread of weeds and pathogens	Construction	Likely	Minor	Medium	Mitigation measure BIO10 will be implemented to avoid the introduction and spread of weeds and pathogens.	Unlikely	Minor	Low
Aquatic biodiversity								
Direct impact to instream and riparian vegetation during construction of the new weir.	Construction	Almost certain	Moderate	High	Where instream and riparian vegetation outside of the footprint of the new weir is directly impacted the disturbed areas will be rehabilitated in accordance with mitigation measure AB2 as soon as practical, progressively and in accordance with the rehabilitation strategy.	Almost certain	Insignificant	Medium
Aquatic fauna injury or death	Construction	Unlikely	Minor	Low	Aquatic fauna salvage will occur to prevent injury or death in accordance with mitigation measure AB1.	Very unlikely	Minor	Low
Permanent inundation of aquatic habitat in the new town pool	Operation	Almost certain	Major	Very high	No specific mitigation is proposed. An appropriate aquatic biodiversity offset is being negotiated with Fisheries NSW to address this impact of the proposal.	Almost certain	Moderate	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Temporary inundation of about 18.81 river kilometres of aquatic habitat upstream of the existing weir pool when the new weir is in drought security operation mode	Operation	Almost certain	Minor	High	No specific mitigation is proposed. As discussed in **Section 13.6.2**, temporary inundation of about 18.81 kilometres of the river upstream of the existing weir pool when the new weir is in drought security operation mode would wet this reach of the river when it may otherwise be dry, which may benefit some species.	Almost certain	Minor	High
Impacts to flowing water habitat and aquatic species caused by a reduction in water velocities upstream of the new weir. This would occur as a consequence of the greater backwater effect of the new weir due to it being a greater obstruction in the waterway area than the existing weir	Operation	Almost certain	Moderate	High	No specific mitigation is proposed. An appropriate aquatic biodiversity offset is being negotiated with Fisheries NSW to address the aquatic ecology impacts of the proposal.	Almost certain	Moderate	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Impacts to aquatic habitat and species caused by a reduction of flows downstream of the new weir, primarily due to downstream flows ceasing when the new weir is in the filling phase	Operation	Almost certain	Major	Very high	Mitigation measure HY2 will be implemented to refine the triggers for the filling phase with the aim of reducing the frequency of filling. Minimisation of 'false filling' would reduce the instances of the operation of the new weir causing unnecessary downstream cease-to-flow spells. The new weir would include a translucency rule that would result in some downstream flows during dry periods which the existing weir would not provide. Mitigation measure HY3 will be implemented to identify opportunities to optimise translucency flows.	Almost certain	Moderate	High
Potential for the fishway at the new weir to not provide fish passage past the new weir as expected	Operation	Unlikely	Major	Medium	Mitigation measures AB5 and AB6 will be implemented to maintain the fishway and monitor its effectiveness respectively.	Very unlikely	Major	Medium
Aboriginal heritage								
Removal of culturally significant trees	Construction	Almost certain	Major	Very high	Mitigation measures AH2, AH7, AH12 and AH13 will be implemented to ensure impacts to culturally significant trees are the minimum required to enable the construction works.	Almost certain	Moderate	High
Total or partial harm to Aboriginal archaeological heritage sites and items	Construction	Almost certain	Major	Very high	Mitigation measures AH1, AH3, AH4, AH5, AH9, AH10, AH14 and AH15 will be implemented to reduce harm to Aboriginal archaeological heritage sites and items that are within or near to the construction footprint.	Almost certain	Moderate	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Potential impact on previously unidentified heritage items (unexpected finds)	Construction	Likely	Moderate	Medium	Mitigation measures AH6, AH10, AH11, AH15 and AH16 will be implemented to reduce the potential for impacts to previously unidentified Aboriginal heritage items.	Unlikely	Moderate	Medium
Non-Aboriginal heritage								
Direct impacts to the existing Wilcannia Weir, which has local heritage significance	Construction and operation	Almost certain	Major	Very high	Mitigation measure NAH2 will be implemented to address the direct impacts of the proposed on the heritage values of the existing weir.	Almost certain	Moderate	High
Potential impact on previously unidentified heritage items (unexpected finds)	Construction	Unlikely	Minor	Low	Mitigation measures NAH4 and NAH5 will be implemented to reduce the potential for impacts to previously unidentified non-Aboriginal heritage items.	Very unlikely	Minor	Low
Increased risk of corrosion to the piers of the Wilcannia Bridge due to the new town pool	Operation	Likely	Moderate	Medium	The corrosion risk to the piers of the Wilcannia Bridge will be addressed by Central Darling Shire Council. Mitigation measure NAH1 will be implemented to ensure that these works occur before construction of the new weir starts.	Very unlikely	Moderate	Low
Social, land use and property								
Temporary reduction in local amenity from construction activities e.g. dust, noise and visual impacts	Construction	Likely	Moderate	Medium	The community will be kept informed of the progress of the construction works and likely impacts during each stage of construction in accordance with the community communication strategy required in mitigation measure S1. Community awareness of when impacts would occur and their likely duration is expected to reduce their concerns about these impacts.	Unlikely	Moderate	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Community's perceived impacts to cultural heritage sites or values, and impacts to important features such as large River Red Gum trees during construction	Construction	Likely	Moderate	Medium	As noted above, mitigation measure S1 requires a community communication strategy and it will explain why impacts are required and also put these impacts into context against the benefits that the proposal would deliver. The social impact management plan will be implemented in accordance with mitigation measure S2 to ensure that key social benefits of the proposal are delivered.	Unlikely	Moderate	Medium
Reduced accommodation availability for locals and tourists during construction	Construction	Unlikely	Moderate	Medium	Mitigation measure S3 will be implemented by the construction contractor to ensure that any demand for accommodation for the construction workforce does not adversely impact the local rental market.	Very unlikely	Moderate	Low
Potential increased demand for local health services during construction of the proposal	Construction	Unlikely	Minor	Medium	Mitigation measure S4 will be implemented by the construction contractor to ensure that any demand for health services by the construction workforce does not impact the local community's access to health services.	Very unlikely	Minor	Low
Temporary closure of Victory Park Caravan Park during partial removal and decommissioning of the existing weir would reduce the amount of accommodation available in Wilcannia	Construction	Almost certain	Minor	High	No specific mitigation is proposed because Victory Park Caravan Park would only be closed for the duration of the works to partially remove and decommission the existing weir, which is expected to take about 10 weeks.	Almost certain	Minor	High

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Reduced access to the Darling River (Baaka) at the new and existing weir sites during construction	Construction	Likely	Minor	Medium	The community will be kept informed of the progress of the construction works and likely impacts during each stage of construction in accordance with the community communication strategy required in mitigation measure S1. Community awareness of when restrictions on accessing the Darling River (Baaka) would occur is expected to reduce their concerns about this impact.	Likely	Minor	Medium
Existing fish trapping sites between the new and existing weirs would be inundated. The local Aboriginal community would need to travel to downstream of the new weir to carry out fish trapping	Operation	Almost certain	Moderate	High	Inundation of fish trapping locations between the new and existing weirs is an unavoidable impact of the proposal. No specific mitigation of this impact is proposed.	Almost certain	Moderate	High
Reduced access to the Darling River (Baaka) at the new weir site during operation	Operation	Likely	Minor	Medium	The river would remain accessible at Union Bend and the improved amenity proposed at the community river place is likely to make this a preferred location for accessing the river.	Likely	Minor	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Visual amenity								
Impacts on visual amenity associated with construction activities	Construction	Almost certain	Minor	High	Visual impacts associated with construction works and construction traffic would be temporary, particularly at the existing weir site where the works are only expected to occur for about 10 weeks. A rehabilitation plan for the existing weir site will be prepared in accordance with mitigation measure LV4 and this will address the visual impact to nearby sensitive receivers resulting from removed vegetation and temporary construction work sites.	Unlikely	Minor	Low
Impacts on visual amenity associated with the new weir and associated infrastructure during operation	Operation	Almost certain	Minor	High	A rehabilitation plan for the new weir site will be prepared in accordance with mitigation measure LV1. The plan will address the visual impacts resulting from removed vegetation and temporary construction work sites and the new infrastructure.	Likely	Minor	Medium
Impact on visual amenity associated with the new town pool and temporary inundation upstream of the existing weir pool	Operation	Almost certain	Insignificant	Medium	No mitigation is proposed for the visual impact of the permanent new town pool and, when the new weir is in drought security operation mode, temporary inundation of about 18.81 kilometres of the river channel upstream of the existing weir pool. The proposed changes to visual amenity as a result of a permanently increased river level in the new town pool and a temporary increase in river level upstream of the existing weir pool would fit into the existing open rural and waterway views.	Almost certain	Insignificant	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Geology, soils and contamination								
Exposure of saline soils during construction	Construction	Unlikely	Moderate	Medium	Mitigation measure GS1 will be implemented to manage the risk of encountering saline soil during construction of the proposal.	Very unlikely	Moderate	Low
Exposure of contaminated soil, groundwater or materials during construction	Construction	Unlikely	Moderate	Medium	Mitigation measures GS2 and GS3 will be implemented to manage the risk of encountering contaminated soil, groundwater and materials during construction of the proposal.	Very unlikely	Moderate	Low
Traffic and transport								
Traffic risks associated with construction vehicles operating on roads in Wilcannia to access construction work site	Construction	Unlikely	Minor	Low	Construction traffic will be managed in accordance with a construction traffic management plan prepared in accordance with the requirements of mitigation measure T1.	Very unlikely	Minor	Low
Noise and vibration								
Construction noise and vibration impacts on sensitive receivers	Construction	Likely	Moderate	Medium	Construction noise and vibration will be managed in accordance with a construction noise and vibration management plan prepared in accordance with the requirements of mitigation measure NV1. The plan will include the comprehensive range of noise mitigation and management measures provided in **Table 20-13.**	Unlikely	Moderate	Medium

Summary of key impacts	Construction / Operation	Likelihood	Consequence	Risk	Mitigation measures	Residual likelihood	Residual consequences	Residual risk
Air quality								
Impacts to sensitive receivers from dust emissions from construction work sites	Construction	Unlikely	Minor	Low	Mitigation measures AQ1, AQ2 and AQ4 will be implemented to avoid dust emissions from construction sites impacting sensitive receivers.	Very unlikely	Minor	Low
Waste								
Generation of waste during construction of the proposal	Construction	Likely	Insignificant	Low	Waste generated during construction of the proposal will be managed in accordance with mitigation measures W1 to W4.	Likely	Insignificant	Low
Bush fire								
Potential for the construction works to cause a bush fire or for a bush fire to impact the construction works	Construction	Unlikely	Moderate	Medium	Mitigation measure BF1 will be implemented to manage bush fire risks during construction of the proposal.	Very unlikely	Moderate	Low
Climate change and greenhouse gas emissions								
Greenhouse gas emissions would be generated during construction of the proposal	Construction	Very likely	Insignificant	Medium	Greenhouse gas emissions generated during construction of the proposal will be minimised in accordance with mitigation measure CC1.	Likely	Insignificant	Low

23.1 Residual impacts / risks

23.1.1 High and medium residual risk

The risk analysis outlined in **Table 23-1** has identified the following issues as having a very high to medium residual risk after implementation of the mitigation and management measures proposed in this environmental impact statement:

- Hydrology
- Geomorphology
- Groundwater
- Surface water quality
- Terrestrial biodiversity
- Aquatic biodiversity
- Aboriginal heritage
- Non-Aboriginal heritage
- Social, land use and property
- Visual amenity
- Noise and vibration.

Opportunities will be identified during detailed design to:

- Resolve residual impacts and risks through design refinement
- Develop effective construction methodologies to ensure that mitigation measures are implemented
- Implement a process of review, correction and audit for the mitigation and management measures identified in **Appendix E**. A process of continuous improvement will allow for mitigation measures to be updated during construction and operation where feasible.

The assessment carried out for these issues has determined the likely extent of impacts can be suitably managed with the implementation of recommended feasible and reasonable mitigation measures. The implementation of the construction environmental management plan (refer to **Section 24.6.3**) would help to further reduce these potential impacts.

23.1.2 Low residual risk

Issues that have a low residual risk can be adequately managed through detailed design and construction and by the implementation of standard management measures so that all necessary environmental criteria and guidelines would be achieved. Issues with a low residual risk level include:

- Flooding
- Geology, soils and contamination
- Traffic and transport
- Air quality
- Waste
- Bush fire
- Climate change and greenhouse gas emissions.

24. Proposal justification

This section provides a justification and evaluation of the proposal as a whole, having regard to its economic, environmental and social impacts and the principles of ecologically sustainable development.

24.1 Overview

This environmental impact statement has detailed the need to construct and operate a new weir on the Darling River (Baaka) at Wilcannia to secure the town's water supply though a drought that equals the longest drought on record. It has explained why the proposal is the best alternative compared to alternatives such as doing nothing and upgrading the town's existing weir. The proposal would be delivered as part of the NSW Government's Safe and Secure Water Program and is consistent with a range of NSW Government policies including *Building Momentum State Infrastructure Strategy 2018-2038* (Infrastructure NSW, 2018), NSW State Priorities (NSW Government, 2019) and the *NSW Water Strategy* (DPIE, 2021b).

24.2 Proposal summary

The proposal comprises the construction and operation of a new weir and fishway and the decommissioning and partial demolition of the existing weir at Wilcannia.

The proposed new weir would be located on a reach of the Darling River (Baaka) downstream of Union Bend. The new weir would be about 4.92 river kilometres downstream of the existing weir, and about two kilometres south of the Wilcannia township.

The key design features of the new weir are shown in **Figure 24-1** and include:

- A weir with storage capacity of about 7,832 megalitres of water when the weir gates and fishway gates are closed
- A fixed crest portion of the weir about five metres high and 21.5 metres wide, next to the left riverbank
- A fishway about 120 metres long and 10.5 metres wide, next to the right riverbank
- Two weir gates built into a gate bay structure, about 22 meters long and eight meters wide, located between the fixed crest weir and the fishway
- New and upgraded access tracks for construction and maintenance activities
- A new electricity easement to provide high voltage power to a new substation near the weir. Underground consumer mains would provide low-voltage power from a new main switchboard near the substation to operate the weir and fishway gates.

The new weir would meet the future demand for town water, which is forecast to increase from 322 megalitres of unrestricted dry year extraction in 2020, to 362 megalitres per annum in 2050 (Public Works Advisory, 2021).

A new section of weir pool of about 4.92 river kilometres would be created between the new and existing weirs, which is referred to as the 'new town pool'.

The new weir would have dual modes of operation comprising a normal operation mode when it would operate at the existing ('normal') full supply level (65.71 metres AHD) and a drought security operation mode when it would operate one metre higher at a drought full supply level of 66.71 metres AHD. The temporary increase in the full supply level of one metre during drought security operation mode would result in a weir pool that extends about 18.81 river kilometres further upstream than the existing weir pool.

The proposal also includes:

- Developing a small recreation area, known as a community river place, at Union Bend. An informal parking area would be developed at the community river place, and visitors to the new weir would be able to walk between the community river place and the new weir via an existing trail along the top of the right riverbank
- Minor modifications to an existing flow gauging station located between the new and existing weirs
- Decommissioning of the existing weir. This would involve partially removing the wall of the existing weir so that it does not impede flows or block fish passage.

Construction of the new weir would start once all necessary planning and statutory approvals are received, and a detailed design prepared. Depending on when these occur, it is anticipated that construction would start in early 2023 and take about 12 to 18 months to complete. Partial removal and decommissioning of the existing weir is expected to take about 10 weeks.

Figure 24-1 Key design features of the proposal

24.3 Avoidance and minimisation of impacts

This environmental impact statement has assessed a preliminary concept design of the proposal. Water Infrastructure NSW has developed the preliminary concept design for the proposal in close consultation with the local Wilcannia community and other key stakeholders. Impacts have been avoided or minimised through the preliminary concept design development process by way of the following design elements:

- New weir location — The new weir is located about two kilometres from Wilcannia, which reduces the potential for the local community to be adversely impacted by noise, vibration, dust and visual impacts during its construction and operation
- Fish passage — The new weir includes a fishway that would enable fish to move upstream and downstream past the new weir when there are flows in the river greater than 30 megalitres per day
- Dual modes of operation — The new weir would only operate at the drought full supply level when low flows in the river are anticipated or occurring. This provides water security for Wilcannia for the longest drought on record without permanently storing the volume of water required to provide this level of water security. This minimises the hydrology, groundwater, flooding and aquatic ecology impacts of operating the new weir at a higher full supply level than the existing weir
- Translucency discharges — Inflows to the new town pool and Pool 1 would be discharged when the new weir is in drought security operation mode, which would increase the frequency of flows downstream of Wilcannia during droughts compared to the existing weir
- Vegetation clearing — Temporary construction compounds and laydown areas would be located away from areas of good quality or dense native vegetation, which would minimise clearing required for the project. Vegetation impacts have also been reduced by using existing tracks to provide access to construction sites, where feasible. The proposed staging of the construction works would further reduce the footprint of the construction works compared to carrying out all of the works concurrently
- Aboriginal cultural heritage — The construction footprint for the proposal is designed to avoid impacts to some Aboriginal cultural heritage items located near the new weir site, particularly hearths
- Partial removal of the existing weir — The existing weir has cultural significance to the local Wilcannia community and its partial removal respects the wishes of the community while ensuring that it does not impede flows or block fish passage. Partial removal of the existing weir would be timed to occur during low flows in the river to minimise potential impacts to surface water quality.

24.4 Uncertainties and resolution

This environmental impact statement is based on preliminary operating rules for the new weir that will be further developed by Water Infrastructure NSW during the detailed design and commissioning phases of the proposal in consultation with DPE Water, DPI Fisheries, the Environment, Energy and Science Group of the DPE, the Murray-Darling Basin Authority and WaterNSW. However, the preliminary operating rules are considered to result in 'worst case' environmental impacts that may be improved by the refinements to the operating rules that are expected to be made during the next phases of the proposal.

The fishway has been designed specifically to suit native fish species known to occur in the Darling River (Baaka). The effectiveness of the fishway in providing fish passage will be monitored in accordance with environmental management measure AB6.

24.5 Summary of key impacts that have not been avoided

The proposal would have a range of impacts, particularly to hydrology, terrestrial and aquatic biodiversity and Aboriginal cultural heritage as well as some socio-economic and visual impacts. There would also potentially be impacts to groundwater and, during the construction phase of the proposal, temporary impacts to surface water quality, noise and vibration and air quality.

A summary of the key potential impacts of the proposal is provided in **Table 24-1**.

Table 24-1 Summary of the key potential impacts that have not been avoided

Issue	Potential impacts
Construction	
Hydrology	▪ During construction of the fishway, river flows would be constricted by the narrowing of the river channel to accommodate the cofferdam around the fishway work site, which could result in some water temporarily ponding behind the cofferdam before flowing past the work site ▪ During construction of the weir wall and upstream and downstream embankments, flows would be directed into the newly built fishway to pass the work site. The elevation of the upstream end of the bed of the fishway relative to the elevation of the riverbed would result in ponding of water to a depth of 2.87 metres before it would spill down the fishway and continue downstream.
Surface water quality	▪ During construction, there would be potential for sediment and nutrient laden runoff from areas disturbed by construction to impact water quality in the Darling River (Baaka) through increased turbidity if this risk is not appropriately managed. Areas which would present a high risk of soil erosion include locations where both surface gradients and slope lengths combined would increase the erosive potential of runoff.
Terrestrial biodiversity	▪ The proposal would directly impact 10.14 hectares of native vegetation, including about 1.49 hectares of native vegetation present in the river channel between the new and existing weirs that would be inundated by the new town pool. The impacted vegetation includes ecosystem credit species habitat for the purposes of the Biodiversity Offset Scheme for 25 birds, seven mammals and one reptile.
Aquatic biodiversity	▪ The proposal would require the removal of instream vegetation at the new weir site including within the footprint of the fishway.
Aboriginal cultural heritage	▪ Five Aboriginal cultural heritage items would be directly impacted including removal of Union Bend Canoe Tree 7 (24-5-208), ground disturbance at open archaeological sites Wilcannia New Weir 1 (24-5-176) and Wilcannia New Weir 2 (24-5-177), trimming of Union Bend Coolamon Tree 1 (24-5-210) above the height of this tree's scar, and disturbance of the fish traps at the existing Wilcannia Weir ▪ Excavation may also impact currently unidentified subsurface Aboriginal objects, which could include artefacts, hearths, midden and potentially human burials.
Non-Aboriginal heritage	▪ The partial removal of the existing weir would directly impact this local heritage item.
Social, land use and property	▪ There could potentially be some competition for temporary accommodation between the construction workforce and the travelling public during the peak tourism season ▪ Victory Park Caravan Park would be closed for about 10 weeks during the partial removal and decommissioning of the existing weir ▪ There would be no public access to the new weir site during construction ▪ The removal of some large River Red Gum trees at the new weir site would be a concern for some of the local community.

Issue	Potential impacts
Operation	
Hydrology	▪ The new weir would permanently inundate about 4.92 river kilometres of the Darling River (Baaka) between the new and existing weirs ▪ When the new weir is in drought security operation mode it would temporarily inundate about 18.81 river-kilometres of the Darling River (Baaka) at the upstream end of the existing weir pool to a depth of up to one metre. The existing weir pool and the new town pool would also be inundated by an extra one metre of water ▪ Modelling of the proposed operating regime of the new weir predicts an increase in short duration (less than five days) cease-to-discharge events due to the new weir not discharging when it is in the filling phase. Due to the short duration of these events their effect on flows downstream of the new weir is likely to dissipate, which would limit their effect on downstream cease-to-flow characteristics ▪ The implementation of translucency operating rules at the new weir would break some long duration cease-to-flow events into two (or more) shorter duration cease-to-flow events. This would reduce the mean duration of cease-to-flow spells compared to the existing weir ▪ The number of very-low-flow events would increase but the duration of these events would decrease, due to the filling phase being triggered and the weir being in drought security operation mode for brief periods. However, the net result would be minor, with the total number of days of very-low-flow spells predicted to be similar to that for the existing weir ▪ The number of base flow 2 events would increase by about one-third, but the mean duration of these events would only decrease by about 10 per cent, resulting in an increase in the total duration of base flow 2 spells. This alteration in base flow behaviour is attributed to the application of the translucency rule during drought security operation mode, which would result in discharges from the new weir when there are inflows to the new town pool and Pool1, whereas some of these flows would not have passed the existing weir.
Groundwater	▪ Equilibrium groundwater levels are expected to rise to within five metres of the ground surface either side of the river at the new town pool between the new and existing weirs. The rise in the groundwater level along this section of the river would be similar to that along the river at the existing weir pool ▪ Long-term groundwater salinisation in low-lying areas up to 100 metres from the new town pool would be similar to that which already occurs upstream of the existing weir in low-lying areas.
Aquatic biodiversity	▪ The permanently change in the hydraulic characteristics of the river at the new town pool from a flowing environment to a still water environment has the potential to impact the abundance and diversity of species reliant on flowing conditions as it can disrupt life-cycles of species and degrade habitat conditions ▪ The predicted increase in short duration cease-to-flow events has the potential to result in local scale impacts immediately downstream of the new weir. The downstream extent of any impact to aquatic ecology is likely to be short for the predicted increase in short duration cease-to-flow events given that discharge from the new weir would recommence relatively quickly (within days). Downstream flows would continue as pools drawdown and these pools would refill once discharge from the weir recommences. The short duration of the increase in number of cease-to-flow events at the weir discharge point means that downstream pools are unlikely to draw down to levels that would result in downstream flows ceasing before refilling occurs

Issue	Potential impacts
	▪ Aquatic habitat in the about 18.81 river kilometres of the Darling River (Baaka) upstream of the existing weir pool would be subject to temporary inundation when the new weir is in drought security operation mode. These lentic conditions would occur when there are low or no flow conditions in the Darling River (Baaka) upstream of Wilcannia. The proposal would retain water in this section of the river for longer than would the existing weir, which would benefit some aquatic species.
Aboriginal cultural heritage	▪ The new town pool would permanently inundate five Aboriginal cultural heritage items: Wilcannia Weir Fishtrap (24-5-167), The Rocks, or Rocky Crossing/Fish Trap (24-5-161), Springs and Ochre Site (24-5-162), Springs and Stony Bank (24-5-163) and Boblo's Hole Fishing Place (24-5-164).
Non-Aboriginal heritage	▪ Fluctuations in the level of the new town pool have the potential to exacerbate existing corrosion to the piers and cross braces of Wilcannia Bridge. The new town pool would also complicate any attempts at stabilisation or remediation of Wilcannia Bridge due to the permanent presence of water under the bridge.
Social	▪ The new town pool would create a different swimming environment to the current (sometimes shallow) flowing water and sandbar environment that the community is accustomed to at Baker Park and elsewhere along the river between the new and existing weirs. This may present some safety risks for young children or people who are not strong swimmers.
Visual amenity	▪ The new weir and fishway would be permanent structures within the river channel downstream of Union Bend in what is currently a mostly natural setting ▪ About 4.92 river kilometres of the Darling River (Baaka) between the new and existing weirs would be transformed from a flowing water and sandbar environment to a weir pool with deep standing water ▪ Power poles and overhead powerlines and a new access track would cross the landscape between Union Bend Road and the new weir ▪ The retained portion of the existing weir would be inundated by the new town pool, with only the top of retained portion of the weir crest visible when the water level in the weir pool is low ▪ The use of land at Union Bend for public recreation would be more visually apparent due to informal car parking, picnic tables, and seating and an expected increase in usage by the local community.

24.6 Proposed measures to avoid or minimise impacts

A summary of the mitigation and management measures that will be implemented during the pre-construction, construction and operation phases of the proposal is provided in **Appendix E.**

24.6.1 Overall approach to environmental management

Construction environmental management documentation that would be prepared in accordance with the planning approval documents includes:

- Communication and stakeholder management plan
- A construction environmental management plan
- Construction environmental management sub-plans
- Social impact management plan
- Performance and compliance reports.

These planning approval documents are discussed further in the following sections.

24.6.2 Communication and stakeholder management plan

A communication and stakeholder management plan will be prepared to manage community and stakeholder engagement during the construction phase of the proposal. The plan would describe in detail the approach that Water Infrastructure NSW will take to community and stakeholder engagement and the consultation activities proposed during construction.

The communication and stakeholder management plan would include:

- A list of stakeholders relevant to the construction phase of the proposal
- Stakeholder level of involvement and means of engagement
- A register of potential impacts to stakeholders
- A risk assessment and proposed actions to mitigate or minimise the impact to stakeholders
- External and internal communications protocols
- Procedures for dealing with complaints and enquiries
- Procedures for early notification to the community
- Procedures for publicising the details of design and construction work
- Procedures for publicising information on key topics such as refinements to the site rehabilitation plans, restrictions on public access during construction, and changes to the weir pool
- Procedures for training employees and subcontractors as relevant to the implementation of the community communication strategy
- A crisis communications plan.

24.6.3 Construction environmental management

A construction environmental management plan would be prepared for the proposal and would be reviewed and approved by Water Infrastructure NSW and the DPE, prior to the commencement of construction work. It would provide the overarching framework for construction environmental management and would include:

- A description of the activities to be carried out during construction
- Construction methodologies
- An environmental risk matrix that identifies the environmental mitigation and management measures that would be implemented to address these risks
- Environmental responsibilities
- Environmental induction and training requirements
- Management strategies for reviewing the effectiveness of environmental mitigation and management measures
- Processes and methodologies for surveillance and monitoring, auditing and reviewing and reporting on environmental and sustainability performance including compliance tracking
- Procedures for emergency and incident management, non-compliance management and corrective and preventative action
- Procedures for the control of environmental documents and records
- A matrix of the relevant conditions of approval and mitigation and management measures in **Appendix E**, referencing where each requirement is addressed.

The construction environmental management plan would be a working document that would be updated during the construction phase to respond to any changes in the construction methodologies, environmental risks and the management of these risks, or other changes to the construction of the proposal.

Construction environmental management sub-plans

The following sub-plans to the construction environmental management plan would likely be required to manage specific environmental impacts during construction:

- Soil and water management plan including a dewatering management plan
- Vegetation management plan
- Rehabilitation plan
- Aboriginal cultural heritage management plan
- Heritage interpretation plan
- Social impact management plan
- Traffic management plan
- Noise and vibration management plan
- Bushfire emergency management plan
- Sustainability management plan.

The number and type of sub-plans to the construction environmental management plan may be modified during detailed construction planning to respond to particular contractor or stakeholder requirements.

24.6.4 Social impact management plan

A social impact management plan will be prepared in consultation with key stakeholders to support the proposed engagement activities through to the completion of construction. Guidance on preparing a social impact management plan is provided in the *Social Impact Assessment Guideline for State Significant Projects July 2021* (DPIE, 2021d).

The social impact management plan will outline:

- Roles and responsibilities for stakeholders involved in the implementation of the plan
- How any local employment opportunities would be planned, communicated and managed
- How any local procurement and supply opportunities would be planned, communicated and managed
- Ongoing training and development opportunities
- Monitoring and reporting requirements and responsibilities.

24.6.5 Performance and compliance reports

Performance and compliance reports will be prepared during the construction phase to evaluate how the construction of the proposal is meeting the requirements of the conditions of approval, community and stakeholder management plan, construction environmental management plan, and social impact management plan. Performance and compliance reports would be made publicly available.

24.7 Proposal justification

24.7.1 Addressing the need

The need for the proposal is detailed in **Section 2.1** and is driven by:

- The existing Wilcannia Weir pool is the primary source of water for the township. The Darling River (Baaka) experiences prolonged low flow and dry periods that threaten critical town water supply. Future climate change would increase this threat

- The existing weir is in poor condition and is unable to maintain an upstream weir pool at the design full supply level. The poor condition of the existing weir makes the town more susceptible to low and no flow periods in the Darling River (Baaka)
- The existing weir is likely to continue to degrade in height, and hence the weir pool would continue to reduce in volume. This would lead to more frequent restrictions on water use associated with use of the emergency bores or implementation of emergency pumping from upstream river pools to maintain supply, resulting in risks to the security and reliability of water for the local community
- A secure yield analysis of the capacity of the existing weir to meet the town's water needs if there was nil inflow to the weir pool for 12 months found that it would not provide water security to Wilcannia
- Upgrading the existing weir to rectify its poor condition would require installation of a new line of steel sheet piling and a fishway and would have a similar cost to constructing a new weir and fishway. Without a cost advantage, the option of upgrading the existing weir would have few benefits relative to developing a new weir and fishway.

The proposal would address this need by providing a more reliable long-term town water supply for Wilcannia. The new weir has been sized so that when it is in drought security operation mode it would provide sufficient storage capacity to meet Wilcannia's forecast water demand for the longest drought on record and for no inflows to occur during this period.

24.7.2 Biophysical, economic and social considerations including the principles of ecologically sustainable development

Biophysical, economic and social factors have been considered during the development of the proposal and this is reflected in the following elements of the proposal:

- *Fishway* — The proposal includes a fishway that would allow fish passage past the new weir when flows in the river are greater than 30 megalitres per day. Fish passage past the new weir is predicted to be possible for a mean of 255 days per year, which is substantially greater than the mean of 54 days per year that fish passage is predicted to be possible past the existing weir. Importantly, the fishway would significantly increase the number of days that fish passage is available during the spawning season (October to April). Increased fish passage will provide species with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which will in turn boost biodiversity, long-term population resilience and contribute to food webs.
- *New town pool* — The proposal would extend the weir pool to include the reach of the river between the new and existing weirs, which would result in there nearly always being some water visible in the river where it runs through the township. The new town pool would enhance civic amenity and pride, and engender a 'feel good factor' in the local community. Also, the new town pool would be visible from the Barrier Highway at Wilcannia Bridge and could encourage more tourists to stop in Wilcannia and visit Baker Park. Any increase in foot traffic in Wilcannia as a result of more tourists stopping in the town would create greater trading opportunities for retail businesses.
- *Community river place* — The community river place would provide a space where cultural teachings could be conducted, a place for relaxation and recreational activities and also offers opportunities to celebrate cultural connections to the Darling River (Baaka). The community river place, together with the new weir, has the potential to be a local tourist attraction, particularly if the local community pursues opportunities such as incorporating these sites into an Aboriginal cultural heritage walk, for example.
- *Training and employment* — The proposal is likely to generate direct and indirect benefits for local and regional businesses, in industries that provide goods and services to support construction activities. Water Infrastructure NSW has established the Wilcannia Weir Local Business Register and would share the details of businesses on the register with the principal contractors who tender for the construction of the new weir so that they can select and partner with registered businesses as part of their commercial offer. Water Infrastructure NSW, in partnership with the Regional Enterprise Development Institute and Murdi Paaki Regional Assembly, has supported a TAFE program to upskill local residents to be job ready for employment opportunities when construction planning commences.

24.7.3 Precautionary principle

The precautionary principle has been applied during the development of the concept design for the proposal. A precautionary approach has been taken where there is uncertainty as to the nature and magnitude of the proposal's potential impacts. Examples of the precautionary approach taken during the design of the proposal include:

- The preferred option for the new weir would store sufficient water to sustain Wilcannia through a reoccurrence of the worst historical drought on record (the Federation drought) inclusive of the consideration of the future impact of climate change
- Conservative preliminary trigger levels for the transition of the new weir from normal operation mode to drought security operation mode were adopted for the purposes of storage behaviour modelling, so as to provide confidence that the hydrology modelling predictions on which this environmental assessment is based are a worst case scenario.

24.7.4 Intergenerational equity

Intergenerational equity is at the core of the proposal. Consistent with the principle of intergenerational equity, the proposal seeks to provide water security to Wilcannia while minimising impacts on the Darling River (Baaka) to the benefit of both current and future communities.

The preferred option for the new weir has been sized based on a secure yield analysis for the period 2020 to 2050 carried out by Public Works Advisory (2019). The new weir would sustain Wilcannia through a reoccurrence of the worst historical drought on record (the Federation drought) by storing a volume of water that exceeds the unrestricted dry year extraction requirements by about 100 megalitres per annum.

The proposal also seeks to minimise impacts to flows in the Darling River (Baaka) so that future generations are able to experience the social, economic and cultural benefits of a flowing river. Elements of the design of the new weir that would minimise impacts to flows in the river include weir gates that would enable the weir to operate at different full supply levels based on whether there are drought conditions or indicators and which would also enable a translucency rule to be applied to enable inflows to the weir pool to be passed downstream when the new weir is in drought security operation mode. The proposal also includes a fishway that would enable fish passage past the new weir when flows in the river are greater than 30 megalitres per day, which would be supportive of native fish populations and their important place within the river ecosystem.

Additionally, the proposal includes a community rive place and that aims to support the local Barkandji people's connection to the Darling River (Baaka) and nurture this connection among future generations.

24.7.5 Conservation of biological diversity and ecological integrity

The proposal would conserve biological diversity and ecological integrity by:

- Including a fishway that would provide native fish populations with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which would in turn boost biodiversity, long-term population resilience and contribute to food webs
- Minimising the need for native vegetation clearing by locating construction compounds and laydown areas on sparsely vegetated areas, where possible
- Rehabilitating areas impacts during the construction works that are not required during the operation phase of the proposal using native species that are endemic to the area
- Offsetting the biodiversity impacts of the proposal in accordance with the biodiversity offset requirements of the NSW Biodiversity Offsets Scheme and the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013) for terrestrial and aquatic biodiversity respectively.

24.7.6 Improved valuation, pricing and incentive mechanisms

The proposed new weir would result in impacts to terrestrial and aquatic ecology and, as the proponent of the proposal, Water Infrastructure NSW would offset these impacts in accordance with the requirements of the NSW Biodiversity Offsets Scheme and the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013) respectively. This is consistent with the 'polluter pays' approach to the valuation of biodiversity.

24.8 Consideration of the objectives of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the proposal can be considered. A summary of how the objectives of the EP&A Act have been considered in relation to the proposal is provided in **Table 24-2**.

Table 24-2 Consideration of the objectives of the EP&A Act

Objective	Comment
To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposal would improve the liveability of Wilcannia by securing the town's water supply and providing readily available water for consumption. The proposal would also provide new recreational and tourism opportunities. The proposal includes a fishway that would provide fish passage past the new weir when there flows in the Darling River (Baaka) are greater than 30 megalitres per day. The impact of the proposal on flows in the Darling River (Baaka) would be minimised by the operation of weir gates that would enable the new weir to have two modes of operation with additional water only being stored when there are drought conditions or indicators. The weir gates would also enable a translucency rule to be applied to enable inflows to the weir pool to be passed downstream when the new weir is in drought security operation mode.
To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	The objectives of the proposal address economic, environmental and social considerations (refer to **Section 1.1.2**). In line with these objectives, the proposal would deliver economic, environmental and social benefits including: ▪ providing Wilcannia with readily available water for consumption at all times ▪ a fishway that would provide native fish populations with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which would in turn boost biodiversity, long-term population resilience and contribute to food webs ▪ a community river place that would provide a space where cultural teachings could be conducted, a place for relaxation and recreational activities and also offers opportunities to celebrate cultural connections to the Darling River (Baaka).The community river place, together with the new weir, has the potential to be a local tourist attraction, particularly if the local community pursues opportunities such as incorporating these sites into an Aboriginal cultural heritage walk, for example.
To promote the orderly and economic use and development of land.	The new weir is proposed on Crown Land. The land is currently undeveloped. During construction of the new weir land owned by Wilcannia Local Aboriginal Land Council under Western Lands Leases would be used temporarily for access, a construction compound, stockpile and laydown areas and crane operations. This land that would be used includes an unsealed access track but is otherwise undeveloped. The community river place is proposed on land managed by Central Darling Shire Council that is used for recreational purposes. There is minimal development on this land.

Objective	Comment
To promote the delivery and maintenance of affordable housing.	This objective is not applicable to the proposal.
To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The potential biodiversity impacts of the proposal are assessed in **Sections 12** and **13**. The proposal would directly impact 10.14 hectares of native vegetation, including 1.49 hectares of native vegetation present in the river channel between the new and existing weirs that would be inundated by the new town pool. Native vegetation directly impacted by the proposal comprises three different plant community types, one of which is part of the listed endangered ecological community Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions. The proposal would not result in any direct impact to threatened species or their habitat that are 'credit species' for the purposes of the Biodiversity Offset Scheme. However, the impacted vegetation is 'ecosystem-credit species habitat' for a range of threatened bird, mammal and reptile species under the Biodiversity Offset Scheme. Impacts to biodiversity have been minimised where possible by locating construction compounds, laydown areas and stockpiles in areas that are sparsely vegetated.
To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	An Aboriginal cultural heritage assessment report has been prepared for the proposal and is provided in **Technical Report 4** and summarised in **Section 14**. Due to the acknowledged importance of the Wilcannia area, and in particular the Darling River (Baaka) to Aboriginal cultural heritage, careful consideration of Aboriginal cultural heritage constraints and issues was a core component of the development of the design for the proposal. Water Infrastructure NSW has engaged in extensive consultation with the local Aboriginal community during the development of options for the proposal and the confirmation of the preferred location for the new weir. The development of the proposal footprint, particularly the proposed location of construction activities, has incorporated careful consideration of Aboriginal cultural sites and values. Potential impacts on Aboriginal heritage were minimised, as far as practicable, by: ▪ Utilising existing access tracks as far as practicable to avoid unnecessary ground disturbance ▪ Early identification and mapping of significant trees along the riverbanks near the new weir site to facilitate avoidance where practicable, particularly culturally modified trees ▪ Close consultation with the Aboriginal community to ensure Aboriginal cultural values were understood and reflected in the location and design of the proposal ▪ Reconfiguration of the construction footprint, such as laydown areas, to avoid sensitive cultural heritage sites and particularly hearths. The potential impacts of the proposal on non-Aboriginal heritage are assessed in a Statement of Heritage Impact in **Technical Report 5** and are summarised in **Section 15**. Two heritage items would be impacted by the proposal: the existing Wilcannia Weir and Wilcannia Bridge. Impacts to the existing weir would be minimised by carrying out the minimum demolition required to decommission the structure. The proposal would increase the risk of corrosion to the piers and cross braces of Wilcannia Bridge, which is assessed as a minor direct impact to this item. Mitigation and management measures are proposed to minimise the impact of the proposal on these two heritage items.

Objective	Comment
To promote good design and amenity of the built environment.	The new weir is proposed at a location that is not near any sensitive receivers. Murals are proposed on the wall of the new weir and the nearby control room walls to make these structures of greater visual interest and to provide an attraction for visitors to the site. The proposal would improve amenity at Union Bend by providing seating and picnic areas at the community river place, which should encourage visitors to the site to take advantage of the recreational opportunities presented by the new town pool. Similarly, seating and picnic areas are proposed at the existing weir site and these should encourage guests at the Victory Park Caravan Park to spend time alongside the river. More generally, the new town pool would result in there almost always being water visible in the river through the township, which is expected to enhance civic amenity and pride, and engender a 'feel good factor' in the local community.
To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	The proposal includes pre-fabricated control room at the new weir site. These buildings are described in **Section 3.4.10**. The control room buildings would have a two-hour fire protection rating as per WaterNSW Electrical Works Specification with fire rated doors and no windows. An eight-metre-wide bush fire asset protection zone would be maintained around the control rooms in accordance with Table A1.12.6 of *Planning for Bush Fire Protection* (NSW Rural Fire Service, 2019).
To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	The statutory planning approval pathway for the proposal is described in **Section 4.1**. The proposal is declared State significant infrastructure under section 2.13 and Schedule 3 of the State Environmental Planning Policy (Planning Systems) 2021. The consent authority for State significant infrastructure is the Minister for Planning, according to section 5.14 of the EP&A Act. Water Infrastructure NSW has engaged with Central Darling Shire Council during planning for the proposal in their capacity as the owner of the land on which the community river place is proposed and the Victory Park Caravan Park, which would be used temporarily to access the existing weir during its partial removal and decommissioning.
To provide increased opportunity for community participation in environmental planning and assessment.	Water Infrastructure NSW has carried out extensive engagement with the local community during planning for the proposal as detailed in **Section 5**. Engagement with the local Aboriginal community is guided by Water Infrastructure NSW's (2021) *Strategy for Delivering Aboriginal Community Outcomes*, which identifies priority initiatives for delivering outcomes for Aboriginal communities including conducting best class, sustainable and ongoing engagement with Aboriginal communities, creating employment pathways and opportunities for Aboriginal communities during the delivery of water infrastructure projects, and delivering economic benefits to Aboriginal communities from infrastructure investments.

24.9 Conclusion

This environmental impact statement addresses the key issues identified in the Secretary's environmental assessment requirements issued under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* and the relevant provisions of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

The proposal would improve the liveability of Wilcannia by securing the town's existing and future water supply and providing readily available water for consumption. The new weir is designed to minimise the impact of the improvements to the town's water security on flows in the Darling River (Baaka). The new weir would include weir gates that would enable two modes of operation with additional water only being stored when there are drought conditions or indicators. The weir gates would also enable a translucency rule to be applied to enable inflows to the weir pool to be passed downstream when the new weir is in drought security operation mode.

The proposed new town pool would result in there almost always being water visible in the river within the township, which is expected to enhance civic amenity and pride, and engender a 'feel good factor' in the local community. The visibility of water in the river from Wilcannia Bridge could encourage more tourists to stop in Wilcannia and visit Baker Park, which would create greater trading opportunities for retail businesses.

The proposal includes a fishway that would allow fish passage past the new weir when flows in the river are greater than 30 megalitres per day. Increased fish passage will provide species with improved ability to complete migration, spawning and larvae dispersal, as well as reduce population fragmentation which will in turn boost biodiversity, long-term population resilience and contribute to food webs.

The merits of the proposal have been considered against other alternatives including do-nothing and providing a new weir at the site of the existing weir. No other alternative would satisfy the need and objectives as effectively as the proposal.

The operation of the new weir is predicted to result in an increase in short duration downstream cease-to-flow events. However, the downstream extent of any impact to aquatic ecology is likely to be short and downstream pools are unlikely to draw down to levels that would result in downstream flows ceasing before refilling occurs. The proposal would also permanently inundate about 4.92 river kilometres of key fish habitat between the new and existing weirs. However, habitat conditions in this reach of the river are overall poor and it is unlikely to represents critical spawning or refuge habitat for threatened species. An aquatic biodiversity offset is currently being negotiated with Fisheries NSW for the proposal in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013).

The proposal would directly impact 10.14 hectares of native vegetation. This biodiversity impact of the proposal would be offset in accordance with the NSW Biodiversity Offsets Scheme.

Construction of the new weir would require the removal of a culturally modified tree (24-5-208) (Union Bend Canoe Tree 7), a dead River Red Gum in poor condition that has fallen and currently rests on the sloping bank of the river. Another culturally modified tree, Union Bend Coolamon Tree 1 (24-5-210), would require trimming above the upper extent of the cultural scar to enable operation of a crane. Construction of the new weir would also directly impact some surface and archaeological artefacts and hearths and salvage of these items is proposed to be carried out with the assistance of registered Aboriginal parties.

The proposal includes the partial removal and decommissioning of the existing weir, which is of local heritage significance and registered as Aboriginal site due to its long-term continuing use as a fish trap. Removal of the existing weir would only occur to the extent necessary to stop it functioning as a water storage and as a barrier to fish passage. The decommissioning works would be carried out so as to avoid direct impacts to the area immediately downstream of the existing weir wall that the local community values because of the recent history of fish trapping at this location.

Construction of the proposal would also result in some minor noise, visual and traffic impacts that would be manageable with the implementation of the proposed environmental mitigation and management measures.

Water Infrastructure NSW is engaged in several initiatives to maximise the benefits of the proposal to the local community. This includes working with TAFE NSW and partners to increase the employment opportunities available to Aboriginal community members during the construction and operational phases of the proposal.

The expected improvements to water security and fish passage together with the potential social benefits identified above means that the proposal would be in the public interest.

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