WaterNSW

Macquarie River Drought
Temporary water security works at Warren - Review of Environmental Factors

August 2019
Executive summary

WaterNSW is Australia’s largest supplier of raw water, delivering water from 42 dams, state rivers and pipelines to NSW irrigators, licensed authorities, retail suppliers and councils. WaterNSW develops infrastructure solutions to ensure water supply security.

WaterNSW operates and maintains dams, weirs and ancillary structures across the Macquarie and Castlereagh River system in western NSW to deliver water to customers. WaterNSW also works with the Department of Planning, Industry and Environment (DPIE) to assess drought conditions including relating to water allocations to licence holders.

The Macquarie River Catchment is regulated to mitigate flooding and supply water to cities and towns that include Dubbo, Wellington, Narromine, Warren, Nyngan and Cobar. The main water storages in the catchment are Lake Burrendong, on the Macquarie River upstream of Wellington, and Lake Windamere, on the Cudgegong River upstream of Mudgee.

Due to the current drought, inflows to Lake Burrendong between May 2017 – April 2019 are 38% of the previous drought of record and the storage is at 5.2% of capacity. The storage is predicted to be less than 5% capacity by 1 September 2019 and the area is already classified as being in a Stage 4 drought – critical drought / water storage. The Macquarie River is projected to cease to flow downstream of Burrendong Dam in November 2019 if there are no inflows to the system and in the absence of any drought contingency measures and drought response works. As a result of the current drought conditions the relevant water sharing plan for the Macquarie and Cudgegong Regulated River has been partly suspended under the Water Management Act 2000, shifting the priorities from environmental water to critical human water needs in the relevant stretches of the river subject to the suspension order.

WaterNSW, local water utilities (Councils) and DPIE are jointly and individually planning to implement a range of projects and actions in stages to provide emergency water supplies to affected communities under Stage 4 drought conditions. This includes implementing temporary works (referred to as the ‘proposal’) to supply water to communities that rely on surface water delivered from Burrendong Dam, including Nyngan and Cobar. The proposal involves:

• Raising the operating level of the Warren Weir by 250 mm by installing drop boards
• Blocking flow through fishways at the Warren Weir, Duck Creek Regulator, Crooked Creek Regulator, Gunningbar Creek Regulator, and Marebone Regulator

The proposed works to temporarily raise Warren Weir and close fishways at Warren Weir, Duck Creek, Crooked Creek, Gunningbar Creek and Marebone regulators will conserve water by retaining it in the main channel of the Macquarie River upstream of Warren whilst enabling 50 ML/day to be delivered to the Nyngan weir pool via the Albert Priest Channel.

The fishway on Mareboone Weir will be closed at the request of the NSW Department of Primary Industries – Fisheries (DPIF) to prevent downstream discharges unless there are tributary flows. This will retain water in a pool to provide refuge habitat for fish.

Based on projected storage depletion rates, implementing the proposal in August 2019 will delay a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren by three months (from November 2019 to February 2020). It will bring forward the cease to flow event by two months in the 80 kilometre long section of the Macquarie River and associated effluent creeks downstream of Warren. The proposal is
temporary and only required until there are substantial inflows to the Macquarie River system and the Minister lifts the drought declaration in the Macquarie Valley.

Compared to the do-nothing scenario, the proposal will result in a 180 kilometre reduction in the length of the Macquarie River that is predicted to be affected by a cease to flow event in November 2019.

The proposal will delay a cease to flow event in the Macquarie River by three months which provides time for WaterNSW to transfer additional water from Lake Windamere to Lake Burrendong, and install infrastructure to access water that is below the current offtake level at Burrendong Dam (where, relevant, will be subject to a separate approval process). The combined effect of these works is predicted to delay a cease to flow event in the Macquarie River between Burrendong Dam and Warren by about 11 months.

The Minister for Water has issued an order under section 49B of the Water Management Act 2000 to suspend part of the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016 for certain river stretches with respect to planned environmental releases, available water determinations and water allocation account management due to the extreme dry period. This reflects a NSW Government decision, with concurrence from the NSW Minister for Energy and Environment, that environmental releases are to cease and water is to be prioritised for critical human need. This prioritisation of water for critical human need is consistent with the intent of the Macquarie-Cudgegong Incident Response Guide.

The proposal would provide a significant benefit by securing a temporary water supply for critical human needs to Nyngan and Cobar, as well as cities and towns downstream of Burrendong Dam including Wellington, Dubbo, Narromine and Warren.

The proposal is justified because it would delay a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will extend the duration that fish are able to move between refuge habitat within the river and reduce the risk of adverse water quality conditions developing within the river. This is a beneficial impact compared to the do-nothing scenario which is predicted to result in a cease to flow event that would affect a 260 kilometre long section of the Macquarie River between Burrendong Dam and the Macquarie Marshes in November 2019.

The proposal will be constructed and operated in accordance with an approval that would be issued under the Water Management Act 2000 and permits issued under the Fisheries Management Act 1994. Operational impacts would be monitored by implementing water quality and aquatic ecology monitoring plans that would be developed in consultation with DPIE-W, and DPIE-BC and the DPIF.

The REF assesses the potential impacts of the proposal. It has been prepared in accordance with Part 5 of the Environmental Planning and Assessment Act 1979 (‘EP&A Act’) and considers the factors listed in clause 228 of the associated Regulation. This REF documents the potential environmental impacts of the proposal, considering both potential positive and negative impacts and recommends management and mitigation measures to protect the environment.

Overall, potential negative impacts associated with the proposal can be adequately managed by implementing mitigation measures, and the beneficial impacts are considered to outweigh the adverse impacts. For the reasons described in this report, the proposal is unlikely to have a significant impact on the environment and does not require an EIS to be prepared, or a referral to the Commonwealth under the EPBC Act.

If the scope of work or study area assessed in this REF change, WaterNSW would determine whether additional environmental assessment is needed to ensure that their obligations under the EP&A Act are addressed.
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1. **Introduction**

1.1 **Background**

WaterNSW is Australia’s largest supplier of raw water, delivering water from 42 dams, state rivers and pipelines to NSW irrigators, licenced authorities, retail suppliers and councils. WaterNSW develops infrastructure solutions to ensure water supply security and contributes to the protection of the environment and catchments.

WaterNSW operates and maintains dams, weirs and ancillary structures across the Macquarie and Castlereagh River system in western NSW to deliver water to customers. WaterNSW also works with the Department of Planning, Industry and Environment (DPIE) to assess drought conditions and determine whether it is necessary to reduce water allocations to licence holders.

The Macquarie River Catchment is regulated to mitigate flooding and supply water to cities and towns that include Dubbo, Wellington, Narromine, Warren, Nyngan and Cobar. The main water storages in the catchment are Lake Burrendong which is on the Macquarie River, upstream of Wellington, and Lake Windamere which is on the Cudgegong River upstream of Mudgee (refer to Figure 1). Figure 2 shows the high security water users in the Macquarie Valley which include major urban centres, permanent plantings, stock and domestic water supply schemes, industry, and other uses such as the Western Plains Zoo at Dubbo.

Water to the town of Nyngan is supplied from the Bogan River, which flows intermittently, and from water transferred from the Macquarie River via the 67 kilometre long Albert Priest Channel. Cobar is supplied largely from the Macquarie River via the Albert Priest Channel. Water is piped to Cobar from the Bogan River weir pool at Nyngan. The Albert Priest Channel has its offtake at the Gunningbar Creek which is an effluent stream of the Macquarie River at Warren.

Due to the current drought, inflows to Lake Burrendong between May 2017 – April 2019 are 38% of the previous drought of record and the storage is at 5.2% of capacity. The storage is predicted to be less than 5% capacity by 1 September 2019 and the area is already classified as being in a Stage 4 drought – critical drought / water shortage. The Macquarie River is projected to cease to flow downstream of Burrendong Dam in November 2019 if there are no inflows to the system and in the absence of any drought contingency measures and drought response works.

WaterNSW, local water utilities (Councils) and DPIE are jointly and individually planning to implement a range of projects and actions in stages to provide emergency water supplies to affected communities under Stage 4 drought conditions. This includes implementing temporary works to supply water to communities that rely on surface water delivered from Burrendong Dam, including Nyngan and Cobar.

1.2 **Overview of the proposal**

WaterNSW proposes to implement temporary works (referred to as the ‘proposal’) at existing structures to enable water to continue to be diverted from the Macquarie River at Warren to supply Nyngan and Cobar. These works are described in section 3 and involve:

- Raising the operating level of the Warren Weir by 250 mm by installing drop boards
- Blocking flow through fishways at the Warren Weir, Duck Creek Regulator, Crooked Creek Regulator, Gunningbar Creek Regulator, and Marebone Regulator
Raising the operating level of the weir and blocking flow through the Warren Weir, Duck Creek Regulator, Crooked Creek Regulator, and Gunningbar Creek fishways will raise the level of the weir pool to enable water to be delivered to the Nyngan via the Albert Priest Channel offtake on Gunningbar Creek. These works will enable 50 ML/day to be delivered to the Nyngan weir pool via the Albert Priest Channel.

Under normal operating conditions, delivering 50 ML/day to Nyngan via the Albert Priest Channel would require the Warren Weir pool to be raised to a level that results in the weir being overtopped and water being discharged downstream. The proposal will save water by ceasing these flows downstream of Warren Weir and the fishways on Duck, Crooked and Gunningbar Creeks.

The fishway on Mareboone Weir will be closed at the request of the NSW Department of Primary Industries – Fisheries (DPIF) to prevent downstream discharges unless there are tributary flows. This will retain water in a pool to provide refuge habitat for fish.

Based on projected storage depletion rates, implementing the proposal in August 2019 will delay a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren by two months (from November 2019 to January 2020). It would also bring forward the cease to flow event by two months in the 80 kilometre long section of the Macquarie River and associated effluent creeks downstream of Warren. The proposal is temporary and only required until there are substantial inflows to the Macquarie River system and the Minister lifts the drought declaration in the Macquarie Valley.

![Figure 1: Macquarie River Catchment](image)

**Figure 1 Macquarie River Catchment**
Figure 2  Regulated river (High security) access license holders in the Macquarie Valley
1.3 Purpose of this report

WaterNSW engaged GHD Pty Limited (GHD) to prepare this review of environmental factors (REF) to assess the potential environmental impacts of constructing, operating and decommissioning the proposal. WaterNSW is the proponent and the determining authority for the proposal under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The purpose of the REF is to describe the proposal, document the likely impacts of the proposal on the environment, and detail measures to mitigate impacts that cannot be avoided. The REF helps to fulfil the requirements of section 5.5 of the EP&A Act that WaterNSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The description of the proposal and associated environmental impacts have been undertaken in context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the Biodiversity Conservation Act 2016 (BC Act), the Fisheries Management Act 1994 (FM Act), and the Australian Government’s Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The findings of the REF would be considered when assessing:

- whether the proposal is likely to have a significant environmental impact and therefore the need for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Industry under Part 5.1 of the EP&A Act
- the significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement
- The potential for the project to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian government Department of Environment and Energy (DoEE) for a decision by the Commonwealth Minister for the Environment on whether approval is required under the EPBC Act.

1.4 Limitations

This report: has been prepared by GHD for WaterNSW and may only be used and relied on by WaterNSW for the purpose agreed between GHD and the WaterNSW as set out in this report.

GHD otherwise disclaims responsibility to any person other than WaterNSW arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.
2. Proposal need and alternatives

2.1 Need for the proposal

2.1.1 Effect of the drought on water supply in the Macquarie Valley

The current drought is having a severe impact on water storages in the Macquarie River valley. Figure 3 indicates that inflows to Burrendong Dam have been substantially lower during this drought compared to four previous droughts.

![Comparison of inflows to Burrendong Dam during droughts](image)

**Figure 3 Comparison of inflows to Burrendong Dam during droughts**

The total inflow to Burrendong Dam during the previous two worst years of drought (June 1979 – May 1981) was 258 GL. Compared to this, inflows between May 2017 – April 2019 were 99 GL which represents 38% of the previous drought of record. The impact of these record low inflows on storage levels is shown in Figure 3. At 30 June 2019, storage in Burrendong Dam was at 5.2% capacity. Of the remaining storage, 60 GL is ‘active’ and is able to be accessed using the existing offtake infrastructure. The remaining 20 – 30 GL is deep-water storage that is below the level that is able to be accessed using the existing offtake infrastructure.

The Macquarie River is predicted to cease to flow in November 2019 if there are no inflows to Burrendong Dam from July 2019 and in the absence of any drought contingency measures and drought response works. The river is predicted to cease to flow in December 2019 if inflows after July 2019 are equivalent to those that have occurred over the past two years, or are equivalent to the drought of record.

2.1.2 Impact of the drought on the water supply to Nyngan and Cobar

The Nyngan-Cobar Water Supply Scheme supplies water to the towns of Nyngan and Cobar, the Cobar Mines and a number of stock and domestic water users and irrigators. Water is sourced from the Macquarie River and is delivered to the upper Nyngan weir pool in the Bogan River at Nyngan via the 63 kilometre long Albert Priest Channel. The Macquarie River supply is dependent on surface water releases from Burrendong Dam. The Albert Priest Channel has its
offtake at Gunningbar Creek. Water is pumped from the upper Nyngan weir pool to Nyngan and Cobar (refer Figure 4).

Irrigators and stock and domestic water users extract water directly from the Albert Priest Channel and the Bogan River weir pools. Bogan Shire Council and the Cobar Water Board also hold licences to take an unregulated river entitlement from the Bulbodney Grahway Creek Water Source (directly from the Bogan River). This is a secondary supplementary supply as the Bogan River is ephemeral.

Town water for Nyngan and Cobar is ordered from Gunningbar Creek, conveyed via Albert Priest Channel and stored in Nyngan upper weir pool on the Bogan River. The town water and water for the mines in Cobar are ordered together. Water is ordered at a rate of 50 ML/day as this is the capacity of the Albert Priest Channel and generally in blocks of 1,000 ML -1,500 ML that is delivered over 20 to 30 days. On receipt of a water order, the Warren Weir pool is filled to its spill level of 1.88 metres to enable water to be delivered to Gunningbar Creek. It takes about two to three weeks for the weir pool to drop to 1.5 metres when the next block is ordered. By the time the next block of water arrives at the weir pool the level at the weir pool may have dropped to about 1.1 metres. This cycle then continues to the end of the year. The frequency of this cycle may differ during the summer months as the evaporation rates from the storage and channel could exceed 20 millimetres.

There have been zero flows in the Bogan River upstream of Nyngan for many months. Downstream flows past Nyngan have also ceased. Water in the weir pool is anticipated to last about two months without additional flows into the Nyngan Weir pools and assuming that the current order regime applies.

![Nyngan – Cobar Water Supply Scheme schematic](image)

Figure 4  Nyngan – Cobar Water Supply Scheme schematic
2.1.3 Water operations

**Macquarie-Castlereagh Incident Response Guide and prioritisation of supply**

The NSW Extreme Events Policy introduces a staged approach to managing extreme events such as severe droughts or poor water quality events, and to the associated Incident Response Guides (IRGs).

Tables 1.1 and 1.2 of the Macquarie–Castlereagh IRG state the priorities that apply to the distribution of water. The water allocations for higher priority licences are to be diminished at a lesser rate than the water allocations of lower priority licences. Table 1.2 of the IRG is repeated below in Table 1 and indicates that the first priority is to supply water for domestic and essential town services. The water needs of the environment are the second priority.

Table 1 below indicates that the first priority is to supply water to meet critical human needs. The water needs of the environment become the third priority under the WM Act section 60(3A) as parts of the Water Sharing Plan were suspended under an order made under s49B (attached as Appendix G).

<table>
<thead>
<tr>
<th>Take type / use</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The first priority is to be given to meeting critical human water needs</td>
<td>First</td>
</tr>
<tr>
<td>• The taking of water for domestic purposes by persons exercising basic landholder rights, and the taking of water for domestic purposes or essential town services authorised by an access licence</td>
<td>Second</td>
</tr>
<tr>
<td>• Needs of the environment</td>
<td>Third</td>
</tr>
<tr>
<td>• The taking of water for stock purposes by persons exercising basic landholder rights, and, in the case of regulated rivers, the taking of water for purposes (other than domestic purposes) authorised by a regulated river (high security) access licence, and the taking of water for the purposes of supply of commercial and industrial activities authorised by a major utility access licence or local water utility access licence, subject to the water made available being in accordance with any drought management strategy established by the Minister for that purpose, and the taking of water for the purposes of electricity generation authorised by a major utility access licence (not applicable in this WRPA), and the taking of water for purposes authorised by a domestic and stock access licence or by persons exercising any other water rights in relation to stock, and the taking of water for purposes authorised by a conveyance access licence in connection with the supply of water for any other purpose or need referred to in this paragraph (not applicable in this WRPA).</td>
<td>Fourth</td>
</tr>
<tr>
<td>• Taking of water for purposes authorised by any other category or subcategory of access licence</td>
<td>Fifth</td>
</tr>
</tbody>
</table>

**Note:** In a case where orders under both sections 49A and 49B are in force in relation to the same water management area or water source, the rules set out in WM Act s60 ss (3A) prevail.

The Macquarie regulated river water source has been in Stage 4 - Critical Drought / Water Shortage as defined under the Macquarie-Castlereagh IRG since May 2019 ([https://www.industry.nsw.gov.au/water/allocations-availability/allocations/summary](https://www.industry.nsw.gov.au/water/allocations-availability/allocations/summary)). Stage 4 is the highest level under the IRG.
Critical human water needs means the needs for a minimum amount of water reasonably be provided from the Basin water resources, required to meet: (a) core human consumption requirements in urban and rural areas, and (b) those non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs.

**Figure 5** Map of incident response guide criticality levels of NSW inland river systems

Table 2 summarises factors that are considered when determining the criticality of an event under the IRG. Table 3 summarises the approaches under the Water Sharing Plan during each of the four stages. Under Critical drought Stage 4, normal Water Sharing Plan operations are suspended and contingency measures are adopted.
### Table 2  Determining the stage of criticality for water quantity extreme events (source: WaterNSW)

<table>
<thead>
<tr>
<th>Criticality</th>
<th>Evidence base for surface water</th>
<th>Evidence base for groundwater</th>
<th>Broad intent of measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1  Normal management</td>
<td>Can deliver all account water under normal river operations practices.</td>
<td>Groundwater levels remain within acceptable ranges, with annual recovery as expected given rainfall/recharge events</td>
<td>Provide certainty for water use planning. Long term water security and emergency/drought contingency planning</td>
</tr>
<tr>
<td>Stage 2  Emerging drought/water shortage</td>
<td>Unable to deliver 100% of high priority account water and maximum expected use of general security under normal river operations practices.</td>
<td>Unacceptable groundwater level and or pressure declines potentially or actually impacting on groundwater availability to high priority GDEs, BLRs and/or LWUs. Drawdown to levels that could lead to aquifer subidence.</td>
<td>Operational measures in the current water year to reduce transmission losses and prevent potential future failure to supply water in accounts (surface water). Limit potential impacts in local areas via dealings restrictions and potential local area access restrictions (groundwater). Drought response readiness (LWUs).</td>
</tr>
<tr>
<td>Stage 3  Severe drought/water shortage</td>
<td>Only able to deliver restricted high priority demands and restricted remaining general security account water.</td>
<td>Continuing unacceptable groundwater level or pressure declines Unacceptable drawdown impacts on 'efficiently constructed' BLR bores (i.e. levels below the pump or deeper than the bore) Evidence of aquifer compaction.</td>
<td>Restricting access to account water, restricting trade, and suspending some WSP rules in addition to increased operational measures to prevent potential future failure to supply water in accounts (surface water). Restrict access from bores in all affected areas. Drought management/restrictions (LWUs).</td>
</tr>
<tr>
<td>Stage 4  Critical drought/water shortage</td>
<td>Only able to deliver restricted town water supply, stock and domestic and other restricted high priority demands.</td>
<td>Water level declines pose a risk to long term availability of the groundwater resources - subsidence, and/or mobilisation and induced flow of poorer water quality Access by 'efficiently constructed' BLR bores significantly impacted.</td>
<td>Suspension of some WSP rules. Severe restrictions required to prioritise remaining supplies for critical human water needs (surface water and groundwater). Avoidance of permanent damage to aquifers (compaction or salinization). Emergency drought management measures/restrictions (LWUs).</td>
</tr>
</tbody>
</table>
Table 3  Stages of the Incident Response guide (IRG) framework (source: WaterNSW)

<table>
<thead>
<tr>
<th>Stage based on level of risk</th>
<th>Agency/management approaches</th>
<th>Normal Rules</th>
<th>Contingency / Operational Measures</th>
<th>Suspension of parts of a water sharing plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Normal management operations - long term planning, including drought security planning.</td>
<td>In force</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td>Operational adjustments may be required. Emergency management readiness implemented.</td>
<td>In force</td>
<td>Possibly activated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inter-agency Critical Water Advisory Panel for surface water sources established and updated regularly (by WaterNSW). Minister advised. Initial communications with potentially affected communities and stakeholders.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td>Adjustments to management operations. Emergency management on stand-by.</td>
<td>Possibly also in force</td>
<td>In force</td>
<td>Possibly activated</td>
</tr>
<tr>
<td></td>
<td>Critical Water Advisory Panel operational and meeting for both groundwater and surface water sources, with regular Ministerial updates. Communications with affected communities and stakeholders increased.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td>Normal operations untenable, emergency management activated.</td>
<td>In force</td>
<td></td>
<td>In force</td>
</tr>
<tr>
<td></td>
<td>State agency/regional response implemented if required/triggered.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Critical Water Advisory Panel maintained, with regular Ministerial updates.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regular communications with affected communities and stakeholders increased.</td>
<td></td>
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</tr>
</tbody>
</table>

**Water Sharing Plan Part Suspension (Macquarie Regulated River) Order 2019**

Given the severity of the drought, on 3 July 2019 the Minister for Water, Property and Housing gazetted the Water Sharing Plan Part Suspension (Macquarie Regulated River) Order 2019 under section 49B of the *Water Management Act 2000*. This order suspends the operation of the Water Sharing Plan for the *Macquarie and Cudgegong Regulated Rivers Water Source 2016* with respect to planned environmental releases, available water determinations and water allocation account management in relation to the Macquarie Regulated River due to an extreme dry period. The concurrence of the NSW Minister for Energy and Environment was obtained before making this order.

Issuing an order to suspend part of a Water Sharing Plan is consistent with the approaches to manage risk in a Stage 4 critical drought / water shortage under the IRG. It also reflects that water is being prioritised for critical human needs.
2.2 Water security options

WaterNSW, local water utilities (Councils) and DPIE are jointly and individually planning to implement a range of projects and actions in stages to secure water supplies for critical human need given current Stage 4 - Critical Drought/Water Shortage. The measures are intended to extend the available water supply until there are substantial inflows to the Macquarie River system. Figure 6 summarises short, medium and long term strategies that are being pursued.

Critical human need refers to the minimum amount of water needed to meet basic human needs. It also includes non-human needs, where a failure to meet these needs would cause too much damage to social, economic or national security (MDBA, 2019).

The following sections outline options that have been investigated to secure water supplies for critical human needs, including measures that have already been implemented.

![Figure 6 Short, medium and longer term supply strategies]

### 2.2.1 Do nothing option

The do-nothing option would involve not implementing the proposal and continuing to allow water to flow over the Warren Weir and through the fishways on the Warren Weir, Duck Creek, Crooked Creek and Gunningbar Creek when water is being delivered to Nyngan via the Albert Priest Channel under the exiting operating arrangements.

If there are no inflows to Burrendong Dam the Macquarie River would cease to flow downstream of the dam in November 2019 (refer to Figure 7). The cease to flow event would affect the full length of the river, including the approximately 260 kilometre long section of the river between Burrendong Dam and the Macquarie Marshes.

Figure 7 also indicates that the Macquarie River is predicted to cease to flow in December 2019 if inflows after July 2019 are equivalent to the drought of record, or are consistent with those received over the past two years.

If the river ceases to flow, WaterNSW would be unable to operate the system to deliver water to cities and towns downstream of Burrendong Dam, including Wellington, Dubbo, Nyngan and Cobar and this would result in significant socio-economic impacts across the Macquarie valley.
The river could not be operated to deliver water to Nyngan and Cobar because it would not be possible to release water from Burrendong Dam to raise the water level in the Warren Weir pool to enable water to be diverted into Gunningbar Creek and the Albert Priest Channel so it can be delivered to the Nyngan upper weir pool. In the absence of deliveries from the Albert Priest Channel, it is estimated that there is two months of water supply in the Nyngan upper weir pool.

The Macquarie River ceased to flow below the Macquarie Marshes in December 2018 and in July 2019 the cease to flow point was in the southern Macquarie Marshes below the Oxley hydrometric gauge (421022) downstream of Warren. The river does not currently connect to the Barwon River. Crooked Creek has also ceased to flow and is no longer hydraulically connected to Marra Creek which is a tributary of the Barwon River.

The do-nothing option would result in the Macquarie River ceasing to flow downstream of Burrendong Dam in November or December 2019. This would result in flows ceasing in effluent watercourses such as Gunningbar Creek, Duck Creek and Crooked Creek. As water levels decline, the river and creeks would revert to a series of pools that provide refuge habitat for aquatic biota. The extent and quality of aquatic habitat would progressively decline as the size of these pools diminishes due to evaporation, infiltration and extraction for human needs. This would affect the full length of the Macquarie River downstream of Burrendong Dam, including the 260 kilometre long section between the dam and the Macquarie Marshes, and has the potential to result in water quality impacts such as stratification, eutrophication and fish kills. It would affect refugia for native biota, including deep holes upstream and downstream of Warren that provide habitat for threatened species. This cease to flow event would have the potential to result in impacts that include:

- Complete loss of flowing habitat from Burrendong Dam to the marshes. This flowing habitat is the preferred habitat for the threatened Trout Cod and with warming temperatures over summer could lead to mass fish kills of Trout Cod.

- Increased fish biomass in dwindling pools would lead to an increase in nutrients. This combined with still water due to the lack of flow will lead to cyanobacterial domination of the algal community. High Cyanobacterial numbers in still water would cause stratification and the creation of an anoxic layer reducing oxygen levels for fish remaining and likely result in large scale fish kills of all species with the larger species dying first, as happened during January 2019 at the Darling River near Menindee Lakes. The decaying fish carcases would release nutrients, causing an increase in the algal biomass and increasing oxygen demand on the pools at night and likely cause the death of the remaining fish.

- Depending on how hot 2019-20 summer is, the remaining refuge pools from Burrendong to Warren would have ideal conditions for cyanobacterial blooms and could result in the loss of Murray Cod, Trout Cod, Golden Perch and Silver Perch along the Macquarie River and its tributaries.

- Shallow refuge pools too shallow to stratify would likely dry out over the summer with all fish trapped dying.

Under the do-nothing scenario, any mitigation strategies implemented by WaterNSW to minimise environmental impacts would likely need to be implemented over a large geographical range downstream of Burrendong Dam, including but not limited to targeted water quality monitoring in key residual pools. Based on the results of the monitoring, recommendations would be made to other agencies such as DPIE and DPIE-W and this may lead them to additional monitoring and management strategies.
### Figure 7  Scenarios to defer a cease to flow event in the Macquarie River downstream from Burrendong Dam

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case - until cease to flow</td>
<td></td>
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<tr>
<td>Stage 1 - Raise Weir at Warren Weir</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Impact of Stage 1 on cease to flow</td>
<td></td>
<td></td>
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<tr>
<td>Stage 2 - Transfer Volume from Windamere Dam</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Impact of Stage 2 on cease to flow</td>
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<tr>
<td>Stage 3 – Pump out Deep storage from Burrendong Dam</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Impact of Stage 3 on cease to flow</td>
<td></td>
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<tr>
<td>Alternatives for High security and BLR need in place Users to have alternate source in place.</td>
<td></td>
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</tr>
</tbody>
</table>

**Key:**
- Zero inflow
- Recent observed inflow - past two years repeated (SDR 1)
- Drought of Record
- Under Drought of Record MAY NOT cease to flow

**Date of Assessment 28 June 2019**
The do-nothing option would result in a critical water shortage sooner as water would not be able to be delivered to meet the critical human water needs of cities and towns downstream of Burrendong dam, including Nyngan and Cobar. This would occur because the Macquarie River would cease to flow before Stages 2 and 3 of the temporary works (section 2.2.2) and the additional water supply measures (sections 2.2.3 – 2.2.6) can be implemented. It also has the potential to result in significant environmental impacts due to the large extent of the Macquarie River that would be affected by the cease to flow event. This is not a feasible option.

2.2.2 Staged implementation of temporary works

The NSW Government has developed a three-stage strategy to delay a cease to flow event in the main channel of the Macquarie River downstream of Burrendong Dam that would occur under the do-nothing option. Stage 1 (this REF) involves temporary works in August 2019 to raise the level of the Warren Weir. Stage 2 involves transferring water from Windamere Dam to Burrendong Dam in December 2019. Stage 3 involves installing infrastructure to enable water to be pumped from the deep storage within Burrendong Dam from February 2020 (see below).

Once the Stage 1 works are complete, flow past the Warren Weir, and Duck and Crooked Creek regulators would only occur if there are tributary flows into the Macquarie River downstream of Burrendong Dam, or if the Warren Town Weir is required to be topped up for fire-fighting purposes (being a critical human water need). Water that would otherwise flow through the fishways at the weir and regulators would be retained in the Warren weir pool to enable diversions to Nyngan and Cobar via the Albert Priest Channel.

As this option would maintain flow in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren, it would prolong the ability for fish to move between refuge habitat in the main channel of the river. Maintaining flow in the river also reduces the risk of adverse water quality conditions to develop. This is a substantial environmental benefit compared to the do-nothing option.

The key environmental concern relates to impacts associated with temporarily ceasing discharges through the fishways on the weir and regulators. These fishways were installed in 2004 and prior to 2004 there was no fish passage provided at these structures. Given the current Stage 4 drought conditions, the Macquarie River has already ceased to flow in the southern Marshes downstream of the Oxley hydrometric station, so this option would effectively move the cease to flow point further upstream. If Stage 1 is implemented in August 2019, compared to the do-nothing scenario it will bring forward the date of the cease to flow event by two months in sections of the watercourses downstream of Warren Weir, Duck Creek and Crooked Creek regulators. As a result, the proposal would have an incremental adverse impact by bringing forward the cease to flow event that would affect the approximately 80 kilometre long section of the river downstream of Warren.

The combined effect of the three stages would have a positive impact as it is predicted to delay the cease to flow event in the approximately 180 kilometre long section of the river between Burrendong Dam and Warren from November 2019 to September 2020 if there are no inflows (refer to Figure 7). All three stages need to be implemented to realise the benefits of this delay. If Stage 1 is delayed, there is a risk that the Macquarie River would cease to flow between Burrendong Dam and Warren before the Stage 3 infrastructure is installed to pump from the deep storage within Burrendong Dam.

This is the preferred option. Stage 1 is the subject of this REF, as described in section 3, and is scheduled to be implemented in August 2019.
Stage 2 does not require construction activity or environmental approval because water transfers are an existing approved operational activity. A separate environmental impact assessment will be undertaken for Stage 3.

### 2.2.3 Water delivery arrangements

The severe and ongoing drought conditions across NSW are having a significant impact on the ability of WaterNSW to deliver water to users. While allocations for the Macquarie River system have been announced by the DPIE, the delivery of water is restricted due to the ongoing drought.

The Macquarie River system is being operated under drought contingency measures with water delivery restrictions and operational arrangements defined for each river section (see Appendix A).

This option is already being implemented and access to water in the 2019/2020 water year will be highly dependent on further inflows into the catchment and associated tributary inflows downstream from WaterNSW storages.

### 2.2.4 Alternative Water Sources

#### 2.2.4.1 Carting water

Water cartage to Nyngan is considered unfeasible. The Drought Management Plan (HydroScience Consulting, 2010) indicates that sixteen 25 kilolitre tanker loads per day at $400 a trip would be required at a cost of $49,000 per week to supply Nyngan. Water cartage to Cobar is also considered unfeasible due to the cost and volume of water required.

#### 2.2.4.2 Groundwater supplies

**Nyngan and Cobar**

Nyngan and Cobar are challenged by the lack of reliable surface water sources. The original purpose of the Albert Priest Channel was to address the lack of reliable water sources at Nyngan, and construction of the pipeline from Nyngan to Cobar was justified for the same reason. Local groundwater typically has low productivity and high salinity.

There are no known viable groundwater sources within 100 kilometres of Cobar to provide an alternative supply. The groundwater within the Nyngan /Cobar area has a high salt content and is not considered adequate for human consumption without treatment. Treatment involving reverse osmosis for salt removal is a very expensive option and has not been considered to date.

**Dubbo and Narromine**

Investigations have been undertaken to confirm the availability of groundwater sources to supplement water supplies to Dubbo and Narromine. The NSW Government has committed $30 million for Dubbo to expand its borefield and $2 million to allow Narromine to access groundwater (https://www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/update/critical-valleys-in-drought).

### 2.2.5 Improved efficiencies in the Nyngan and Cobar water supply scheme

Options set out in the Drought Management Plan focus on increased storage at Cobar, improved efficiencies of transfer from the Macquarie River e.g. piping the Albert Priest Channel, and better reuse and demand management.
The Bogan Shire developed a business case for water security in 2017, which included additional storages at Nyngan, piping of the Albert Priest Channel in 2017 and a new borefield at Warren. The capital cost for this option is estimated to be in excess of $100 million. The NSW Government has committed $8.3 million for the off-stream storage for Nyngan and Cobar and $2m for critical maintenance of the Albert Priest Channel which supplies Nyngan and Cobar (https://www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/update/critical-valleys-in-drought).

As a drought contingency measure a total of 1,000 ML of carryover allocations were purchased by Bogan Shire Council with the funds provided for by the NSW Government in 2018-19 and all the water was diverted via Albert Priest Channel before 30 June 2019. Currently the new off river storage in Nyngan is full.

2.3 Justification for the preferred option

The proposal is justified primarily because the Minister for Water has issued an order under section 49B of the Water Management Act 2000 to suspend part of the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016 in certain river stretches with respect to planned environmental releases, available water determinations and water allocation account management due to the extreme dry period. This reflects a NSW Government decision, with concurrence from the NSW Minister for Energy and Environment, that environmental releases are to cease and water is to be prioritised for critical human water needs. This prioritisation of water for critical human water needs is consistent with the intent of the Macquarie-Cudgegong IRG. The proposal would be decommissioned once the drought declaration is identified as recovering (refer to section 3.4.4).

The proposal would provide a significant benefit by securing a temporary water supply for critical human needs to Nyngan and Cobar, and will also benefit upstream towns such as Wellington and Dubbo as it will delay a cease to flow event in the Macquarie River between Warren and Burrendong Dam. This will provide additional time for alternative water supply measures to be implemented for these cities and towns.

The proposal is also justified on an environmental basis because it would delay a cease to flow event in the approximately 180 kilometre long section of the main channel of the Macquarie River between Burrendong Dam and Warren. This will extend the duration that fish are able to move between refuge habitat within the river and reduce the risk of adverse water quality conditions developing within the river. This is a beneficial impact compared to the do-nothing scenario, which is predicted to result in a cease to flow event in November 2019 that would affect the full length of the Macquarie River, including the 260 kilometre long section between Burrendong Dam and the Macquarie Marshes.

The proposal is designed to:

• be cost effective by maximising the use of existing infrastructure and minimising the need to invest in new infrastructure
• enable it to be constructed and commissioned within a short timeframe in response to the current drought
• enable it to be decommissioned within a short timeframe in advance of inflows to Lake Burrendong
• minimise environmental impacts by limiting construction to existing disturbed areas and enabling tributary flows to be passed downstream. It will also reduce the length of the Macquarie River that is affected by a cease to flow event by about 180 kilometres compared to the do-nothing scenario.
The proposal will be constructed and operated in accordance with an approval that will be issued under the *Water Management Act 2000* and the *Fisheries Management Act 1994*. Operational impacts would be monitored by implementing water quality and aquatic ecology monitoring plans that would be developed in consultation with DPIF and DPIE.

Overall, while there are potential negative impacts associated with the proposal, these are considered no worse than the do-nothing scenario and are able to be adequately managed by implementing the mitigation measures outlined in section 6. The proposal is unlikely to have a significant impact on the environment and does not require an EIS or Species Impact Statement to be prepared under the NSW EP&A Act, and does not require a referral to the Commonwealth under the EPBC Act.
3. Description of the proposal

3.1 Location

The proposed work sites are within the Macquarie River catchment near Warren in western NSW. WaterNSW owns, operates and maintains the structures that the works would be undertaken on. WaterNSW has agreements with the landholders to access the Duck and Crooked Creek regulators and fishways as access to these is through private property. WaterNSW is empowered under s 32(1) (b) & (c) of the Water NSW Act 2014 to ‘enter and occupy land ... to operate...to construct new works and, for these purposes, carry out any work below or above the surface’. This provides WaterNSW with ‘lawful authority’ to erect a structure on crown land without the need for a licence under the Crown Lands Management Act 2016.

<table>
<thead>
<tr>
<th>Name</th>
<th>LGA</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Lot and DP</th>
<th>Zoning</th>
<th>Land ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warren Weir</td>
<td>Warren</td>
<td>-31.734394</td>
<td>147.866667</td>
<td>Lot 4 DP 1189460</td>
<td>R5 – Large lot residential</td>
<td>WaterNSW / DPI Water</td>
</tr>
<tr>
<td>Crooked Creek Fishway</td>
<td>Warren</td>
<td>-31.656330</td>
<td>147.760548</td>
<td>Crooked Creek waterway (no Lot or DP)</td>
<td>RU1 Primary Production</td>
<td>Crown land (access through private property)</td>
</tr>
<tr>
<td>Duck Creek Fishway</td>
<td>Warren</td>
<td>-31.656455</td>
<td>147.760628</td>
<td>Lot 7001 DP 1057356</td>
<td>RU1 Primary Production</td>
<td>Crown land (access through private property)</td>
</tr>
<tr>
<td>Gunningbar Creek Fishway</td>
<td>Warren</td>
<td>-31.678611</td>
<td>147.761202</td>
<td>Lot 2 DP 116478</td>
<td>RU1 Primary Production</td>
<td>WaterNSW</td>
</tr>
<tr>
<td>Marebone Fishway</td>
<td>Warren</td>
<td>-31.385553</td>
<td>147.695625</td>
<td>Lot 10 DP 1164048</td>
<td>RU1 Primary Production</td>
<td>WaterNSW</td>
</tr>
<tr>
<td>Coffer dam and borrow site</td>
<td>Warren</td>
<td>-31.661760</td>
<td>147.760944</td>
<td>Lot 3 DP 1164783</td>
<td>RU1 Primary Production</td>
<td>WaterNSW and Crown land</td>
</tr>
</tbody>
</table>

3.2 Overview

The proposal involves temporary works to modify an existing weir and four fishways to enable water to be diverted to meet critical human water needs of Nyngan and Cobar during a Stage 4 - Critical Drought/Water Shortage. These works involve:

- Raising the operating level of the Warren Weir by 250 mm by installing drop boards (approximate increase of 300m3 weir pool storage)
- Blocking flow through fishways at the Warren Weir, Duck Creek Regulator, Crooked Creek Regulator, Gunningbar Creek Regulator, and Marebone Regulator.

Raising the operating level of the weir and blocking flow through the fishways at Warren Weir and the Duck, Crooked and Gunningbar regulators will raise the level of the weir pool to enable water to be delivered to the Nyngan via the Albert Priest Channel offtake on Gunningbar Creek. These works will enable 50 ML/day to be delivered to the Nyngan upper weir pool. Figure 8 provides a schematic to show how flows will be managed during the diversion.

The gate on the fishway at the Marebone regulator will be closed at the request of the DPIF to prevent downstream flows and maintain a pool of water as refuge habitat for native fish.
Figure 8  Proposed Macquarie River flow diversion

3.3  Construction

Table 5 summarises the proposed works at each site.
### Table 5  Summary of proposed works

<table>
<thead>
<tr>
<th>Site</th>
<th>Proposed works</th>
<th>Construction methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warren Weir</strong></td>
<td>Warren Weir is about four kilometres upstream of the town of Warren on the Macquarie River. The regulated flows in the Macquarie River are controlled by releases from Burrendong Dam located about 200 kilometres upstream of Warren, requiring approximately six days for releases to reach the weir. It is a 400 mm wide fixed crest weir with a fishway that has an upstream gate.</td>
<td>Construction will involve:</td>
</tr>
<tr>
<td></td>
<td>The scope of works at this site is to raise the operating level of the weir by 250 mm with an additional 250 mm of freeboard, The proposal will enable 50 ML/day to be delivered to Albert Priest Channel via the Gunningbar Creek offtake and there would be zero flow past the Warren Weir. The proposal will install a fabricated weir wall by:</td>
<td>• Temporarily reinstating an access track to the fishway that was used to construct the fishway in 2004. This would allow small mobile crane/ hiab access.</td>
</tr>
<tr>
<td></td>
<td>• installing vertical galvanised steel channel sections on top of a new reinforced concrete crest</td>
<td>• Concreting to widen the existing crest from 400 mm to 700 mm by forming and dowelling to the downstream face of the weir. Steel reinforcing dowels will be installed in the existing concrete floor.</td>
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<tr>
<td></td>
<td>• fixing vertical uprights to the new crest via a bolted connection to cast in screw attachments (ferrules) to allow easy removal in the future.</td>
<td>• Installing cast-in ferrules weir crest to allow vertical uprights to be installed.</td>
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<tr>
<td></td>
<td>• installing four 125 mm high aluminium drop boards at each ‘bay’.</td>
<td>• Installing galvanised steel channel sections vertically to house drop boards to raise the pool level as required.</td>
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<tr>
<td></td>
<td>The fishway will be opened to allow tributary flows downstream. Drop-in precast concrete sections dowelled into the existing concrete</td>
<td>• Install aluminium drop boards into vertical uprights.</td>
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<tr>
<td></td>
<td></td>
<td>Construction requires the upstream water level to be temporarily lowered below the existing concrete crest for one week to enable the concrete works to be carried out.</td>
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</table>

*Photograph of Warren Weir and fishway*
The Duck Creek and Crooked Creek regulators are lay flat gate operated weirs with gravity fed fishways.

<table>
<thead>
<tr>
<th>Site</th>
<th>Proposed works</th>
<th>Construction methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>will be installed at the remaining sloped concrete sections either side of the existing flat fixed crest section of the weir. Appendix B includes concept designs for the proposal. The upstream gate would be closed to prevent water flow through the fishway.</td>
<td>Construction will involve:</td>
</tr>
<tr>
<td></td>
<td>The scope of works at these sites involves installing removable shutters on the Duck and Crooked Creek fishways to prevent flows downstream. The aluminium shutters would be installed behind the existing baffles on the fishways. Aluminium channels would be fixed to the baffles to allow the shutters to be removed when required. A galvanised steel walkway would be fabricated and installed across the fishways to allow safe access to the baffles when removing the shutters. Refer Appendix B for concept designs.</td>
<td>• Temporarily blocking the upstream waterway by installing an earth coffer dam formed using soil that is excavated from a section of man-made bank along Crooked Creek. The coffer dam will be in place for the duration of construction. About 200 m³ of material will be transported to the coffer dam site using an excavator, before being placed into creek and compacted. • The area between the coffer dam and the fishway will be dewatered by allowing water to drain away via gravity or pumping it downstream. • Once the fishways have been dewatered, fabricated channel sections will be installed to house...</td>
</tr>
<tr>
<td>Site</td>
<td>Proposed works</td>
<td>Construction methodology</td>
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</tbody>
</table>
|      | Photograph of coffer dam and borrow site along existing access track | aluminium shutters between baffles in the fishway.  
• Some minor scour protection works will be included at either the baffles to stop water going around the baffles when blocked e.g. sandbags and geofabric.  
• The coffer dam will be removed once the shutters have been installed and the soil to be replaced back in its original location and the bank reformed  
• A pre-fabricated walkway will be installed to span the row of baffles to allow access to remove the shutters.  |
| The Gunningbar Creek and Marebone regulator currently have fishways that enable fish passage to be closed. The Marebone fishway is a gated structure and the Gunningbar fishway has slots to enable drop boards to be installed to block flow. | The proposed works involve closing the gate on the Marebone fishway and installing stop logs in the Gunningbar fishway. | Laydown areas will be adjacent to the fishways on land that was disturbed during construction of the fishways. |
|      | | No construction activities are required at these sites. |
3.3.1 Proposed construction equipment

WaterNSW has engaged Ertech as the contractor to construct the proposal. The contractor will select the construction plant and equipment to undertake the works and this is expected to include the following:

- All terrain crane – 100 tonne
- Excavator – 30 tonne (for the coffer dam)
- Crane truck – 25 tonne
- 10 cubic metre capacity tip truck
- Concrete boom pump
- Trailer mounted air compressor
- Trailer mounted generator
- Large rigid tray truck
- Fuel bunding.

3.3.2 Temporary laydown areas

A temporary laydown area will be established on cleared land adjacent to existing structures at Warren Weir, Duck Creek and Crooked Creek regulators. The laydown areas would be on land that has been cleared and disturbed by previous construction activities and the locations will be identified in the Construction Environmental Management Plan (CEMP) that will be prepared by the Contractor and endorsed by WaterNSW before work commences.

The existing site access is suitable for the plant and equipment that is likely to be used and access tracks will not be upgraded.

Fuel will be stored in vehicles on site and taken away each night. No vehicles will need to be refuelled on site. Any refuelling of small generators will occur within plastic bunds that would be located at least 40 metres from the waterway on cleared land.

Laydown areas are not required at the Gunningbar Creek or Marebone regulators because no civil works are required at these locations.

3.3.3 Timing and working hours

As indicated in section 2.2.2, the proposal is required to be installed in August 2019. Construction is expected to take two weeks to complete and work. The following standard working hours defined in the Environmental Protection Authority’s (EPA) Interim Construction Noise Guidelines (2009):

**Monday to Friday:** 7:00am to 6:00pm

**Saturday:** 8:00am to 1:00pm

**Sunday and Public Holidays:** No work.

Given the criticality of the works, construction will be required outside these standard hours. This will involve working on Saturday and Sunday from 8:00am to 4:00pm. The ICNG indicates that work may be undertaken outside the standard construction hours under certain circumstances, including if it involves public infrastructure works and the extended hours will shorten the length of the project and are supported by the affected community. WaterNSW will consult with affected stakeholders regarding the extended working hours.
Work would only occur outside the nominated working hours for the following reasons, and subject to prior approval by WaterNSW:

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

It is not anticipated that work outside of work hours will be required.

### 3.3.4 Earthworks

Earthwork is required to install and decommission the coffer dam upstream of the Duck Creek and Crooked Creek regulators. Material for the coffer dam will be sourced from the man-made bank of the Gunningbar Creek, about one kilometre upstream of the fishways. The creek at the proposed location has been channelised and the capacity has been increased by raising the bank. No vegetation will be removed to access the site or undertake the works.

About 200 m$^3$ of material will be excavated from creek bank and transported to the coffer dam site via excavator. The material will be placed in creek and track rolled by the excavator.

The coffer dam will be decommissioned once the shutters have been installed on the fishways. This will involve excavating the material and using this to restore the creek bank. The creek bank will be back bladed and native grass seed will be scattered on the disturbed area to air rehabilitation.

### 3.3.5 Traffic and access

The works sites will be accessed via the following existing roads and tracks:

- **Warren Weir** – unsealed public access track about 500 metres from Ellengerah Road (southern bank) or Wambianna Road (northern bank) about five kilometres south east of Warren
- **Duck Creek Regulator** – unsealed private property access track off Canonbar Road (Old Warren Road), about nine kilometres north west of Warren
- **Crooked Creek Regulator** – unsealed private property access track off the Carinda Road, about eight kilometres north of Warren.
- **Gunningbar Creek Regulator** – access from an unsealed road that extends from Canoba - Warren Road, about 6.5 kilometres north west of Warren
- **Marebone Regulator** – access via an unsealed track that extends from Nellievale Road, about 38 kilometres north of Warren.

WaterNSW will consult with landholders if access to private property is required, such as to the Duck and Crooked Creek Regulators.
3.4 Operation

3.4.1 Overview

The proposal will be operated by WaterNSW. Water flow and allocation priorities will be managed in accordance with the Order to suspend the Water Sharing Plan, and in consultation with the DPIF and DPIE where adaptive management of tributary flows is to be applied. As indicated in section 2.1, the Minister for Water issued an order under section 49B of the Water Management Act 2000 to suspend the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016 with respect to planned environmental releases, available water determinations and water allocation account management due to an extreme dry period. This suspension reflects that water is to be managed to prioritise water for critical human water needs.

The proposal will raise the operating level of Warren Weir by 250 mm to enable about 50 ML/day to be diverted into the Albert Priest Channel via Gunningbar Creek. Water will only be discharged downstream of the Warren Weir if the Warren Town Weir level needs to be topped up to maintain supplies for firefighting (a critical human water need). Flows downstream of the Duck Creek, Crooked Creek, Gunningbar Creek and Marebone regulators and fishways will cease unless prioritised delivery of water is required downstream.

The proposal will be operated by WaterNSW in accordance with procedures that apply to the remainder of its water supply network, including arrangements to implement temporary works during droughts. Specific measures that will be developed in consultation with DPIE and DPIF and relate to monitoring water quality. The monitoring program is intended to enable a real-time risk assessment to be undertaken based on the best available evidence of conditions in different reaches of the river. This would identify key sites to be monitored and aim to prioritise actions to minimise the risk of adverse impacts and maximise potential benefits. This would involve identifying locations where specific measures are to be implemented, such as deploying aerators, to reduce the risk of poor water quality conditions developing. The extent of monitoring downstream of Warren would be determined by WaterNSW in consultation with DPIE and DPIF and this would confirm whether monitoring is undertaken in deeper pools downstream of Marebone Weir that DPIF advised provided habitat for threatened aquatic species.

The monitoring program will reflect that it is being implemented to provide information to assist to manage impacts associated with the temporary works. It would not be a long-term program that would continue once the drought declaration is lifted and the proposal is decommissioned.

3.4.2 Operation of structures to allow tributary flows

During temporary drought operations, fishways will be operated as the first option to distribute water in accordance with the Water Sharing Plan Part Suspension (Macquarie Regulated River) Order 2019 and dated 3 July 2019, until the order is revoked, replaced or expires on 30 June 2020. Should the suspension order still be in place at a change from IRG drought Stage 4 to Stage 3, WNSW is still required to operate in accordance with the WSP suspension order priorities, however, at Stage 3 there is likely be more water available to supply additional priorities after supplying critical human water needs and the WSP suspension order priorities and this would enable fishways to be opened to deliver flows.

Tributary inflows received at the structures during drought operations will be managed through the fishways and structures as required to supply the critical human water needs and additional priorities in accordance with the WSP suspension order and as outlined within the Tributary Flow Management Plan (refer to section 3.4.3).
3.4.3 Management of tributary flows

One of the key benefits of the proposal is its ability to deliver tributary flows to assist to maintain fish populations downstream of the affected structures. The proposal has been designed to enable tributary inflows downstream of Burrendong Dam to be delivered to the Macquarie River downstream of Warren Weir by removing drop boards and opening fishways. An adaptive management framework will be developed in consultation with the DPIF and DPIE to manage tributary inflows and will be detailed in the Tributary Flow Management Plan.

WaterNSW’s hydrometric network includes limited monitoring of the inflows from the tributaries downstream of Burrendong Dam. Tributary flows may occur in varying flow rates, volumes and durations. Active management of the individual flow event by WaterNSW will be limited by the shape of the hydrograph and the capacity of the regulating structures currently in the Macquarie River. Some tributary flows may be large enough to meet more than one of the principles listed below.

Principles for managing tributary flows

The following principles would apply when managing tributary flows and would be consistent with order issued under section 49B of the Water Management Act 2000, Macquarie-Cudgeong River Operations Stakeholder Consultation Committee (ROSCCo) recommendations, and consultation with government agencies:

- Tributary flows are managed adaptively.
- Deliver current restricted regulated demands by reducing dam releases.
- Restore flows in regulated sections that are stopped to allow access to basic landholder rights (BLR) and to meet the critical needs of the environment in those locations.
- Divert flows to ‘dam-supported’ stock and domestic replenishments, if not completed already.
- Divert flows to ‘tributary only’ stock and domestic replenishments – by matching available volume and duration with needs.
- Deliver supplementary events when triggered as per Water Sharing Plan rules after allowing for higher priority requirements.

Heads of Consideration

The following heads of consideration would apply when determining how tributary flows are to be managed:

- Water Management Act 2000 S60 (3A) while an order under section 49B is in force
- Water Management Act 2000 s324 (1) order suspension of remaining carryover allocations in general security accounts in the Macquarie River including environmental licences (page 2251);
- Water Management Act 2000 s49B suspension of operations of planned environmental flow rules
- Restrictions to water delivery in the Macquarie River as per operations update:
**Governance**

Decision making on distribution of tributary flows during any events is by WaterNSW system operations manager after considering legislated priorities.

Consultation regarding management of tributary flows would involve the following representatives:

- WaterNSW Water system operations manager
- DPIE Biodiversity and Conservation North West Branch Senior Wetlands and Rivers Conservation Officer
- DPIE Fisheries Senior Fisheries Manager – Western

WaterNSW will also seek recommendations from the broader group of stakeholders via the Macquarie-Cudgeong River Operations Stakeholder Consultation Committee (ROSCCo).

**Environmental risk factors to be considered when distributing tributary flows**

*Critical environmental needs* are defined as ‘avoiding irrevocable damage to environmental assets or values.” Practically, this involves two key specific items:

- Survival of native fish within drought refugia
- In the event of extended drought, avoiding critical drying thresholds of long-lived vegetation in the Macquarie River riparian areas and Macquarie Marshes – primarily River Red Gum woodlands and forests, recognizing not all areas can be reached with smaller flows.

Known drivers of fish survival in pools based on observations of other recent environmental flow events in the northern basin include:

- Timing, flow rate and water quality of imminent flows – antecedent temperatures (high heat, sudden temperature drops), are the flows sufficient to de-stratify or heat up pools, hypoxic water or likely high Biochemical Oxygen Demand.
- Status of river pools at the time
  - Stratification (yes/no)
  - Depth/volume within the pool (carrying capacity)
  - Water quality of the pool (dissolved oxygen, salinity, hypoxic blackwater)
  - Fish biomass (carrying capacity), if known
  - Biomass of algae and cyanobacteria (risk of fish death upon destratification)

There is the potential for tributary flow releases to alter water quality in downstream waterways. The viability of effectively topping up of river refuge pools through tributary flows will be based on real-time assessments from:

- on-ground monitoring. It is proposed to identify the overall risk of drought refuge pools on a fortnightly basis over warmer months from October to March, and monthly in other times. This will be dependent on the creation of a short-term intervention monitoring program between NSW and Commonwealth agencies.
- In the absence of information from on-ground monitoring, flow thresholds as listed in the *Macquarie–Castlereagh Long Term Water Plan* (draft, DPIE BioCon) and anecdotal evidence may be considered.
**Table 6  Indicative Adaptive management of tributary flows**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Capacity (ML/D)</th>
<th>River Flow Level (175 ML/d)</th>
<th>Trib Flow Level 1: Up to 400 (ML/d)</th>
<th>Trib Flow Level 2: Above 400 (ML/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scenario 1 (cooler months)</td>
<td>Option 1</td>
<td>Option 2</td>
</tr>
<tr>
<td>Downstream of Warren Weir (over sill)</td>
<td>9800</td>
<td>0</td>
<td>0</td>
<td>85</td>
</tr>
<tr>
<td>Gunningbar Creek offtake Regulator</td>
<td>&gt;1500 d/s channel capacity</td>
<td>150</td>
<td>400</td>
<td>290</td>
</tr>
<tr>
<td>Trans losses Gunningbar offtake - Gunningbar Weir</td>
<td>10 - 50</td>
<td>20</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Gunningbar Creek downstream Weir</td>
<td>400 d/s channel capacity</td>
<td>40</td>
<td>300</td>
<td>80</td>
</tr>
<tr>
<td>Albert Priest Channel</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Duck Creek Regulator</td>
<td>70 - 100 d/s env channel capacity</td>
<td>0</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>Duck Creek Fishway</td>
<td>25 - 30</td>
<td>25</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Crooked Creek Regulator</td>
<td>80 offtake</td>
<td>0</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>Crooked Creek Fishway</td>
<td>15 - 20</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
</tbody>
</table>
3.4.4 Decommissioning

The works approved under ISEPP cl 129 (3) as temporary works for or associated with drought relief are temporary and as such, the proposed temporary structures will remain in place while the NSW Department of Primary Industries Combined Drought Indicator (CDI) indicates a condition of drought within the Bogan, Warren, Narromine and Western Plains Regional Local Government Areas. The temporary structures will be removed within four months of all the areas no longer being in drought, as identified by the DPI CDI (https://edis.dpi.nsw.gov.au/). Drought status will be considered as being removed when the CDI for the LGA is identified as Recovering.

The removal of temporary structures includes components such as walkways, shutters or drop boards and their supports, installed as part of the works at Duck and Crooked Creek fishways and at Warren Weir.

The concrete installed along the downstream side of the Warren Weir crest to provide additional strength to the existing weir will not to be removed as it is required to strengthen the crest regardless of the temporary works. The additional concrete left in place will not change the operation or height of the weir or increase its capacity upon a return to higher river flows. This work has been assessed and is permissible under Infrastructure SEPP Clause 127(a).

Fishways at Warren Weir, Marebone and Gunningbar Creek will also be reopened and functioning as there will no longer be a need to keep them closed.
4. Planning context

4.1 Environmental Planning and Assessment Act 1979

All development in NSW is assessed in accordance with the provisions of the Environmental Planning and Assessment Act 1979 (EP&A Act) and Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). The EP&A Act institutes a system for environmental planning and assessment, including approvals and environmental impact assessment for proposed developments. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

As discussed in section 4.2.1, the proposal does not require development consent under Part 4 of the EP&A Act. The proposal is an activity that requires assessment under Part 5 of the EP&A Act.

Section 5.5 of the EP&A Act outlines the duty of determining authorities to consider the environmental impacts of an ‘activity’. When considering an activity, the determining authority is required to ‘examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment’.

Section 5.7 of the EP&A Act requires the determining authority to consider whether an activity is ‘likely to significantly affect the environment’ (including critical habitat) or threatened species, populations or ecological communities, or their habitats. If a determining authority is of the opinion that an activity would be likely to significantly affect the environment, by virtue of a Ministerial order, the activity would then require the approval of the Minister for Planning. Factors that need to be taken into account when considering the likely impact of an activity on the environment are outlined in Clause 228 of the EP&A Regulation. A review of the proposal against Clause 228 is found in Appendix C.

Section 6 of this REF assesses the likely effect of the proposal on the environment. As the proposal is unlikely to result in significant impacts, an environmental impact statement is not required. A REF has been prepared to assess the environmental impacts to satisfy the requirements of Part 5 of the EP&A Act.

WaterNSW as the proponent is also the determining authority for the proposal. Other approvals for the proposal are required from:

- Natural Resources Access Regulator (NRAR) for approvals and licences under the Water Management Act 2000
- DPIF for permits under the Fisheries Management Act 1994.

4.2 Environmental planning instruments

4.2.1 State environmental planning policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) includes planning provisions and development control for 25 types of infrastructure works or facilities. Division 25 of Part 3 of the Infrastructure SEPP relates to waterway or foreshore management activities. Clause 129(3) states that:

Development for the purpose of temporary works for or associated with drought relief may be carried out by or on behalf of a public authority without consent, but only if the development is:
(a) carried out on land publicly identified by the Minister for Primary Industries as being in drought, and

(b) removed, and the area rehabilitated, within 4 months after the date on which the area is no longer so identified.

Note: Areas of NSW that are in drought are identified on the website of the Department of Primary Industries.

As the proposal is a temporary work associated with drought relief and will be on land that the Minister has identified as being in drought, it does not require consent and is subject to assessment under Part 5 of the EP&A Act.

Division 24 of Part 3 of the Infrastructure SEPP relates to water supply systems. Clause 127 states that:

Development for the following purposes carried out by or on behalf of a public authority is exempt development if the development is in connection with a water supply system and complies with clause 20 and if it involves no greater soil or vegetation disturbance than necessary and no increase in stormwater drainage or run-off from the site:

(a) emergency works or emergency maintenance to protect a water supply system.

As the proposal to strengthen the Warren Weir crest is required regardless of the proposed temporary works and will not be removed, it is considered as emergency maintenance works to protect a water supply system and complies with Infrastructure SEPP cl 127(a).

Consultation

Clauses 13, 14, 15 and 16 of the ISEPP require public authorities to undertake consultation with councils and other agencies in certain circumstances when proposing to carry out development without consent. The proposal does not require consultation under clauses 13, 14 or 15.

WaterNSW will advise Roads and Maritime Authority of the temporary block bank within Gunningbar Creek and waterway obstruction.

State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) was reviewed to determine whether the proposal requires approval under Part 5.1 of the EP&A Act. The proposal does not meet the criteria for State significant development under Clause 8(1)(a) of the SRD SEPP because it is permissible without development consent under Part 4 of the EP&A Act due to the application of Clause 125 of Infrastructure SEPP.

Under Clause 14(1) of the SRD SEPP, development is declared State significant infrastructure if:

(a) the development on the land concerned is, by the operation of a State environmental planning policy, permissible without development consent under Part 4 of the Act, and

(b) the development is specified in Schedule 3.

Clause 1 of Schedule 3 of the SRD SEPP relates to:

Infrastructure or other development that (but for Part 5.1 of the Act and within the meaning of Part 5 of the Act) 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 Act.
The proposal would not require an EIS under Part 5 of the EP&A Act as it is unlikely to result in significant environmental impacts. As the proposal is not of a type specified in Schedule 3, it is not State significant infrastructure and does not require approval under Part 5.1 of the EP&A Act.

4.2.2 Warren Local Environmental Planning

Land use within the Warren local government area is regulated by the Warren Local Environmental Plan 2012 (LEP). The proposal does not require development consent under the LEP due to the application of clauses 1.9 and 5.12 of the LEP, and State Environmental Planning Policy (Infrastructure) 2007.

The proposal would be located on land that is zoned for the following purposes under the LEP:

- RU1 Primary Production – Duck Creek, Crooked Creek, Gunningbar Creek Weir and Marebone regulators.
- RU5 Large Lot Residential – Warren Weir

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

The primary objective of the EPBC Act is to ‘provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance’ (NES). Environmental approvals under the EPBC Act may be required for an ‘action’ that has, will have or is likely to have a significant impact on:

- NES matters
- The environment on Commonwealth land (whether or not the action is occurring on Commonwealth land)
- The environment anywhere in the world, where the action is to be undertaken by a Commonwealth agency.

Approval for such an action may be required from the Australian Government Minister for the Environment.

An ‘action’ is considered to include a project, development, undertaking, activity or series of activities. NES matters include:

- World heritage areas
- National heritage places
- Wetlands of international importance (i.e. Ramsar wetlands)
- Nationally listed threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions.

If the proponent considers that an action will have or is likely to have significant impacts on a NES matter or on Commonwealth land, a referral is made to the Commonwealth Department of Environment and Energy (DoEE). A proposal may also, but is not required to be referred to
the DoEE where an action will not have or is not likely to have a significant impact. If it is determined through the referral process by the DoEE that an action is likely to have a significant impact on a NES matter, or on Commonwealth land, then the project is a ‘controlled action’ and approval from the Minister would be required.

An EPBC Act protected matters search was undertaken on 6 May 2019 which identified several NES matters that may occur in, or may relate to, the proposal area. Table 7 provides a summary of the results.

**Table 7  EPBC protected matters search results**

<table>
<thead>
<tr>
<th>NES matters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>World heritage areas</td>
<td>None</td>
</tr>
<tr>
<td>National heritage places</td>
<td>None</td>
</tr>
<tr>
<td>Wetlands of international significance (RAMSAR sites)</td>
<td>The Macquarie Marshes, a listed Ramsar wetland are located downstream of the proposed works. The Macquarie Marshes, a listed Ramsar wetland are located downstream of the proposed works</td>
</tr>
<tr>
<td>Commonwealth marine areas</td>
<td>Not relevant</td>
</tr>
<tr>
<td>Great Barrier Reef Marine Park</td>
<td>Not relevant</td>
</tr>
<tr>
<td>Threatened ecological communities</td>
<td>Five threatened ecological communities were identified as having potential to occur in the search area.</td>
</tr>
</tbody>
</table>
| Threatened species                       | 14 threatened species were identified as having potential to occur in the search area. Of these, 11 are birds, mammals or plants that are unlikely to be significantly impacted. Section 6.4 reflects that there are three threatened fish species that have the potential to be impacted:  
  • *Maccullochella macquariensis* Trout Cod - Endangered (EPBC Act), Endangered (FM Act);  
  • *Maccullochella peeli* (Murray Cod) - Vulnerable (EPBC Act); and  
  • *Bidyanus bidyanus* (Silver perch) - Critically Endangered (EPBC Act), Vulnerable (FM Act). |
| Listed migratory species                  | Seven migratory species were identified as having the potential to occur in the search area and section 6.4 reflects that these are unlikely to be significantly impacted. |

The proposal will not impact upon any world heritage areas, national heritage places, Commonwealth marine areas, or the Great Barrier Reef Marine Park. Potential impacts on threatened species, threatened ecological communities, or migratory species that are listed under the EPBC Act are assessed in section 6.4.

**4.3.2 Commonwealth Water Act 2007**

The *Water Act 2007* (Water Act) requires the preparation and adoption of a Basin Plan which provides for the integrated management of Basin water resources. Important functions of the *Basin Plan 2012* include providing for:

- Giving effect to relevant international agreements to the extent they relate to the use and management of Basin water resources,
- Establishment and enforcement of environmentally sustainable limits on qualities of surface water and groundwater that may be taken from Basin water resources,
- Basin-wide environmental objectives for water-dependent ecosystem, and water quality and salinity objectives,
• Requirements that must be met by water resource plans, and
• Giving effect to the priority of critical human water needs.

The Basin Plan sets out Water Resource Plan (WRP) requirements, including those relating to critical human water needs and water quality. Clause 86 (A(2)) of the Water Act defines Critical human water needs as the needs for a minimum amount of water, that can only reasonably be provided from Basin water resources, required to meet:
• core human consumption requirements in urban and rural areas; and
• those non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs.

Each WRP is to include a quality management plan with identifies water quality target values and measures to address the water quality of fresh water-dependent ecosystems, irrigation water and recreational purposes. WRPs are to describe how extreme dry periods and certain water quality events will be managed. If those dry periods or events would compromise a Basin State’s ability to meet critical human water needs, the WRP must set out measures to ensure critical human water needs are met (Part 13 (2)).

The Water Resource Plan of relevance to the proposal is the Draft Macquarie–Castlereagh Surface Water Resource Plan. The WRP includes an Incident Response Guide (IRG) for managing access to water during an extreme event is a severe water shortage or water quality event. The IRG is discussed in section 2.1.3 and reflects that the proposal will be implemented under a Stage 4 drought to prioritise water for critical human need.

### 4.3.3 Native Title Act 1993

The objectives of the Native Title Act 1993 are to:
• recognise native title rights and sets down basic principles in relation to native title in Australia
• provide for the validation of past acts which may be invalid because of the existence of native title
• provide for a future regime in which native title rights are protected and conditions imposed on acts affecting native title land and waters
• provide a process by which native title rights can be established and compensation determined, and by which determinations can be made as to whether future grants can be made or acts done over native title land and waters
• provide for a range of other matters, including the establishment of a National Aboriginal and Torres Strait Islander Land Fund.

The proposal involves works on Crown land. NRAR has notified native title claimants in accordance with the requirements of the Native Title Act 1993 as part of the process to consider the application for a Water Supply Works Approval under the Water Management Act 2000.

### 4.4 NSW legislation

#### 4.4.1 Water Management Act 2000

The Water Management Act 2000 (WM Act) governs the sustainable and integrated management of the State’s water for the benefit of both present and future generations. Under the WM Act, a Water Supply Work Approval (WSWA) is required to use a specified water supply work at a specified location. WaterNSW holds a WSWA for the Macquarie and
Cudgegong Regulated Rivers Water Source. WaterNSW has consulted NRAR and confirmed that an additional WSWA is required for the proposal. This application was submitted on 26 May 2019.

4.4.2 Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016

The *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016* (WSP) covers the sections of the Macquarie River, Duck Creek and Crooked Creek where the proposal will be undertaken. The WSP sets the rules for the management of water access licences, water allocation accounts, the extraction of water, the operation of dams and the management of environmental water flows.

Conditions in relation to water supply works approvals are also provided in the WSP. WaterNSW undertake the works in accordance with the WSP.

Section 2.1.3 reflects that under a Stage 4 critical drought / water shortage, the WSP may be partially suspended as part of measures to manage water supplies under the Macquarie-Castlereagh IRG. Given the severity of the drought, on 3 July 2019 part of the WSP was suspended and until 30 June 2020, unless revoked sooner. The Water Sharing Plan Part Suspension (Macquarie Regulated River) Order 2019 was issued under section 49B of the *Water Management Act 2000*. It suspends the operation of the Water Sharing Plan for the *Macquarie and Cudgegong Regulated Rivers Water Source 2016* with respect to planned environmental releases, available water determinations and water allocation account management in relation to the Macquarie Regulated River due to an extreme dry period. The concurrence of the NSW Minister for Energy and Environment was obtained before making this order.

4.4.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the sustainable management of fish and fish habitats and outlines approval processes for the activities that may impact on threatened fish species and habitats.

The Minister for Fisheries is required to be notified under section 199 of the FM Act of any proposed dredging and reclamation works in ‘waterland’ undertaken by a public authority (other than a Council). The proposal involves work within a waterway to install a coffer dam and this meets the definition of dredging and reclamation. WaterNSW is required to notify DPIF and consider any matters raised by DPIF within 21 days of the notice being given.

Under Section 218 (5) A **public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway (or to approve of any such construction, alteration or modification)**:

(a) **Must notify the Minister of the proposal, and**

(b) **Must, if the Minister so requests, include as part of the works for the dam, weir or reservoir, or for its alteration or modification, a suitable fishway or fish by-pass.**

The proposal will modify Warren Weir and the fishways on Duck Creek and Crooked Creek regulators. It will close the fishways at Warren Weir, Gunningbar Creek Weir and Marebone regulators, and also construct a temporary coffer dam in Gunningbar Creek.

Under Section 219 it is an offence to obstruct fish passage. The proposed works will affect fish passage through the closure of existing fishways and the construction of a temporary block bank. WaterNSW has consulted with DPIF and an application will be made to temporarily block fish passage at the affected structures.
4.4.4 **Biodiversity Conservation Act 2016**

The *Biodiversity Conservation Act 2016* (BC Act) provides legal status for biota of conservation significance in NSW. The BC Act aims to, amongst other things, ‘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’. It provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development, and establishes a standard method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts.

This Act applies in relation to animals and plants and not in relation to fish and marine vegetation (refer *Fisheries Management Act 1994*).

Part 7.2 (1) of the BC Act, states that development or an activity is “likely to significantly affect threatened species” if:

*It is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3, or*

*The development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of development on biodiversity values, or*

*It is carried out in a declared area of outstanding biodiversity value.*

Potential impacts on threatened species or ecological communities, or their habitats have been considered in section 4.4.4 and impacts are not considered to be potentially significant.

4.4.5 **Biosecurity Act 2015**

The *Biosecurity Act 2015* guides the management of weeds at the regional level throughout NSW. Under the Act, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant who knows or ought to know of any biosecurity risk, has the duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. Individual landholders and managers are required under the Act to control priority weeds for their area according to the relevant biosecurity toolset.

There is the potential for priority weeds to be present on site and this is discussed in section 6.4.2. These weeds will be managed in accordance with the *Biosecurity Act 2015*.

4.4.6 **Crown Lands Management Act 2016**

Under Division 9.2 of the *Crown Lands Management Act 2016* it is an offence to erect a structure, clear or dig up public land without a lawful authority. Works will occur on existing structures that are located on Crown land managed by WaterNSW. Crown land licences exist on these assets and given works will be undertaken by or on behalf of WaterNSW, additional licences are not required.

The coffer dam will be installed within a waterway that is Crown land. WaterNSW has an exemption that enables temporary structures such as block banks and coffer dams to be installed on Crown land if they are drought relief measures.

As indicated in section 3.1, WaterNSW is empowered under s 32(1) (b) & (c) of the *Water NSW Act 2014* to ‘enter and occupy land … to operate…to construct new works and, for these purposes, carry out any work below or above the surface’. This provides WaterNSW with ‘lawful authority’ to erect a structure on crown land without the need for a licence under the *Crown Lands Management Act 2016*.
4.4.7 Water NSW Act 2014

Under Section 32 of the Water NSW Act 2014, WaterNSW is permitted to enter and occupy land for the construction of new works and to carry out the work on, below or above the surface of the land and to repair, replace, maintain, remove, extend or improve any of its systems for the purposes of carrying out the terms and conditions of its operating licences.

WaterNSW has notified DPI- Lands of the proposed works and that construction activities will be undertaken at those sites and assets that occur on Crown Land.

Where the works are to be undertaken or access is required on private land, the landowner has been consulted regarding the proposed works and an access agreement will be negotiated and agreed to by the land owner.

4.4.8 Heritage Act 1977

The objects of the NSW Heritage Act 1977 include the conservation of heritage and the identification and registration of items of State heritage significance. The Act is concerned with all aspects of conservation, including protection against damage and destruction, to restoration and enhancement. All historic remains and all potential sub-surface archaeological features are subject to provisions of the Act and are therefore afforded concurrent statutory protection.

Section 170 of the Act applies to items listed on a government agency Heritage and Conservation Register are to be impacted. Warren Weir is listed on the Section 170 WaterNSW heritage and conservation register (refer section 6.7.1). The proposal is temporary and will not require the demolition of heritage structures and therefore formal notification of works is not required to the Heritage Council under section 170A (1) (c) of the Heritage Act.

4.4.9 National Parks and Wildlife Act 1974 (NPW Act)

The National Parks and Wildlife Act 1974 promotes and regulates the management of national parks and historic sites or places of cultural value within the landscape and the conservation of certain fauna, native plants and Aboriginal objects and places.

The NPW Act provides the basis for legal protection and management of Aboriginal sites in NSW. All Aboriginal objects within the state of New South Wales are protected under Part 6 of the NPW Act. The implementation of the Aboriginal heritage provisions in the NPW Act is the responsibility of the DPIE.

No known Aboriginal sites are located within or in proximity to the work sites (refer to section 6.6). The proposal will be limited to existing disturbed land and impacts to Aboriginal sites are unlikely. No permits are likely to be required under the NPW Act.
5. Consultation

5.1 Community and Stakeholder Engagement Plan

WaterNSW has prepared a Community and Stakeholder Engagement Plan (CSEP) for the Macquarie Valley Drought Temporary Works which outlines:

- WaterNSW’s engagement goals and objectives
- Key stakeholder groups
- Risk management measures
- Engagement tools
- Policies and protocols for community and stakeholder engagement.

WaterNSW aims to provide timely information to manage stakeholder and community expectations and build understanding of the project and its benefits. All communications and engagement activities will be guided by the following principles:

- To clearly communicate the objectives of this project;
- Consult with stakeholders to inform the development of the detailed business case;
- Be proactive. Engage the stakeholders early in the process;
- Be open and honest in any communications;
- Be inclusive. Ensure stakeholders have access to the process and information about the study;
- Be responsive. Respond to stakeholder contact in a timely manner;
- Communication and engagement to be flexible and tailored to capture various stakeholders;
- Continual monitoring of activities to ensure communication and engagement requirements meet ongoing project stages, and
- Keep stakeholders up to date and honour commitments made during consultation.

Key stakeholder groups across the broader Macquarie Valley are listed in Table 8.

Table 8 Key stakeholders

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministers</td>
<td>Minister for Water, Property and Housing</td>
</tr>
<tr>
<td></td>
<td>State Ministers</td>
</tr>
<tr>
<td>Federal Government</td>
<td>Commonwealth Environmental Water User</td>
</tr>
<tr>
<td>State Government</td>
<td>Including: Office of Environment and Heritage</td>
</tr>
<tr>
<td></td>
<td>National Parks and Wildlife Services</td>
</tr>
<tr>
<td></td>
<td>State emergency services (SES)</td>
</tr>
<tr>
<td></td>
<td>Rural Fire Services</td>
</tr>
<tr>
<td></td>
<td>Department of Industry, Water</td>
</tr>
<tr>
<td></td>
<td>Department of Primary Industry, Fisheries</td>
</tr>
<tr>
<td></td>
<td>NRAR</td>
</tr>
<tr>
<td>Local Government</td>
<td>Including: Warren Shire council</td>
</tr>
<tr>
<td></td>
<td>Bogan Shire council</td>
</tr>
<tr>
<td></td>
<td>Narromine Shire Council</td>
</tr>
<tr>
<td></td>
<td>Dubbo City Council</td>
</tr>
<tr>
<td></td>
<td>Mid-western regional council</td>
</tr>
<tr>
<td></td>
<td>Orana Joint Organisation of Councils,</td>
</tr>
</tbody>
</table>
### Stakeholder Group | Organisation
--- | ---
**Major customers** | Including Auscott; Agriland; Dubbo City Council; Beitana (Warren); Narrumine Irrigation Board of Management; Trangie Nevertire Co-operative; Tenandra Scheme; Nyngan-Cobar Water Supply Scheme; Dubbo Zoo; Fletchers; Mines – Cobar and Tritton; Abattoirs Targeting customers downstream of Warren Weir

**Irrigators and other water users** | Including: Orana Water Utilities Alliance Cudgegong Water users Macquarie Effluent Creeks Association Lower Bogan Water Users Association Macquarie Marshes Environmental Landholders Association Macquarie River Food and Fibre Lower Macquarie Groundwater Irrigators Association Macquarie Cotton Growers Association Lower Macquarie Water Utilities Alliance Inland Waterways Rejuvenation Association [Central West Councils Environment & Waterways Alliance](#) Albert Priest Channel Association Australian Floodplain Association (AFA) Flood Mitigation Zone Reference Panel NSW Farmers Association NSW Minerals Council Regional Development Australia – Orana Trangie Agricultural Research Centre

**Environmental groups** | Landcare groups River care groups

**Community groups**

**Recreational groups** | Fishing groups Caravan parks Visitor centres

**Indigenous Groups** | Local Aboriginal Land Councils

**River front properties** | All landholders and customers downstream of Warren Weir, Duck Creek, Crooked Creek, Gunningah Creek, Marebone Creek

**WaterNSW targeted stakeholder groups** | Customer Advisory Groups (CAGs) River Operating Stakeholders Consulting Committee (ROSCCo) WaterNSW Operations Road show – community information sessions

**General community**

### 5.2 Consultation relating to this REF

Table 9 summarises the activities that have been or are planned to be implemented to consult with the stakeholders in Table 8. Matters raised in these consultation activities will be considered by WaterNSW when implementing the proposal.
Table 9  Summary of stakeholder communication and engagement activities undertaken

<table>
<thead>
<tr>
<th>Date to happen</th>
<th>Stakeholders</th>
<th>Communication activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed 9/5/19</td>
<td>Customers (post/email) Customers, landowners and stakeholders via EWN (email)</td>
<td>Notification for project introduction to the raising of Warren weir and temporary structures at Duck Creek and Crooked Creek</td>
</tr>
<tr>
<td>Completed 9/5/19</td>
<td>General community (landowners)</td>
<td>Media release on the Macquarie valley; When investigations start; Outcome of investigations and start of construction</td>
</tr>
<tr>
<td>Completed 16 May 2019</td>
<td>Community/ targeted groups</td>
<td>Presentation by Operations team to ROSCCo Updates on project progress, objective and impacts. Representatives to be encouraged to share information with members. <a href="https://www.waternsw.com.au/supply/regional-nsw/ro%D8%B3%D9%83%D9%88">https://www.waternsw.com.au/supply/regional-nsw/roسكو</a></td>
</tr>
<tr>
<td>Completed 28 May 2019</td>
<td>Targeted groups / community</td>
<td>WaterNSW drought operations roadshow (28/5) - update of works provided to session</td>
</tr>
<tr>
<td>Completed 16 June 2019</td>
<td>Customers and landowners via EWN (email)</td>
<td>Update notification for Warren Weir raising and temporary structures at Duck Creek and Crooked Creek. Update available on drought operations webpage</td>
</tr>
<tr>
<td>Completed 28 June 2019</td>
<td>NRAR OEH DPI Fisheries</td>
<td>Meeting to discuss approval requirements for upcoming works at Warren weir and Duck and Crooked creek and impacts including fish passage, aquatic environment, environmental water</td>
</tr>
<tr>
<td>Completed 3 July 2019</td>
<td>Targeted groups</td>
<td>Customer Advisory Groups (CAGs) – update of works provided to session <a href="https://www.waternsw.com.au/customer-service/feedback/groups/macquarie-cudgegong-cag">https://www.waternsw.com.au/customer-service/feedback/groups/macquarie-cudgegong-cag</a></td>
</tr>
<tr>
<td>Completed 4 July 2019</td>
<td>DOEE (Canberra)</td>
<td>Meeting to discuss approval requirements for upcoming works at Warren weir and Duck and Crooked creek and impacts including fish passage, aquatic environment, environmental water</td>
</tr>
<tr>
<td>Completed 18 July</td>
<td>NRAR OEH DPI Fisheries</td>
<td>Follow up meeting to finalise REF and proposed works</td>
</tr>
<tr>
<td>Before construction</td>
<td>Affected landowners</td>
<td>Discuss and sign off on land access agreements for landowners adjoining Duck Creek and Crooked Creek Regulators</td>
</tr>
<tr>
<td>Before construction</td>
<td>Customers and landowners via EWN (email) Customers (post/email)</td>
<td>Update notification / fact sheet / Q&amp;As for Warren Weir raising and temporary structures at Duck Creek and Crooked Creek and upcoming projects with impacts outlined Identify landowners downstream of Warren regarding impacts around basic landowner rights</td>
</tr>
<tr>
<td>Before construction</td>
<td>General public Stakeholder listing (email/phone) including community, recreation groups</td>
<td>Update notification / fact sheet / Q&amp;As / Advertising for Warren Weir raising and temporary structures at Duck Creek and Crooked Creek and upcoming projects with impacts outlined Identify landowners downstream of Warren regarding impacts around basic landowner rights **Distribute information to public areas – libraries, community halls, shopping areas</td>
</tr>
<tr>
<td>Before construction</td>
<td>Non-customers / basic landowner rights / key stakeholders (phone/email)</td>
<td>Update discussion/email: to ensure they have received information and they are aware of the water outage and operation of the temporary structures, when the temporary structures will be removed; how to keep informed</td>
</tr>
<tr>
<td>Before construction</td>
<td>General community (landowners)</td>
<td>Media release on the Macquarie valley; When installation/construction to start; Update on Macquarie Valley projects including bulk water transfer, access to deepwater at Burrendong dam</td>
</tr>
<tr>
<td>Date to happen</td>
<td>Stakeholders</td>
<td>Communication activity</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Before construction</td>
<td>Councils</td>
<td>Notify councils to discuss: Expected start of work, duration and work hours; Scope of work, location; Communication during the work; Water quality, managing fish, water outage, structure operation</td>
</tr>
<tr>
<td>August 2019</td>
<td>General community</td>
<td>Organise community information session to provide updated details on our works and how we are extending the water supply to meet critical needs including fact sheets, maps and latest notifications</td>
</tr>
<tr>
<td>August 2019</td>
<td>Warren</td>
<td>Media release – a week prior to operation of temporary structures and update on bulk water transfer, access to deepwater at Burrendong dam</td>
</tr>
<tr>
<td>August 2019</td>
<td>General community</td>
<td>Media release – a week prior to operation of temporary structures and update on bulk water transfer, access to deepwater at Burrendong dam</td>
</tr>
<tr>
<td>During operation</td>
<td>Customers and</td>
<td>Update notification to customers of upcoming bulk water transfer, with updated daily transfer figures, expected date for transfer, what to expect during the transfer, where to go for further information.</td>
</tr>
<tr>
<td>August 2019</td>
<td>landowners via EWN</td>
<td>Update website - Bulk Water Transfer with updated daily transfer figures, expected date for transfer, what to expect during the transfer, where to go for further information.</td>
</tr>
</tbody>
</table>

Note: Action Plan forms part of the CSEP and will be updated to proactively address and inform stakeholders and community of the proposed works

5.2.1 Agencies

WaterNSW has consulted with the following agencies during preparation of this REF:

- NRAR
- DPIE – Water
- DPIE – Biodiversity & Conservation
- DPI - Fisheries
- DoEE
- DPI – Crown Lands

Table 10 provides a summary of the responses received and indicated the sections in this REF where the issues raised have been addressed.

DPIF and DPIE reviewed the draft REF and their comments have been incorporated in the final document.

Table 10 Summary of consultation responses

<table>
<thead>
<tr>
<th>Agency</th>
<th>Comment</th>
<th>Where addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPIF</td>
<td>Include design plans for each temporary structure and how they will be operated under a range of flow scenarios.</td>
<td>Section 3.4.3 and Appendix B</td>
</tr>
<tr>
<td></td>
<td>What is the duration for which each temporary structure is proposed to remain in place and what are the removal triggers for the structures?</td>
<td>Section 3.4.1</td>
</tr>
<tr>
<td></td>
<td>How will flows be manages at Warren, Duck and Crooked Creek fishways? Including the management of un-regulated and tributary flows in accordance with water sharing plans.</td>
<td>Section 3.4.3</td>
</tr>
<tr>
<td></td>
<td>How will residual pools downstream be managed e.g. replenishment flows and measures to avoid fish kills? WaterNSW must identify and mitigate</td>
<td>Section 3.4.3</td>
</tr>
</tbody>
</table>
impacts to native fish which may arise as a result of a cease to flow downstream of each structure. A permit is required to temporarily block fish passage under Section 219 of the Act. Section 4.4.3

Consider impacts to the Macquarie marshes through change in flows – potential implications for EPBC Act. Section 6.4

How will pools be managed downstream for fish health? Section 6.3 and 6.4

How will rain events be handled for flow past Warren Weir? Section 3.4.3

How will rivers be restarted after no flow periods? Section 3.4.3

Adaptive management will need to be applied to Warren Weir control. Section 3.4.3

Requirement to submit an application to NRAR for a new water supply work approval. The application will need to specify the works are for no more than 6 months and that the works are for the purpose of drought relief. If works are to be in place for a longer period the relevant approval requirements will need to be addressed prior to the 6 month period finishing. Section 4.4.1

Potential impacts on MNES need to be considered to determine whether referral is required under the EPBC Act. Section 6.4

The proposal would not impact on any environmental watering events because no environmental water has been allocated in this water year. Noted

The proposal is likely to result in beneficial impacts by deferring a cease to flow event in the main channel of the Macquarie River and maintaining water within this channel. Noted

The Macquarie River has ceased to flow downstream of Warren and is not currently hydraulically connected to the Barwon River. Noted

Community

WaterNSW has engaged and consulted with the community during preparation of the REF as indicated in Table 9. This included:

- Issuing a media release and Operations update on 9 May 2019 that outlines the investigative works for drought relief in the Macquarie Valley, including the proposal.

- Issuing a media release and Operations update on 1 July 2019 that outlines water delivery arrangements in the Macquarie River. This advised the community that the system is being operated under drought contingency measures with delivery restrictions. Delivery restrictions and operational arrangements are specific to each section of the river to best assist landholder and customers. This reflects that water will only be delivered downstream of Warren Weir, Duck Creek and Crooked Creek only with tributary flows, not with releases from Burrendong Dam (refer to Appendix D).

- Informing landholders downstream to Warren Weir, Duck Creek, Crooked Creek and Gunningbar Creek that rely on surface water flows for water requirements, including stock and domestic supplies. As these landholders would be affected by the proposal, discussions focused on identifying alternative supply arrangements.

Community forums are being planned at various locations in the valley to keep local residents and businesses updated about the upcoming drought relief projects and the implications of critical water levels on water allocation.
A river operations stakeholder consultation committee (ROSCCo) meeting was held in Narromine on 16 May 2019 and this discussed:

- What allocation level high priority users require to survive
- What timeframe is manageable between flows in the regulated and unregulated sections including the creeks
- Priorities for downstream tributary flows
- Temporary works to manage storage and system losses – this discussion related to the proposal and ROSSCo supported implementation of these works.
- What trading rules should be applied for efficient operations
- Long term options
- Other initiatives to assist stakeholder to manage drought.

**Previous consultation (prior to project start)**

Prior to the Macquarie Valley temporary drought works project, WaterNSW conducted public roadshows to inform the community on the current drought situation compared with previous drought conditions. These sessions were held on 16 January and 11 February 2019, presenting drought water management plans and how measures would be implemented to extend the water supply to meet high security requirements in local towns if the drought situation continued. The presentation included the proposed works. Advertisements were placed in the local newspapers and emails were distributed via WaterNSW’s EWN network. Local council representatives from the Macquarie Valley were invited to attend a targeted briefing on 16 January, 2019 the conditions and plans to manage supply if the drought situation continued and the valley reached Stage 4 (WRP IRG).

WaterNSW also supported Department of Industry (Water) at a presentation on 30 May at Warren. The presentation included plans to manage supply if the drought situation continued which also included the proposed work.

**5.3 Future consultation**

WaterNSW will continue to engage and consult with affected stakeholders prior to and during implementation of the proposal. This will be undertaken in accordance with the CSEP.

WaterNSW will continue working with DPI (Fisheries) to assess river systems and contribute to discussions around options for managing native fish species levels in the Macquarie Valley. Recent meetings have identified monitoring of priority fish habitat areas along the Macquarie River so that native fish species have the best chance for survival during these critical drought conditions. The proposed works incorporate these priority areas for native fish species along the Macquarie River and are the best option to benefit habitats with the raising of the weir pool. Consultation with DPI Fisheries will be ongoing to proactively assess, plan and monitor priority areas and habitats state-wide.

WaterNSW will continue to consult closely with government agencies and inform key stakeholders of the proposed works.
6. **Environmental impact assessment**

The following section assesses the likely environmental impacts of the proposal and discusses the mitigation measures required to reduce those impacts to acceptable levels. The impact assessment is undertaken in the context of the:

- order made under section 49B of the *Water Management Act 2000* suspending the part of the Water Sharing Plan relating to environmental releases
- existing environmental conditions which are affected by prolonged drought. This has resulted in the Macquarie River ceasing to flow in the southern Macquarie Marshes, downstream of the Oxley hydrometric station and as such that it is not hydraulically connected to the Bogan River. Similarly, Crooked Creek has ceased to flow and does not connect to Marra Creek. There is negligible flow at the downstream end of Duck Creek and it will cease to flow with the onset of warmer temperatures in spring.
- current water delivery operations of the Macquarie River which involves only delivering water downstream of Warren Weir, Duck Creek regulator and Crooked Creek regulator with tributary flows, not with releases from Burrendong Dam (refer to Appendix D). If there are no tributary flows, water is not delivered downstream of these structures.
- projection that the full length of the Macquarie River downstream of Burrendong Dam will cease to flow in November 2019 under the do-nothing scenario. This will affect approximately 260 kilometres of the river between Burrendong Dam and the Macquarie Marshes.

6.1 **Land use**

6.1.1 **Existing environment**

The land use surrounding all sites is rural in nature and predominately used for primary production and/or large lot residential purposes.

**Warren Weir**

The Warren Weir site (Lot 4 DP1189460) is zoned R5 large lot residential under the Warren Local Environment Plan. The site is a local reserve managed by WaterNSW.

The existing structures are located within the Macquarie River and Figure 9 to Figure 12 show the environmental conditions at the site.
Duck Creek and Crooked Creek regulators/fishway

The Duck Creek Regulator and fishway is located within Lot 7001 DP 1057356 which is Crown land. The Crooked Creek Regulator and the fishway is in the waterway which is Crown land and does not have a Lot or DP. These sites are on land that is zoned RU1 Primary Production under the Warren LEP. There is a residence located within about 50 metres of the regulators. There are existing walkways located over the creeks (refer Figure 13). The regulators are accessed via private property and are not publicly accessible.

The coffer dam and borrow pit is located about one kilometre upstream of the Duck Creek and Crooked Creek regulators, on land owned by WaterNSW - Lot 3 DP1164783.

The existing structures are located within waterways (Duck and Crooked Creeks) and Figure 14 to Figure 16 provide photographs of these sites.
The Gunningbar Creek Weir (Lot 2 DP164783) is located on land that is zoned RU1 Primary Production under the Warren LEP. This site is owned by WaterNSW. There is a residence associated with a rural property located within about 365 metres north east of the regulator. There is an existing walkway located over the creek. The regulator is accessed via an unsealed public road through private property that extends from Old Warren Road.

Figure 17 and Figure 18 provides a photograph of the regulator, including the upstream gate on the fishway. Land use surrounding the site is characterised by agricultural activities including irrigation.
Marebone Regulator

The Marebone Regulator and fishway are located in Lot 10 DP1164048 on land that is zoned RU1 Primary Production under the Warren LEP. There is a residence associated with a rural property located within about 200 metres south of the regulator. There is an existing walkway located over the regulator (refer Figure 19). The regulator is accessed via an unsealed public road that extends from Nellievale Road.

Figure 19 & 20 illustrate the environmental conditions at the site. Land use surrounding the site is characterised by agricultural activities including irrigation.

6.1.2 Potential impacts

The proposal will not impact on the existing land use of the site or surrounding area. The works involve modifying existing infrastructure at the Warren Weir and Duck and Crooked Creek fishways which will not change land use. Construction will be limited to the footprint of the structures and immediately adjacent areas that have been previously cleared and disturbed during construction and operation of the structures. The proposed works will not affect continued use of the surrounding land for agricultural purposes.

The Warren Weir site is a publicly accessible reserve that is managed by WaterNSW. Access to the reserve will be maintained during construction, however, it will be restricted in the
immediate vicinity of the weir itself. There will be a minor short term impact on the amenity of the reserve as visitors will be able to access parts of the reserve outside the construction area.

Land use of adjoining properties is unlikely to be significantly impacted by the proposal.

The proposal will not impact on land use at the Gunningbar Creek or Marebone fishways as works would be limited to operating the existing structures by either closing the gate or installing drop boards.

The proposal is unlikely to significantly impact land use downstream of the affected structures. Although flows downstream of these structures will decrease, the current water delivery operations mean that water is only being delivered to these sections of the waterways if there are tributary flows (Appendix D). These watercourses have variable flows and adjacent land uses would have experienced cease to flow events during previous droughts.

### 6.1.3 Mitigation measures

**Table 11 Land use mitigation measures**

<table>
<thead>
<tr>
<th>Land use mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore disturbed areas and return the site to its original condition</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Consultation will property owners to gain access to the Duck Creek/ Crooked Creek site.</td>
<td>WaterNSW</td>
<td>Prior to construction</td>
</tr>
</tbody>
</table>

### 6.2 Traffic and access

#### 6.2.1 Existing environment

Access to the work sites will be via sealed roads leading from Warren and existing unsealed roads on public or private property. These include:

- Warren Weir – unsealed public access track about 500 metres from Ellengerah Road (southern bank) or Wambianna Road (northern bank) about five kilometres south east of Warren
- Duck Creek Regulator – unsealed private property access track off Canonbar Road (Old Warren Road), about nine kilometres north west of Warren
- Crooked Creek Regulator – unsealed private property access track off the Carinda Road, about eight kilometres north of Warren
- Gunningbar Creek Weir – access from an unsealed road that extends through private property from Old Warren Road, about 7.5 kilometres north west of Warren
- Marebone Regulator – access via an unsealed track that extends from Nellievale Road, about 38 kilometres north of Warren

All roads used to access the site experience low traffic volumes and are expected to have substantial unused capacity which is typical of a rural environment.

#### 6.2.2 Potential impacts

**Traffic**

Construction will occur over a one week period and require a small number of vehicle movements to the Warren Weir and Duck and Crooked Creek sites. Heavy vehicles will deliver equipment such as cranes, excavators and small tip trucks. This will have negligible impact on
the local traffic network as the existing network of roads and tracks is suitable for use by the construction vehicles.

There is likely to be spare capacity in the road network to accommodate the additional vehicle movements which are estimated to be about 10 per day to the Warren Weir and Duck and Crooked Creek sites for the one week construction period.

Closing the gate on the Marebone fishway and installing drop boards at the Gunningbar fishway will require access by a light vehicle or small truck and will have negligible impact on the road network.

There will be negligible impact on traffic during operation because vehicle movements will be limited to a small number of light vehicles or small trucks that would access the structures for monitoring and maintenance.

**Access**

The proposed works at the Duck Creek and Crooked Creek fishway require access via private property. There will be negligible impact on property access because vehicles will use existing access tracks and all work will be restricted to the existing footprint of the structure. WaterNSW will consult landholders to confirm arrangements to be implemented to minimise disruption to the landholder’s activities.

The Warren Weir site is a publicly accessible reserve. Access to the reserve will be maintained during the construction period, however it will be restricted in the immediate vicinity of the weir and fishway to enable works to proceed.

**6.2.3 Mitigation measures**

**Table 12 Traffic and access mitigation measures**

<table>
<thead>
<tr>
<th>Mitigation required</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>All site vehicles would keep to the designated access tracks and parking areas.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Public access will be restricted as appropriate within the work zone.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>WaterNSW will notify landholders to gain access to private property.</td>
<td>WaterNSW</td>
<td>Prior to construction</td>
</tr>
</tbody>
</table>

**6.3 Hydrology and water quality**

**6.3.1 Existing environment**

The proposal is located within the Macquarie – Bogan Catchment which has a semi-arid climate. Annual rainfall within the catchment ranges from over 1,200 millimetres in the south east to around 300 millimetres in the north-west (refer Figure 21). Rainfall at Warren averages 450 millimetres per year, with a slight summer dominance.

Evaporation in the catchment has a strong east west gradient, with the mean monthly evaporation in the summer months more than 250 millimetres at Warren.
Figure 21  

Average annual rainfall in the Macquarie-Bogan catchment

Surface water in the Macquarie-Castlereagh Alluvium Water Resource Plan (WRP) is managed through three water sharing plans comprising the regulated Macquarie River, the unregulated Macquarie-Bogan River, and the Unregulated Castlereagh River:

- The Macquarie and Cudgegong Regulated River Water Source is defined as the water between the banks of all rivers, from the upstream limit of Windamere Dam storage to the junctions of the Macquarie River and its effluent rivers with the Barwon River. It includes a number of distributary channels that leave the Macquarie River downstream of Warren such as Gunningbar Creek, Marebone Creek, Duck Creek, Bulgeraga Creek and Crooked Creek.

- The Macquarie-Bogan Unregulated Water Sources comprise all of the streams upstream of Burrendong Dam (excluding the regulated Cudgegong River), and all of the tributaries entering the Macquarie and Bogan rivers downstream of Burrendong Dam. There are 30 unregulated water sources managed through this plan.

- The Castlereagh Unregulated Water Source comprises all of the streams within the catchment of the Castlereagh River. There are seven management zones managed through this plan.

The catchment is a highly regulated system and forms part of the Murray Darling Basin. The Macquarie River is regulated by Burrendong Dam and the lower Bogan River receives regulated water from the Macquarie River by diversions through the Albert Priest Channel, which also supplies water to Nyngan and Cobar.

The Sustainable Rivers Audit examined the ecological health of the Macquarie River at the end of the millennium drought (2008 – 2010) (MDBA). The proposal is located in the lowland zone.
of the Macquarie Valley as defined in the audit. The audit reached the following conclusions for the lowland zone:

- **Physical form** – Moderate condition. Overall the valley’s riverine form was characterised by channel simplification and adjustments in channel size. Elevated sediment loads since European settlement are associated with minor sedimentation within the river channel and moderate to high sedimentation on the floodplain.

- **Hydrology** – The hydrology was in poor condition.

**Macquarie River**

Flows in the Macquarie River are heavily influenced by large rainfall events in the upper catchment and flows in tributary systems. The river is about 626 kilometres long and is formed when the Campbells and Fish rivers join above Bathurst, followed by tributary flows from the Winburndale River, Turon River and Pyrmul Creek. The Macquarie River then flows into Burrendong Dam, south east of Wellington (refer Figure 1).

Below Burrendong Dam, the main tributaries are the Bell River, which enters at Wellington; Little River which enters upstream of Dubbo; and the Talbragar River and Coolbaggie Creek, which enter just downstream of Dubbo. As the land flattens further west of Dubbo, the Macquarie River provides flows to distributary creeks, wetlands and alluvial river flats associated with braided channels. There is a complex system of anabranches and effluent creeks that connect the Macquarie, Darling and Bogan rivers. These distributary channels include Duck Creek and Crooked Creek, downstream of Warren. The Macquarie Marshes are located toward the end of the catchment and are seasonally wet. The Macquarie River is joined by the Castlereagh River downstream of the Macquarie Marshes and then flows into the Barwon River near Brewarrina.

The two major storages in the catchment are Windamere Dam (capacity 368 gigalitres (GL) built in 1984) on the Cudgegong River, and Burrendong Dam on the Macquarie River (storage capacity of 1,188 GL, with additional storage capacity of 489 GL in the flood mitigation zone, built in 1967). The volume and pattern of flows in the Macquarie River have been significantly altered by the construction of Burrendong Dam and extraction of water. Regulating structures are used to manage the diversion of water into distributary creeks.

As indicated in section 2.1, the current state of water storages in the Macquarie River is significantly impacted by the drought:

- Inflows in the last two years are 38% of that received during the previous drought of record
- Burrendong Dam is predicted to be at 5% capacity by September 2019
- The Macquarie River has ceased to flow in the southern marches, downstream of the Oxley hydrometric station and is not currently connected to the Barwon River.
- The full length of the Macquarie River is predicted to cease to flow between Burrendong Dam and the Macquarie Marshes by November 2019 if there are no inflows. This would affect a section of the river about 260 kilometres long.

The downstream section of the Macquarie Marshes ceased to flow in December 2018 at the end of the delivery of environmental water. The cease to flow point is currently in the southern Marshes below the Oxley hydrometric gauge (421022). The gauge at Oxley is indicating a very small flow of about 6 -7 ML/d. The Bulgeragar Creek is continuing to maintain a very small flow (0 – 2 ML/d) through the southern Marshes into the northern Marshes at the Pillicawarrina hydrometric gauge (421147). These flows will cease when the pool at Marebone Weir depletes.
The Marebone Weir pool is slowly dropping as there is only a small flow reaching the weir pool from the flows through the Warren Weir fishway. The Warren Weir fishway is passing about 20 – 25 ML/day in the Macquarie River downstream. The small flow through the Warren Weir fishway is continuing to maintain a small flow into the Marebone Weir pool due to cooler conditions. This small flow through the Warren Weir fishway is expected to cease to flow before reaching the Marebone Weir as conditions start to warm up.

The primary environmental asset in the catchment is the Macquarie Marshes on the lower reaches of the Macquarie River, parts of which are listed as a Wetland of International Importance under the Ramsar Convention (refer section 6.5.1). The Marshes are a large and diverse wetland system that provide habitat for a diverse range of species of plants and animals and have supported some of Australia’s largest waterbird breeding events. Other assets in the catchment include the Macquarie River channel, the unregulated component of the lower Macquarie River downstream of Warren Town Weir and the distributary creek system to the west of the Marshes.

The Macquarie Marshes and Macquarie River support a number of species listed as endangered or vulnerable under the EPBC Act (refer section 6.5.1).

Subject to availability and the provisions of the Water Sharing Plan, environmental water is delivered to the Macquarie River and Macquarie Marshes to achieve ecological outcomes. Section 2.1.3 reflects that the NSW government has issued an order that suspends the part of the Water Sharing Plan that relates to delivery of environmental water due to the prolonged drought. No water environmental releases from Burrendong Dam are planned in the 2019/2020 water year.

**Macquarie River at Warren**

Flows along the lower Macquarie River and into the marshes have been regulated since 1896, when the first weir was built at Warren (Ralph and Hesse, 2010). Burrendong Dam, which controls the discharge along the lower reaches of the Macquarie River, was installed in 1967.

The continuous height and flow records for Macquarie River at Warren Weir between 1986 and 2020 is displayed in Figure 22. This indicates the variability in flows, in particular the occurrence of periods when there have been very low or no flows. Figure 23 provides an analysis of low flows at the Warren Weir for the period 1901 – 2017 and indicates that there is a probability of about 5 % that discharges from the weir would be less than 0.0001 ML/day for a period of over 90 days. This reflects the variable flow of this watercourse downstream of Warren Weir.
Marebone Weir is located on the Macquarie River, about 40 kilometres north of Warren. Continuous height and flow data for the Macquarie River downstream of Marebone Weir is available from 1986 to 2020. The data provides insights into the river's water levels and flow rates over time, which can be crucial for understanding the effects of drought and other environmental factors. Analysis of low flows from 1901 to 2017 further assists in assessing historical water availability and planning future water management strategies.
shown in Figure 24 and the low flow analysis is provided in Figure 25. These figures indicate that low or no flow events have occurred historically. There is a probability of about 2% that discharges from the Marebone Weir would be less than about 1,000 ML/day for a period of over 90 days, and a 2% probability of flows being less than 0.0001 ML/day for a period of 30 days.

Figure 24  Marebone weir – continuous height and flow data

Figure 25  Marebone weir – low flow analysis 1986 – 2017
**Bogan River**

The Bogan River is about 617 kilometres long and begins in the Harvey Ranges between Parkes and Peak Hill. It flows north-west through a broad, flat landscape through Nyngan to join the Darling River near Bourke. In the lower part of the Macquarie/Bogan catchment a series of distributary creeks break away from the Macquarie River and connect to the Bogan River (such as Duck Creek).

Water is diverted from the lower Macquarie River at Warren to the Bogan River at Nyngan to supply water to Nyngan and Cobar (refer Section 2.1.2). The Bogan Weir Pools at Nyngan are an important native fish refuge, particularly to Olive Perchlet – a threatened fish species. An environmental water release was received at the lower weir pool in April 2019, managed by the NSW Office of Environment and Heritage to support the threatened fish species.

The Bogan River is typical of a lowland unregulated river. It ceases to flow for up to 50 per cent of the time, with flows decreasing downstream. Continuous height and flow data for the Bogan River at Nyngan is shown in Figure 26 and low flow analysis is provided in Figure 27. These figures indicate that low or low flow events occur frequently.

![Bogan River at Nyngan - historical flow data](image)

**Figure 26**    Bogan River at Nyngan – historical flow data
Duck Creek and Crooked Creek are effluent creeks, branching from the Gunningbar Creek about 10 kilometres north west of Warren. Crooked Creek converges with Marra Creek and flows north into the Barwon River and Duck Creek delivers regulated flows from the Macquarie River to the lower Bogan River. Due to the ongoing drought, Duck and Crooked Creek had ceased to flow by July 2019 and do not connect to the Bogan River or Marra Creek respectively.

Continuous height and flow data for Crooked Creek is shown in Figure 28 and the low flow analysis is provided in Figure 29. Continuous height and flow data for Duck Creek is shown in Figure 30 and the low flow analysis is provided in Figure 31. These figures indicate that low or no flow events have occurred historically. There is a probability of about 5 % that discharges from the Duck Creek offtake would be less than 0.0001 ML/day for a period of over 90 days. There is a probability of about 2 % that discharges from the Crooked Creek offtake would be less than 0.0001 ML/day for a period of over 90 days. This reflects the variable flow of these watercourses.

There is currently a small flow at the Duck and Crooked creeks at the offtake. The offtake regulators are completely shut and about 5 – 8 ML/day in Duck Creek and 4 – 6 ML/day in Crooked Creek is being released through the fishways. Due to the ongoing drought, Duck and Crooked Creek had ceased to flow part way. Crooked Creek does not connect to Marra Creek. There is a small flow in the bottom end of the Duck Creek that is fed by flows from the Gunningbar Creek via Beni Billa Creek.
Figure 28  Crooked Creek – historical flow data 1986 to 2020

Figure 29  Crooked Creek – low flow analysis 1936 – 2017
Figure 30  Duck Creek at offtake – historical flow data 1986 to 2020

Figure 31  Duck Creek – low flow analysis - 1936 – 2017
### 6.3.2 Potential impacts

#### Construction and decommissioning

Potential impacts to surface water quality during construction would be limited to activities associated with installing new infrastructure at Warren Weir and Duck and Crooked Creek regulators, and installing the coffer dam upstream of Duck Creek/Crooked Creek. An excavator will undertake works within the waterway at Duck/Crooked Creek to install the coffer dam. The excavator will move material from the borrow area (upper creek bank) in the creek bed and track roll to compact it.

Once the shutters have been installed on the fishways at the Duck and Crooked Creek regulators, the coffer dam will be removed and the creek bank reinstated.

Works within the waterway pose the following risks to water quality:

- Fuel spills entering the waterway
- Sediment (soil, gravel, concrete washings) entering the waterway and increasing turbidity
- Disturbance of the creek bed resulting in adverse impacts to water quality.

These impacts will be short term and limited to the one week construction period. Management measures will be implemented to minimise potential impacts.

No plant and equipment will be located in the waterway at Warren Weir. Any necessary plant will use existing access tracks.

No construction activity is required at Gunningbar Creek Weir or Marebone Weir.

There is potential for erosion and subsequent sedimentation and an increase in turbidity within the vicinity of works to construct the coffer dam. Small quantities of soil will be temporarily disturbance and the site would be reinstated once construction is complete. The risk of sediment-laden soils leaving the site and polluting waterways to the extent that there would be adverse impacts is considered low.

There is a risk that spills of fuel, hydraulic fluids and lubricating oils used in construction equipment could release of hydrocarbons and metals into the environment. Fuel will be stored in vehicles on site and taken away each night. No vehicles will be refuelled on site. Small generators will be placed in plastic bunds for refuelling and located at least 40 metres from the waterway on cleared land. Given the small scale of the proposal, it is unlikely that the water quality will be significantly impacted provided the mitigation measures in section 6.3.3 are implemented.

Works at the Warren Weir will involve concreting to increase the width of the weir crest. Concreting will occur on the downstream side of the weir which will be above the waterline. During these works there is a risk of pollution and impacts on aquatic ecology if concrete and concrete wash enter the waterway. Pollution controls such as bunding/sediment fencing will be installed adjacent to the weir crest (downstream side) to minimise the risk of concrete spills entering the waterway. Washing of concrete mixing equipment will be managed as per mitigation measures in section 6.3.3. Waste concrete will be transported off site and disposed of at a licenced waste facility.

Given the small area of soil that would be disturbed, there is a low risk of water quality being impacted by turbid runoff from exposed areas. Monitoring of weather and rainfall events will occur as well as river levels upstream to ensure that the work site is closed prior to any tributary flows occurring.

The Macquarie River Catchment can experience large flood events, however there is significant notice of any tributary flows that have the potential to result in flooding. The proposal would
take place during a severe drought and Burrendong Dam is expected to be at 5 % capacity by September 2019. If there is a significant rain event, there is capacity within Burrendong Dam to capture flows to mitigate the effects of flooding. If significant rainfall occurs that leads to large tributary flows downstream of Burrendong Dam, WaterNSW will suspend construction and move equipment to a location that is unlikely to be affected by rising water levels. It is highly unlikely that a flood would occur that would affect the one week construction period. If such an event did occur, the temporary drought response measures would be decommissioned in any case.

Construction will involve activities that are classified as dredging and reclamation, WaterNSW is required to notify the DPIF under section 199 of the *Fisheries Management Act 1994*. Matters raised by the DPIF within 21 days of the notification being given are required to be taken into consideration.

A Water Supply Works Approval is also required under the *Water Management Act 2000* as the proposal involves modifying the Warren Weir and the fishways on the Duck and Crooked Creek regulators. WaterNSW will obtain this approval before commencing construction.

**Operation**

The proposal will result in both positive and adverse hydrological impacts within this highly regulated catchment. Due to the extreme drought, water levels in Burrendong Dam are critically low, resulting in high-level restrictions on the amount of water released downstream. The proposal will further modify flows downstream of each structure to supply water for critical for human need to Nyngan and Cobar.

As indicated in Figure 22 to Figure 31, the Macquarie River, Duck Creek and Crooked Creek have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought.

The proposal will modify existing structures and result in a temporary changes to the regulation of flow in the Macquarie River downstream of Warren Weir and Marebone Weir, and downstream of the Duck Creek, Crooked Creeks regulators and Gunningbar Creek Weir. The proposal will result in the waterways downstream of the structures beginning to dry up and water contracting to pools. Over time there is a risk of eutrophication (stagnation) of pools, resulting in decreased water quality and the risk of algal blooms.

The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow and the potential impacts of this occurring under the do-nothing scenario are outlined in section 2.2.1. This will affect the estimated 260 kilometre long section of the river between Burrendong Dam and the Macquarie Marshes. From a hydrological perspective, the proposal will:

- Have an incremental impact as it will bring forward by two months the cease to flow event downstream of the affected structures.
- Enable a cease to flow event in the main channel of the Macquarie River to be delayed by about three months time allowing for the work to be completed to access the Burrendong Dam deep water storage so this can be released downstream.
- Minimise the extent of the Macquarie River that is affected by a cease to flow event. It will result in a section of the Macquarie River about 80 kilometres long and related effluent creeks ceasing to flow, as opposed to a 260 kilometre long section that would be affected by the do-nothing scenario.
In the absence of significant inflows, the hydrological and water quality impacts downstream of the affected structures is likely to occur regardless of whether the proposal is implemented or not. As a result, the proposal’s impact would be incremental.

The proposal will have substantial beneficial hydrological impacts by retaining water within the 180 kilometre long main channel of the Macquarie River between Warren and Burrendong Dam and delaying a cease to flow event. This will prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for aquatic species. As indicated in section 6.4, the section of the Macquarie River upstream of the Warren Weir provides habitat for threatened fish such as the Murray Cod, and this species has been recorded in greater numbers upstream of the Warren Weir compared to downstream. Maintaining flows in the river will also reduce the risk of pools stagnating and leading to reduced water quality.

The proposal will enable water to be delivered to the Nyngan upper weir pool on the Bogan River which will benefit and maintain native fish habitat within the Nyngan weir pools. The Nyngan weir pools are known to contain an important endangered population (FM Act) of Olive Perchlet as well as the vulnerable species (EPBC Act) Murray Cod. The proposal will result in water being maintained within the weir pool which will assist to maintain this population.

Ceasation of flows past the affected structures will be temporary because:

- Tributary flows downstream of Burrendong Dam will be managed using adaptive management principles and this will enable flow to be discharged downstream of the respective structures (refer to section 3.4.3). Depending on the frequency and volume of tributary flows, it may be possible to deliver water to maintain supply to residual pools, particularly the pool upstream of Marebone Weir.

- The proposal will be decommissioned when the declaration of drought for the affected areas has been removed. Under clause 129(3) of State Environmental Planning Policy (Infrastructure) 2007, the temporary works are required to be removed within four months of the Minister lifting the drought declaration.

The proposal will not impact on the delivery of environmental water to downstream environments including to the Macquarie Marshes, unless supplementary flows are declared, because the environmental water is not available to be used in the 2019/2020 water year. An order has been gazetted under section 49B of the Water Management Act 2000 that suspends the part of the Water Sharing Plan that relates to environmental releases available water determinations and water allocation account management.

### 6.3.3 Mitigation measures

**Table 13 Hydrology and water quality mitigation measures**

<table>
<thead>
<tr>
<th>Hydrology and water quality mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual monitoring of local water quality (i.e. turbidity, spills/slicks) is to be carried out on a regular basis to identify any potential spills or deficient erosion and sediment controls.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Fuel will be stored in vehicles on site and taken away each night. No vehicles will need to be refuelled on site. Any necessary refuelling will be for small generators which will be placed in plastic bunds for refuelling and located at least 40 metres from the waterway on cleared land</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Spill containment measures (such as drip trays and bunds) to be used where refuelling is required. A spill kit is to be kept onsite at all times.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>
### Hydrology and water quality mitigation measures

In the case of a spill, follow the 4 ‘C’ principle (only if safe to do so and using appropriate PPE):
- ‘Cease’ the spill at source as quickly as possible.
- ‘Contain’ the spill using available containment equipment.
- ‘Clean-up’ using appropriate spill containment material.
- ‘Contact’ your Supervisor (Supervisor to follow project incident management procedure).

All spills or leaks of fuels or chemicals are to be cleaned up and the site remediated to original condition.

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<tr>
<th>Contractor</th>
<th>During construction</th>
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Machinery is to be checked daily to ensure there is no oil, fuel or other liquids leaking.

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<th>Contractor</th>
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All fuels and combustible liquids would be managed and handled in accordance with AS 1940 The storage and handling of flammable liquids, the WH&S Act and Regulation and the Storage and Handling of Dangerous Goods – Code of Practice 2005 (WorkCover 2005).

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No chemicals, fuels and lubricants shall be stored overnight on site unless specifically approved by WaterNSW. If approved, these materials shall be stored with bunding within an established site compound, on a level area clear of native vegetation and at least 40 m from any natural or built drainage line or wetland.

Storage on site of small quantities required for small tools and equipment is acceptable so long as it is contained within a mobile, aboveground spill containment unit. The containment unit must be covered to avoid filling with stormwater.

Minimise the quantity of fuel and chemicals present on site at all times.

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<th>Contractor</th>
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Bunding/sediment fencing and silt curtains will be installed adjacent to the weir crest (downstream side) to catch any concrete spills so as not to enter the waterway.

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<th>Contractor</th>
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If washout of concreting equipment (e.g. Agitator bowls and chutes, concrete pumps and lines) is required on site, all wash-out water will be contained in a purpose built wash down area.

The wash-down area must be located with appropriate sediment controls. These will be inspected and maintained regularly and be repaired or replaced as necessary.

To minimise the amount of wash-down water generated, scrape excess concrete off the equipment before it is washed.

Place excess concrete into a site receptacle designated for concrete.

The wash-down area will drain to a low point where water is allowed to percolate through geotextile fabric into the soil. The settled and hardened concrete residue on the ground must be allowed to set and must be placed in a designated concrete/masonry recycling bin on-site prior to disposal offsite.

Concrete shall not be mixed within 20 m of any natural or built drainage line or wetland.

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Prior to use at the site and/or entry into the waterway, machinery is to be cleaned, degreased and serviced.

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<th>Contractor</th>
<th>During construction</th>
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Hydrology and water quality mitigation measures

| Spill kits are to be available on site at all times during works. Machineiry required to access the waterway will do so via designated access locations. If the channel needs to be accessed with machinery, access will occur at a single point, where possible, to minimise impact to the banks. Silt curtains to be deployed to minimise sedimentation of the waterway. Temporary crossings will be removed entirely when works have finished. No snags are to be removed, realigned or relocated in accordance with DPI Fisheries requirements. The level of sediment potentially disturbed would be minimised. It is an offence under s120 of the Protection of the Environment Operations Act 1997 (POEO Act) to pollute water by allowing the release of sediment into the river. A Flood Response Plan is to be developed, which details triggers and measures is to be implemented to remove potentially dangerous materials from the hardstand area in the event of flooding. The Department of Primary Industry – Fisheries is to be notified in accordance with section 199 of the Fisheries Management Act 1994 and Water Management Act 2000. A Water Supply Works Approval will be obtained under the Water Management Act 2000. Monitoring of weather and rainfall events, as well as river levels upstream to ensure works are ceased and the site restored prior to flood events. Implement a water monitoring and management plan for the Macquarie River, Duck Creek and Crooked Creek in line with requirements under the WSP and Critical Drought Response Plan. Water quality would be monitored at 12 refuge sites downstream of Warren that would be selected in consultation with DPIF. Monthly water quality monitoring would be undertaken, including dissolved oxygen, and algal speciation until March 2020. The monitoring plan will detail the cyanobacterial treatments and aeration that will be undertaken at the refuge sites to minimise the risk of cyanobacterial growth and stratification of these refuges. DPIF will be contacted if water quality in the 12 refuge sites deteriorates and DPIF will then determine an appropriate response. | Contractor | During construction | Contractor | During construction | WaterNSW | Before construction | WaterNSW | Before construction | Contractor | During construction | WaterNSW | During operation |

6.4 Biodiversity

6.4.1 Methodology

The biodiversity assessment is based on a desktop review because construction would be limited to existing disturbed sites and there is an extensive body of knowledge regarding environmental values of the lower Macquarie River valley that have the potential to be affected by operations. The following databases and information sources were reviewed in May 2019 to generate a list of threatened ecological communities, threatened populations and threatened or migratory species (threatened biota) listed under the EPBC Act, BC Act and/or the FM Act that have previously been recorded or are predicted to occur within the locality:
• NSW Wildlife Atlas database (the Atlas) for records of threatened species listed under the BC Act.
• The DoEE Protected Matters Online Search Tool (PMST) for Matters of National Environmental Significance (MNES) listed under the EPBC Act predicted to occur in the locality.
• DPI Fisheries maps showing the indicative distribution of threatened species
• NSW Atlas of Groundwater Dependent Ecosystems.

The register and database searches were based on a 10 kilometre radius of the construction sites at Warren Weir, Duck Creek and Crooked Creek.

The list of threatened biota generated by the desktop review and their likelihood of occurrence within the proposal site is presented in Appendix E.

6.4.2 Environmental values

Overview

The Macquarie valley covers more than 75,000 square kilometres in the state’s north and extends from the Blue Mountains to the Barwon River Plains. The Macquarie and Castlereagh catchments are home to the Macquarie Marshes which is one of the largest remaining semi-permanent wetland systems in inland Australia, and has hosted some of the largest-scale waterbird breeding ever recorded on the continent (https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/macquarie/profile).

The breeding is assisted by targeted delivery of water for the environment to the creeks, rivers, lagoons and wetlands that make up the unique Macquarie valley ecosystem. The Macquarie and Cudgegong Regulated Water Sharing Plan establishes a total allowance for water for the environment of 160,000 ML. As indicated in section 2.1.3, the part of the Water Sharing Plan that relates to environmental water was suspended on 3 July 2019 due to the ongoing dry drought conditions.

While water for the environment in the Macquarie plays a vital role in supporting the Macquarie Marshes and river, the flows are insufficient to meet the needs of all the water-dependent ecosystems in the catchment. Flows from tributary streams downstream of Burrendong Dam, such as the Bell, Little and Talbragar rivers, as well as spills from Burrendong Dam, are critical in sustaining the health of the catchment.

Along with the marshes, flows are targeted to sites such as the Cudgegong and Macquarie river channels, and the Lower Macquarie river downstream of the marshes, with potential for the unregulated distributary systems of the Lower Crooked and Marra creeks (https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/macquarie/profile).

Water for the environment in the Macquarie valley is mainly used to:
• support riverine and wetland ecosystems along the river system, including River red gum forests, reed beds and water couch meadows
• support critical water-needs of colonies of nesting waterbird species in the marshes, including egrets, ibis, cormorants and herons
• provide feeding and breeding habitat for a range of waterbirds including ducks, herons, bitterns, magpie geese and brolgas
provide opportunities for breeding and movement of native fish, including Murray cod and Golden perch
• provide a harbour for several species of international migratory shorebirds that visit the catchment each summer from the northern hemisphere.

*Sustainable Rivers Audit*


The audit found that Macquarie River system’s fish, benthic macroinvertebrate and riverine vegetation communities were in Extremely Poor, Moderate and Moderate condition respectively, while physical form and hydrology were both in Moderate condition. The condition ratings for the fish, macroinvertebrate and riverine vegetation themes were used to derive an Ecosystem Health Index. The River Ecosystem Health was rated as Very Poor (Lowland zone: Poor; Slopes zone: Very Poor; Upland zone: Very Poor). The proposal is within the Lowland zone as defined by this audit.

The Macquarie Valley river ecosystem was in Very Poor health. Within the Lowland zone the River Ecosystem Health was poor. The fish community was in Extremely Poor condition. Many expected species were absent. Species count, abundance and biomass were dominated by aliens; recruitment levels among the remaining native species were very low. The macroinvertebrate community was in Moderate condition, with moderate to substantial declines in the frequency and occurrence of expected macroinvertebrate families. Riverine Vegetation was in Moderate condition overall, with reduced abundance, structure and nativeness in the Near Riparian and Lowland Floodplain domains. The Physical Form of the river system was in Moderate condition with bank dynamics in Good condition and channel form and bed dynamics in Moderate condition. There were moderate to high levels of floodplain sediment deposition. The river system’s Hydrology was in Moderate condition, with mainstem river reaches experiencing considerable change from Reference Condition in low and zero flow events; minor alteration in low and high over bank floods, flow variability and flow seasonality; and little or no alteration in high flow events and flow gross volume.

**6.4.3 Existing environment**

Desktop review

The desktop review identified the following threatened biota of potential relevance for the locality:

• Four Wetlands of International Importance are located within the catchment. The Macquarie Marshes RAMSAR wetland is located 50 – 100 kilometres downstream. The remaining three wetlands are located at least 600 kilometres downstream and are not relevant to this REF.
• A range of plant community types have been mapped that are likely to be commensurate with threatened ecological communities (TECs) listed under the BC Act, FM Act or EPBC Act which have been previously recorded in the locality.
• Six threatened flora species listed under the BC Act has been previously recorded in the locality. Four threatened flora species listed under the EPBC Act as potentially occurring in the locality.
11 fauna species and 14 migratory species are of conservation significance and listed under the EPBC Act as having the potential to occur in the locality, the BC Act (41 species), and/or the FM Act (five species or populations).

Seven migratory species listed under the EPBC Act have the potential to occur in the locality (Atlas).

The existing drought conditions have resulted in the Macquarie River and Crooked Creek ceasing to flow by July 2019 and this has the potential to affect threatened biota listed above. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and the current cease to flow point is in the southern marshes below the Oxley hydrometric station.

Section 2.1.3 reflects that the part of the Water Sharing Plan that relates to environmental watering was suspended on 3 July 2019 and this means that environmental water will not be delivered downstream of Burrendong Dam. The regulators on Duck Creek, Crooked Creek and Warren Weir have been closed and water from Burrendong Dam will not be delivered to these waterways (refer to section 2.2.3). The only water that may flow past these structures is tributary flow downstream of Burrendong Dam.

In July 2019, the only flow in the Macquarie River downstream of the Warren Weir was due to small flows through the fishway. With the onset of warmer weather in mid-late 2019, this flow is likely to be insufficient to maintain flow through to the Marebone weir pool, meaning that the river will cease to flow between Warren and Marebone. Similarly, the only flow through downstream of the Duck and Crooked Creek regulators is due to small flows through the fishways and this is also likely to be insufficient to maintain downstream flows with the onset of warmer weather.

The environment downstream of Warren Weir, and the Duck Creek, Crooked Creek and Marebone regulators is currently responding to the ongoing drought conditions and impacts associated with reduced availability of water. The drought has resulted in some waterways drying up or only containing water in deeper pools. In the absence of inflows, over time these pools will contract which has the potential to result in declining water quality and lead to events such as fish kills. There would also be reduced water available to the terrestrial ecological elements, including mobile species.

In the absence of significant inflows and drought relief works, the Macquarie River is predicted to cease to flow downstream of Burrendong Dam in November 2019. This would affect the 260 kilometre long section of the river between Burrendong Dam and the Macquarie Marshes. If this occurs, it is likely to result in similar ecological responses along this section of the Macquarie River to that which is currently occurring between Warren and the Barwon River, and has been occurring in the Darling River at places such as Menindee. This would result in water quality and aquatic ecology impacts in deep pools both upstream and downstream of Warren that DPIF considers to be ecologically important.

Photographs of the site of the proposed coffer dam indicate that it is likely to contain River Cooba (*Acacia stenophylla*). This species is a common component of watercourse-fringing vegetation in inland areas and occurs in association with PCT 36 River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains, which is a likely vegetation type along the river. Juvenile River Red Gums is also present.

**Darling River EEC**

The *aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (Darling River EEC) is listed under the FM Act and includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons,
billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within the State of New South Wales, and including Menindee Lakes and the Barwon River. The sections of the Macquarie River downstream of Burrendong Dam are part of this EEC, including Duck and Crooked Creek. The Final Recommendation of the Fisheries Scientific Committee indicates that ‘in its natural state, many of the water-bodies in this EEC are characterised by variable and unpredictable patterns of high and low flows.

The TECs and threatened species listed under the BC Act, FM Act and EPBC Act as having being recorded in the locality or have the potential to be present in the locality may occur within the Darling River EEC. Appendix E outlines the likelihood of occurrence of these threatened entities and reflects that:

- It is unlikely that threatened entities are present at the proposed construction sites which are limited to the footprint of the existing structures and associated disturbed areas.
- There is the possibility of threatened entities being present in terrestrial and aquatic environments downstream and upstream of the affected structures.

**Macquarie Marshes**

The Macquarie Marshes is a Ramsar listed wetland, totalling 19,850 hectares in central northern NSW, approximately 100 kilometres north of Warren. The Macquarie Marshes contain a wide range of vegetation types, determined by the frequency and duration of flooding, including River Red Gum woodland, Water Couch grasslands, extensive beds of Common Reed, Coolibah, Black Box, Lignum, reed swamp, Cumbungi and River Cooba. The marshes support a diverse array of wildlife, including migratory birds and threatened species (Department of Environment and Energy, 2019c).

The Macquarie Marshes receive environmental water allocation under the *Water Sharing Plan for the Macquarie-Cudgegong Regulated Water Source 2003* via the Macquarie River, Bulgeragar Creek, Marthaguy Creek and Gum Cowel. The available water determination and allocation of shares to general security access licences determines the amount of water available from regulated flows for the irrigation industry and the environment. As noted in Section 2.1.3, on 3 July 2019, the part of the Water Sharing Plan that relates to environmental releases has been suspended. This order will be in place until 30 June 2020 unless revoked sooner and was made with the concurrence of the DoEE.

**Aquatic biota**

The Macquarie River is mapped as Key Fish Habitat (DPI, 2019) by the NSW Department of Primary Industries. Threatened species distribution mapping produced by DPI (2019) identify indicative habitat for Olive Perchlet, Silver Perch and Eel tailed Catfish within the vicinity of the proposal. Indicative habitat is also mapped for the Darling River Snail approximately 100 kilometres downstream of Warren Weir, between the river exiting the Macquarie Marshes and its confluence with the Barwon River.

Crooked Creek and Duck Creek are mapped as Key Fish Habitat (DPI 2019b) by the DPIF. Threatened species distribution mapping produced by DPI (2019b) identifies Crooked Creek as indicative habitat for the Silver Perch and Eel tailed Catfish within the vicinity of the proposal and the Olive Perchlet, approximately 20 kilometres downstream of the Crooked Creek regulator. No indicative threatened species habitat is identified within Duck Creek.

The Bogan River Weir pool supports native fish refuge, particularly for the Olive Perchlet – a threatened fish species found only in a few Bogan River pools in the Macquarie-Bogan River catchment. A 300 ML environmental water release occurred in April 2019 to support the maintenance of habitat for the Olive Perchlet.
DPIF sampled fish communities as part of a Short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- **Zone 1**: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- **Zone 2**: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir.
- **Zone 3**: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- **Zone 4**: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

Threatened fish species recorded by DPIF include:

- **Murray Cod** – this is listed as vulnerable under the FM Act. This species was recorded in Zones 1 (12 records), 2 (214 records) and 3 (19 records). This reflects that the highest abundances were recorded from Gin Gin to Warren.
- **Silver Perch** – this is listed as vulnerable under the FM Act and critically endangered under the EPBC Act. This species was recorded once and that was in Zone 2.
- **Trout Cod** – this is listed as endangered under the FM Act and EPBC Act. This species was recorded once and that was in Zone 1.
- **Eel Tailed Catfish** – This species is an endangered population under the FM Act and was recorded in Zones 1 (24 records) and 2 (3 records).

### 6.4.4 Impact assessment

**Construction impacts**

Ecological impacts have been assessed based on the assumption that potential direct impacts associated with construction will be limited to the footprint of the Warren Weir and fishways on the Duck Creek and Crooked Creek regulators. Laydown areas will be on adjacent land that has been cleared and disturbed as part of activities to construct the fishways in 2004.

Construction of the coffer dam will occur in an area that has been disturbed previously and vegetation is limited to a small number of River Cooba and River Red Gum. It is understood that this area includes a previous borrow location and that the creek has been channelized and the bank raised.

The proposal will have a very localised disturbance footprint, over a short construction timeframe and removal of vegetation will be limited to a small number of River Cooba and juvenile River Red Gum at the coffer dam location. There is likely to be negligible ecological impacts during construction.
Indirect effects on flora and fauna during construction include the following:

- **Noise**: Temporary disturbance of some fauna due to increased noise levels. If species such as the Barking Owl are nesting in close proximity to the construction sites there is the potential for construction noise to lead to the nest being abandoned. These impacts are considered to be minor due to the short term nature of construction impacts at each site and disturbance footprint that is restricted to the immediate vicinity of existing structures. Noise from construction equipment such as excavators and cranes will be similar to that generated by plant and equipment associated with the ongoing agricultural activities that are undertaken on adjacent land.

- **Erosion and sedimentation**: Uncontrolled erosion of soil from the proposal site and the corresponding deposition of this material into adjacent aquatic habitat. This process can cause weed invasion, reduce aquatic habitat values and stifle plant growth.

- **Weeds**: Dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation could occur during the construction period through erosion (wind and water) or via worker’s shoes and clothing or construction vehicles movements.

- **Pollutants**: Water quality impacts could potentially occur during construction if fuel or chemical spills from construction vehicles or equipment enter adjacent waterways.

Construction impacts will be minimised by implementing the mitigation measures in section 6.4.5 and are unlikely to be significant.

**Operational impacts**

**Impacts on aquatic biota**

Section 6.3 reflects that the proposal will result in both positive and adverse hydrological impacts within this highly regulated catchment, and this is likely to have associated positive and adverse ecological impacts.

The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. This would affect about 260 kilometres of the Macquarie River from Burrendong Dam to the Macquarie Marshes and potential impacts of this event are outlined in section 2.2.1. In the absence of significant inflows and with the onset of warmer weather, the potential ecological impacts downstream of the affected structures is likely to occur regardless of whether the proposal is implemented or not because flow downstream of these structures is predicted to be so small that it would be insufficient to connect pools within these watercourses. As a result, the proposal represents an incremental impact compared to the do-nothing scenario. From an ecological perspective, the proposal will:

- Accelerate the cease to flow event downstream of the affected structures by two months. As a result, water within downstream watercourses will be reduced to a series of pools where aquatic fauna may take refuge.

- Enable a cease to flow event in the main channel of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months, therefore delaying the time at which the main channel of the river is likely to begin to revert to a series of pools.

- Minimise the extent of the Macquarie River, and therefore aquatic habitat that is affected by a cease to flow event. Under the do-nothing scenario, about 260 kilometres of the Macquarie River would be affected by a cease to flow event in November 2019, whereas the proposal will limit this to about 80 kilometres of the river downstream of Warren.
The proposal will cease flow downstream of the affected structures. As a result, existing ponding refuge habitat in downstream watercourses may become susceptible to stagnation, temperature fluctuation and species within the remaining water bodies may become more susceptible to predation and impacts from reduced water quality. This may result in changes to aquatic habitats and aquatic fauna populations downstream of the affected structures, and has the potential to result in fish kills (refer to section 2.2.1). This would affect some deep pools downstream of Warren weir and the Marebone regulator that DPIF has advised is ecologically important refugia. As described in section 3.4.3, an adaptive management regime will be implemented if there are tributary flows downstream of Burrendong Dam and this will enable water to be delivered to the Macquarie River, and Duck, Crooked and Gunningbar Creeks downstream of the affected structures. The amount of water able to be discharged will depend on the volume of tributary inflows. The temporary structures will have the capacity to release tributary flow downstream as required by the removal of drop boards and reopening the fishways.

The proposal will have substantial beneficial ecological impacts by retaining water within the 180 kilometre long section of the Macquarie River upstream of the Warren Weir which provides habitat for threatened fish such as the Murray Cod, and this species has been recorded in greater numbers upstream of the Warren Weir compared to downstream (DPI, 2016). The proposal will also maintain water flow in a section of the Macquarie River near Dubbo that has a population of the Trout Cod which is listed as endangered under the EPBC Act and FM Act. Maintaining flows in the river will also reduce the risk of pools stagnating and leading to reduced water quality that has the potential to impact on aquatic ecology.

The proposal will close the fishway at Marebone regulator at the request of DPI Fisheries to create a pool of refuge habit for aquatic species. This is a positive impact compared to the do-nothing scenario which would result in water continuing to flow through the Marebone fishway and thereby reducing the volume of water held in the refuge habitat behind the weir.

The reduction in discharges through the affected structures is commensurate with the key threatening process under the *Fisheries Management Act 1994* "Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams". In 2002, the NSW scientific community identified "Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands" as a key threatening process. These KTPs would affect sections of the Macquarie River, Duck Creek and Crooked Creek that are identified as Key Fish Habitat under the *Fisheries Management Act 1994* and are part of the Darling River EEC and have potential to provide habitat for a range of threatened species that may occur in the locality.

Appendix E identifies which fish species that are likely to be impacted by the proposal. Assessments of Significance have been prepared for the Darling River EEC and following species (Appendix F).

- *Maccullochella macquariensis* (Trout Cod) – Endangered species (EPBC Act and FM Act)
- *Maccullochella peelii* (Murray Cod) – Vulnerable species (EPBC Act)
- *Bidyanus bidyanus* (Silver Perch) – critically endangered species (EPBC Act), Vulnerable species (FM Act)

This proposal is considered unlikely to significantly impact on the Darling River EEC or these species for the following reasons:

- The proposal is a temporary measure and will be decommissioned within four months of the Minister lifting the drought declaration.
- The proposal would have an incremental impact and potential impacts downstream of the affected structures will occur by November 2019 regardless of whether the proposal is implemented or not. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of the affected structures by about two months. The proposal will change the timing of the cease to flow event downstream of these structures, but will not change whether the event occurs.

- It will enable stages 2 and 3 of the drought response strategy to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and Warren from November 2019 to October 2020 if there are no inflows. The section of the Macquarie River between Burrendong Dam and Warren provides important refuge habitat for biota, including threatened species. By deferring the cease to flow event in this section of the Macquarie River, the proposal will extend the duration that refuge habit is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota, including the Olive Perchlet. The proposal will result in a 180 kilometre reduction in the length of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.

- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these case to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.

- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked Creeks regulators, and Gunningbar Creek Weir were constructed in 2004 as a part of the Minister’s requirements for construction of the Duck and Crooked Creek regulators. Prior to 2004, the weir and regulators presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. On a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004.

- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed in consultation with relevant government agencies, such as the DPIE-W, DPIF, NRAR and DPIE. The measures contained within these plans are likely to be similar to those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area and number of stakeholders that would be affected by mitigative strategies.

The proposal will not impact on the delivery of environmental water to downstream environments including the Macquarie Marshes, unless supplementary flows are declared, because the environmental water is not available to be used in the 2019/2020 water year. An
order has been gazetted under section 49B of the Water Management Act 2000 that suspends the part of the Water Sharing Plan that relates to environmental releases.

Where instream habitat will be impacted, including blockage of fish passage, NSW Fisheries will be consulted in accordance with sections 199 and 219 of the Fisheries management Act 1994.

Impacts on the Macquarie Marshes
Water only reaches the Macquarie Marshes when the volume and flow of water in the Macquarie River is sufficient. WaterNSW’s observations on 5 July 2019 indicate that flow had ceased in the southern extent of the Macquarie Marshes below the Oxley hydrometric station. There is a very small inflow to the marshes and this is likely to cease once warmer weather in spring increases evaporation. This is expected to result in the Macquarie River ceasing to flow between the Warren Weir and Marebone Weir, and would mean there would be no flows to the marshes.

The proposal is unlikely to significantly impact the Macquarie Marshes as it is unlikely to alter the water flows to the marshes compared to the do-nothing scenario.

Impacts on groundwater dependent ecosystems
The proposal will not involve groundwater extraction that has the potential to impact groundwater dependant ecosystems. Potential impacts on groundwater dependent ecosystems would be associated with reduced flows in watercourses downstream of the affected structures, including the Macquarie River groundwater dependant ecosystem and Crooked Creek groundwater dependant ecosystem. The affected watercourses have variable flows and section 6.3.2 indicates that they have experienced periods of very low or no flow in the past. The potential impact of the proposal on groundwater dependent ecosystems would be consistent with that which has historically occurred and is currently occurring due to cease to flow events downstream of Warren.

The proposal is likely to have a positive impact on the Macquarie River groundwater dependent ecosystem compared to the do-nothing scenario as it would delay a cease to flow event in the main channel of the Macquarie River downstream of Burrendong Dam by about 11 months.

Impacts on terrestrial flora and fauna
Operation of the proposal is unlikely to have any adverse effects on native terrestrial flora and fauna above that which are likely to occur if flow downstream of the Warren Weir, Duck Creek and Crooked Creek ceases with the onset of warmer weather, and flows cease in the Macquarie River by November 2019.

A broad range of terrestrial species will benefit from flow being maintained between Burrendong Dam and Warren as this will reduce water stress on vegetation that is along the riparian corridor which may provide habitat for these species. It will also maintain a water source for mobile species to access to drink from.

Vehicles may traverse the easement on occasion for maintenance activities and this would have minimal ecological impact. Impacts due to weeds would continue to be managed through the implementation of mitigation measures in section 6.4.5.
### 6.4.5 Mitigation measures

#### Table 14 Flora mitigation measures

<table>
<thead>
<tr>
<th>Flora mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>All site vehicles would keep to the designated access tracks and parking areas.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>No vegetation to be removed, including snags in waterways.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Machinery should be cleaned prior to entering the sites to ensure that weed seeds and propagules are not imported to the site and moved between sites</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Removal of topsoil at the borrow site and stored adjacent to the creek bank. Topsoil will be used as refill in rehabilitation on decommissioning of the coffer dam.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Scattering of native vegetation seeds endemic to the area at the borrow site following return of soil.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>

#### Table 15 Fauna mitigation measures

<table>
<thead>
<tr>
<th>Fauna mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of native fauna</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>The construction manager or Environmental Officer (EO) will be immediately informed of the presence of native fauna within the work zone. If it is determined by the EO that none of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, the construction activities can continue and the fauna species will be monitored to make sure it doesn’t enter parts of the construction that could potentially result in the injury or death of the animal. If the EO determines that some or all of the construction activities are likely to increase the risk of injury, mortality or stress to the animal, then the EO will ‘capture and release’ the animal where feasible. Construction activities will be monitored closely to ensure that it does not impact the animal at risk in the time leading up to its capture and removal from site.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>A Water Quality Monitoring Plan will be developed in consultation with DPI Fisheries which will include measures to monitor key locations within affected watercourses and identify measures to be implemented to minimise impacts on native fish.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>No removal of vegetation surrounding the worksite. Avoid removal of large woody debris. If modification is required debris should be realigned in stream.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Regular consultation with landholders downstream of works to monitor water holes/pools to ensure the potential drying up of pools is managed early to prevent fish kills.</td>
<td>WaterNSW</td>
<td>During operation</td>
</tr>
<tr>
<td>An ecologist will conduct a pre-construction inspection to identify whether there are any threatened species within or in the immediately</td>
<td>WaterNSW</td>
<td>Before construction</td>
</tr>
</tbody>
</table>
Fauna mitigation measures

vicinity of the construction sites. This will include spotlighting to determine whether species such as the Barking Owl is present within the area and nesting. WaterNSW’s Environmental Advisor will be notified if any threatened are observed and this will involve considering whether any additional management measures or refinements to the work method are required.

6.5 Topography, geology and soils

6.5.1 Existing environment

The work sites at Warren Weir, Duck Creek and Crooked Creek are located within the lowland areas of the Macquarie River Catchment, within the flat alluvial flood plain. The soils within the Macquarie Valley are a mix of vertosols and chromosols (eSpade, 2016), with the soil at each site featuring predominately chromosols.

Soils at the work sites generally contain heavy clay and the topography of the land system is generally flat. A search of the NSW EPA contaminated Land Register (5 July 2019) did not identify any contaminated lands on or adjacent to the work sites.

A search of the Australian Soil Resource Information Sydney (ASRIS) was conducted on 5 July 2019. There is no risk of acid sulphate soils. The works are not located on a low-lying coastal area or an area of acid-bearing rock.

The work sites are at existing WaterNSW structures and no activities are undertaken at these sites that suggest the significant potential for contamination to be present.

6.5.2 Potential impacts

The proposal will have negligible impact on topography as works will largely be limited to existing structures. The land surface will be disturbed when establishing a temporary access track to the Warren Weir, and establishing a laydown area at the Warren Weir and Duck and Crooked Creek regulator sites. The laydown areas and access track will be established on existing disturbed areas and will not require earthworks.

Construction of the coffer dam upstream of the Duck Creek and Crooked Creek fishways will require localised ground and soil disturbance to excavate material from the man-made bank of Gunningbar Creek and deposit the material in the waterway. Risks associated with erosion and sedimentation of the waterway will be managed by implementing the erosion and sediment controls in Table 16. Topsoil will be stripped and stored next to the excavated bank, before being respread over the site to rehabilitate the area once the coffer dam is decommissioned.

Fuel and oil from the construction plant and the ancillary facilities are potential sources of pollution. Any spills could potentially be transported into the waterway/ nearby drainage systems and impact water quality. Mitigation measures will be implemented to reduce the impact of spills.

The clay soils may become sticky when it rains which could impact on access to the site and lead to erosion and sedimentation. The risk of this occurring is low as the construction will be undertaken over a period of a few days at each work site during severe drought conditions. Construction will be delayed if there is a rain event that is likely to impact on soils to the extent that access to the work sites is restricted.
6.5.3 Mitigation measures

### Table 16 Topography, geology and soils mitigation measures

<table>
<thead>
<tr>
<th>Mitigation required</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>No construction to occur during rain events greater than 5 mm per day if this is likely to impede access or lead to access roads being damaged. Weather forecasts shall be checked daily so that expected storm events can be considered for project planning in erosion and sediment management.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Erosion and sediment control measures would remain in place until the area is stabilised to reduce potential surface water impacts on the property.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Spill kits would be available with each refuelling area and all staff would be trained in their use.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Spill containment measures (such as drip trays) to be used where refuelling within 40 metres of a waterway is required, where possible refuelling greater than 40 metres from a waterway should occur.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Soil removed from the creek bank to build the temporary coffer dam will be backfilled to the same location post construction. Topsoil will be stripped and stored next to the site for reuse during site rehabilitation.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>

6.6 Aboriginal heritage

6.6.1 Existing environment

The Macquarie catchment forms part of the lands originally occupied by the Wiradjuri, Wailwan and Wongaibon Aboriginal nations. The three sites where construction activities would be undertaken (Warren Weir, and Duck and Crooked Creek) are located on Wiradjuri land. The water resources within the area are considered the primary factor in the prediction of Aboriginal sites within the landscape and given works will occur within a riverine environment, care should be taken.

A search of the Office of Environment and Heritages (OEH) Aboriginal Heritage Information Management Sydney (AIHMS) indicated no registered Aboriginal sites or places within one kilometre of the Warren Weir, Duck Creek and Crooked Creek (refer Appendix H). AIHMS searches were not done for Marebone or Gunningbar Creek Weir because the proposal does not involve any civil works with the potential to disturb the land surface at these locations.

A search of Native TitleVision, the National Native Title Tribunal’s online mapping database (NNTT, 2019), indicated the following (refer Figure 32):

- no Native Title determinations or applications at the Warren Weir site
- the Duck Creek and Crooked Creek site is within a Native Title application area:
  - Application NC2012/001: Ngemba, Ngiyampaa, Wangaapuwan and Wayilwan
  - No determinations of native title have been made for this application
6.6.2 Potential impacts

**Construction and decommissioning**

The works at Warren Weir, Duck Creek and Crooked Creek fishways will occur on existing structures within a modified environment. No new ground disturbance is proposed, other than construction of the coffer dam.

Construction of the coffer dam upstream of the Duck Creek and Crooked Creek fishways will require localised ground and soil disturbance to excavate material from the man-made bank of Gunningbar Creek and deposit the material in the waterway. This section of Gunningbar Creek is owned by WaterNSW and has been channelized. The capacity of the creek has been increased by depositing soil to raise the bank level, and that material will be sourced from locations that have been previously subject to cut and fill. As the landscape has been modified, installing the coffer dam is considered to be a low impact activity.

Construction laydown areas will be located within areas that were disturbed during construction of the fishways on the Warren Weir, Duck Creek and Crooked Creek regulators in 2004. As such, works will be limited to existing disturbed areas.
There is the potential for unrecorded Aboriginal sites to be uncovered during works. Mitigation measures will be implemented to manage potential impacts if there are unexpected finds during construction.

**Operation**

Operation of the proposal is unlikely to impact on Aboriginal items as no greenfield ground disturbance will occur.

### 6.6.3 Mitigation measures

**Table 17 Aboriginal heritage mitigation measures**

<table>
<thead>
<tr>
<th>Aboriginal heritage mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any changes to the design which include earthworks should be assessed by a suitably qualified heritage professional.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Laydown areas to be sited on existing cleared land</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Machinery used for the proposed work must remain within the amended impact footprint, or on established tracks or vehicle areas.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Inductions for staff undertaking the proposed work must explain the legislative protection requirements for all Aboriginal sites and objects in NSW and the relevant fines for noncompliance. Staff should be briefed on the identification of Aboriginal objects within the Macquarie Valley region.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>If any Aboriginal object as defined in the NPW Act is encountered within or immediately adjacent to the work area, work shall stop immediately until the significance of the item can be established. Water NSW Procedure CD2012/184* - Unexpected Aboriginal Objects Procedure should be followed.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>If any previously unidentified Aboriginal cultural heritage places or items are encountered during construction all works likely to affect the material must cease immediately and the NSW Office of Environment and Heritage’s Environmental Line (tel: 131 555) consulted about an appropriate course of action prior to recommencement of work. It is an offence under the National Parks and Wildlife Act 1974 to disturb or destroy Aboriginal cultural heritage items without an Aboriginal Cultural Heritage Impact Permit from DPIE.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>If human skeletal remains are encountered during construction all work in that area must cease and the Police and DPIE would be notified immediately.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>

### 6.7 Historic Heritage

#### 6.7.1 Existing environment

A desktop search of historic registers including the World Heritage List, National Heritage List, Commonwealth Heritage List, the Register of the National Estate (non-statutory archive), NSW State Heritage Register, WaterNSW’s Section 170 Heritage and Conservation Resister and the heritage schedules of the Warren LEP was undertaken for the proposal site and surrounds.

Searches revealed:
• No world heritage, national heritage or Commonwealth heritage items
• No State heritage listed items
• No listed local heritage items

Section 170 Heritage and Conservation Register

The Heritage Act 1977 requires government agencies and State Owned Corporations, including WaterNSW, to prepare a Heritage and Conservation Register. This is a list of heritage assets owned, occupied or managed by the agency and includes an assessment of their heritage significance. The register identifies buildings, but may also include natural, movable and Aboriginal heritage. The purpose of the register is to assist agencies care for their heritage assets and make decisions about their future conservation and development.

Table 18 summarises heritage items that are recorded on WaterNSW’s Section 170 Heritage and Conservation Register in the vicinity of the proposed works. The State Heritage inventory also includes the following items which have are in the vicinity of the proposal but will not be impacted:

• Duck Creek Weir
• Crooked Creek Weir
• Gunningbar Creek Oftake Regulator
• Gunningbar Creek Weir.

Table 18 Items listed on WaterNSW’s 170 heritage register

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Statement of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunningbar Creek Oftake</td>
<td>Steel mesh and posts. 50m upstream of Warren Weir</td>
<td>The Gunningbar Creek Oftake is a simple steel mesh and post structure designed to control the water level of the pool at Warren Weir and divert it to the Gunningbar Creek. The structure derives its significance from its association with the Warren Weir and Gunningbar Regulator and plays an important role in the water management complex that is part of the Warren Weir. The structure was rebuilt in 1911 after being washed out as a result of floods. The offtake has been assessed to be of Moderate Local Significance.</td>
</tr>
<tr>
<td>Warren Weir</td>
<td>Concrete wall, fixed crested weir supported on the d/s by stone filled timber cribs. The weir is 4.3m high and 56m wide and has a steel sheet piling cutoff on the u/s. The timber cribs consist of a grid of vertical timber piles tied together crosswise with timber beams and filled with stones. The apron is of concrete and rock.</td>
<td>Warren Weir is an item of High State significance. It fulfils the criteria of Historic, Aesthetic, Social, Rare and Representative. The Weir is 106 years old and is a good example of a fixed crest concrete weir with timber cribwork constructed in the late C 19th in rural NSW. Aesthetically, the simplicity and honesty of the design and fabric used as well as its natural setting contribute to the structure's aesthetic appeal. It is both rare and representative of historic public works structures in rural and remote areas of NSW. Warren Weir is 106 years old and afforded automatic protection under the NSW Heritage Act.</td>
</tr>
<tr>
<td>Duck Creek Channel 1</td>
<td>Water Supply Channel, connecting the Macquarie River to Duck Creek via Gunningbar Creek. The width of the cutting upon completion was 5 ft, with slopes of 2 ( \frac{1}{2} ) to 1 and</td>
<td>The Duck Creek Channel No.1 is a simple cutting that regulates water flow down Duck Creek. It is an integral component of the water management system in place along Duck Creek to provide essential domestic, stock and irrigation water supply in this region. The item is 99 years old and therefore afforded automatic protection under the</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Statement of Significance</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>a length of 12 miles. The channel is an earthen embankment with a steel girder road bridge crossing.</td>
<td>auspices of the NSW Heritage Act. The item fulfils the requirements of the Historic category and is assessed to be of moderate local significance.</td>
<td></td>
</tr>
<tr>
<td>Duck Creek Channel 2</td>
<td>Water Supply Channel, connecting the Macquarie River to Duck Creek via Gunningbar Creek. The width of the cutting upon completion was 5 ft, with slopes of 2 ½ to 1 and a length of 12 miles. The channel is an earthen embankment with a steel girder road bridge crossing.</td>
<td>The Duck Creek Channel No.2 is a simple cutting that regulates water flow down Duck creek. It is an integral component of the water management system in place along Duck Creek to provide essential domestic, stock and irrigation water supply in this region. The item is 99 years old and therefore afforded automatic protection under the auspices of the NSW Heritage Act. The item fulfils the requirements of the Historic category and is assessed to be of moderate local significance.</td>
</tr>
<tr>
<td>Marebone Weir</td>
<td>Large vertical lift gates (2), steel superstructure. The weir now has an automated operating system. Marebone Weir and associated works were planned to ‘raise the level of water in the Macquarie River to facilitate diversions to Marebone Break and to Marra Creek by means of a cutting.</td>
<td>The Marebone Weir meets the requirements of the criteria of Social and Representative and has been assessed to be of Low Local significance. This significance is derived from its economic contribution to the development and well being of the local region through the management and provision of essential water to local agricultural and pastoral industries. The Marebone Weir was constructed in 1977 and is not afforded automatic protection under the NSW Heritage Act. Its broader value is acknowledged, as are the collective value of its associated structures.</td>
</tr>
</tbody>
</table>

6.7.2 Potential impacts

Construction

Although works will occur within the vicinity of Duck Creek Channel No 1 and No 2, and the Gunningbar Creek Offtake, the original fabric of the sites will not be impacted. Construction works will not impact these structures.

Works will occur on the Warren Weir, listed on WaterNSW’s Section 170 Heritage and Conservation Register (No. 4550182), to temporarily raise the operating level of the weir. This will involve widening the weir crest and installing metal sections to enable drop boards to be fitted to raise the water level. The crest of the downstream face of the weir will be widened by applying concrete and this will integrate with the existing structure.

The Warren Weir has been upgraded a number of times, including in 2004 to install a fishway. The proposed works are temporary and with the exception of the widened crest, will be removed when the proposal is decommissioned. The proposal will have a minor impact on the heritage fabric of the weir.

As the proposal is permitted without development consent under the Infrastructure SEPP (refer section 4.2.1), and WaterNSW is the asset owner, approval is not required to undertake the proposal on items listed on the section 170 heritage register. WaterNSW is required to follow procedures and guidelines set out in The State Agency Heritage Guide: Management of Heritage Assets by NSW Government Agencies (Heritage Office of NSW, 2005). Guidelines of relevance include:

- 3.24 Altering or Extending Heritage Assets: alterations to a heritage asset should be planned and executed to minimise negative impacts on its heritage significance, curtilage and setting. Alterations should only be undertaken when necessary to upgrade a heritage asset to meet current standards (for example, Building Code of Australia, fire
and life safety, Occupational Health and Safety, disabled access), or to adapt it for a compatible new use, or to ensure its ongoing viability.

- **3.25 Adaptation:** Adaptation should be limited to that which is essential for the use of the heritage asset. Adaptation should occur where the adaptation has minimal impact on the heritage significance of the heritage asset. Adaptation should involve minimal change to significant fabric, and should be undertaken only after demonstrated consideration of alternatives.

- **3.28 Reversibility of Works:** Alterations or extensions which do not contribute to the conservation of a heritage asset should be undertaken in such a way that they are reversible where practical.

- **3.30 Removed fabric:** Significant fabric which has been removed from a heritage asset, including contents, fixtures and objects, should be catalogued and protected in accordance with its heritage significance. Where possible, and culturally appropriate, removed significant fabric should be kept at the heritage asset.

**Operation impacts:**

Operation of the proposal will not impact upon historic heritage.

### 6.7.3 Mitigation measures

**Table 19 Historic heritage mitigation measures**

<table>
<thead>
<tr>
<th>Historic heritage mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care and due diligence would be taken by WaterNSW management, staff and contractors so as to not destroy related features of the Warren Weir, such as timber cribwork and rock structures.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Contracts for works to heritage assets, including sub-contracts, would:</td>
<td>Contractor</td>
<td>Prior to construction</td>
</tr>
<tr>
<td>- Require that contractors and workers be made aware of the significance of the asset and the practices required to conserve the item. This may be done through induction procedures, project drawings or other means.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Require contractors and tradespeople to have the qualifications, skills and experience needed so that work does not damage the heritage asset, detract from its heritage significance, or result in work which will require later remedial action.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A record of all relevant documents, decisions and works undertaken would be maintained for each heritage asset.</td>
<td>WaterNSW</td>
<td>During construction</td>
</tr>
</tbody>
</table>
6.8 Socio-economic

6.8.1 Existing environment

The Macquarie Valley covers more than 75,000 square kilometres in the state’s north and extends from the Blue Mountains to the Barwon River Plains. Burrendong Dam provides water supply to meet customer orders, including downstream irrigators and Dubbo, Nyngan and Cobar town water supplies. It also supplies high security water to critical industries such as mines, Western Plains Zoo at Dubbo, permanent plantings gold clubs and abattoirs.

According to the 2016 Census:

- Dubbo urban centre and locality had a population of 34,339
- Narromine urban centre and locality had a population of 3,528
- Warren urban centre and locality had a population of 1,530
- Cobar urban centre and locality had a population of 3,748
- Nyngan urban centre and locality had a population of 1,988
- Wellington urban centre and locality had a population of 4,519.

Each of these urban areas are surrounding by rural areas that include small towns and villages that access the larger population centres for a range of educational, social, employment and medical services.

6.8.2 Potential impacts

The proposal is the first of a three stage strategy that will be implemented to delay a cease to flow event in the Macquarie River downstream of Burrendong Dam by about 11 months. Although the proposal involves works near Warren, the beneficial impacts of delaying a cease to flow event will be experienced by the towns and communities along the Macquarie River that rely on the Macquarie River for a large proportion of their water supply, including Dubbo, Wellington, Narromine, Warren, Nyngan and Cobar. These towns will benefit because the proposal will enable WaterNSW’s strategy to supply water to towns and high security users to be optimised. The proposal will extend the period of time that the Macquarie River is able to be operated to deliver the water that is currently in storage. Delaying a cease to flow event provides time for inflows to occur and increase the supply, as well as time for additional water supply options to be implemented (refer to Figure 6 and Figure 7).

The proposal is being implemented as part of a strategy under the Macquarie-Castlereagh IRG that will prioritise water to communities for critical human need over other needs (section 2.1.3). Critical human need refers to the minimum amount of water needed to meet basic human needs. It also includes non-human needs, where a failure to meet these needs would cause too much damage to social, economic or national security.

The proposal will cease water flow downstream of Warren Weir and the Duck Creek, Crooked Creek, Gunningbar Creek and Marebone regulators which will impact on the landholders downstream who rely on these waterways for stock and domestic and farm water supply. As indicated in section 2.2.1, these waterways are likely to cease to flow in November 2019 if the proposal is not implemented, so the effect of the proposal is to bring forward this impact by two - three months. WaterNSW is consulting with affected landholders to identify alternative stock and domestic water supply arrangements so these can be implemented (refer to Table 9).
Consultation has been undertaken (refer section 5.2.2) with community and stakeholders to understand water allocation requirements. This reflects that the ROSCCo meeting supported implementation of the proposal.

### 6.8.3 Mitigation measures

Table 20 Socio-economic mitigation measures

<table>
<thead>
<tr>
<th>Socio-economic mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing consultation with landholders and water users downstream of works is required to ensure</td>
<td>WaterNSW</td>
<td>During operation</td>
</tr>
<tr>
<td>impacts of reduced water flow are managed and communicated. This has occurred so far through the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROSSCO meetings and EWN notifications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WaterNSW will continue to publish media releases and operations updates for the Macquarie Valley</td>
<td>WaterNSW</td>
<td>During operation</td>
</tr>
<tr>
<td>WaterNSW will continue to work with the NSW government and relevant agencies to implement drought</td>
<td>WaterNSW</td>
<td>During operation</td>
</tr>
<tr>
<td>contingency measures to ensure water is available for users that rely on water within the Duck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and Crooked Creeks and Macquarie River.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6.9 Air quality

#### 6.9.1 Existing environment

Air quality in the proposed work areas would be typical of the surrounding rural region and generally of a high quality. Dust is the main factor that would contribute to a reduction in air quality, particularly given the prolonged drought. There are no significant point sources of air pollution in the vicinity of the proposed works.

There are existing sensitive receivers within 50 metres from the proposed works areas at Duck and Crooked Creeks. This is a private residence.

#### 6.9.2 Potential impacts

**Construction and decommissioning**

The proposal requires minor earthworks to construct the coffer dam and traffic movements that have the potential to generate dust. The works will be in areas characterised by rural land uses and have few sensitive receivers. Dust generated by vehicles passing over unsealed tracks is a common occurrence in the locality and the proposal will have negligible additional impact. Potential impacts on air quality are unlikely to be significant and will be localised and limited to the construction and decommissioning periods.

Exhaust emissions from vehicles, plant and machinery are considered likely to have negligible impact on regional air quality. These emissions will be small in volume and readily dispersed by prevailing winds.

**Operation**

Operation of the will would have negligible air quality impacts. There will be infrequent impacts associated with dust generation and emissions from maintenance vehicles using unsealed tracks to access the structures.
6.9.3 Mitigation measures

Table 21 Air quality mitigation measures

<table>
<thead>
<tr>
<th>Mitigation required</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adherence to appropriate Australian Standards.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Minimise works during windy periods to minimise dust generation.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Ensure all plant and equipment complies with part 4 of the Protection of the Environment Operations (Clean Air) Regulation 2002.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Construction vehicles and equipment are to be suitably serviced within the six-month period prior to commencement of construction activities and all necessary maintenance undertaken during the construction period. The excessive use of vehicles and powered construction equipment is to be avoided.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Enforce speed limits of no more than 40km/hr on access roads to the site (or as requested by landowner).</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>All construction machinery is to be turned off when not in use to minimise emissions.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>

6.10 Noise and vibration

6.10.1 Existing environment

The background noise environment is typical of a rural area comprised of agricultural properties and rural residences. Background noise levels are expected to be low and the main existing noise sources in the vicinity of the proposal would be associated with traffic on the road network and operation of agricultural plant and machinery.

The nearest noise sensitive receivers are:

- Warren Weir – visitors to the public reserve that the weir is located within, and a residence located about 250 metres to the north west
- Duck and Crooked Creek regulators – a residence located about 50 metres to the south
- Gunningbar Creek Weir regulator – a residence located about 365 metres to the north east
- Marebone regulator – a residence located about 200 metres to the south.

Background noise levels for the proposal site were assumed in accordance with Australian Standard (AS) 1055.2-1997, based on site being in an area with negligible transportation (i.e. relatively low background noise). Table 22 provides average background A-weighted sound pressure levels used for this assessment.

Table 22 Average Background A-weighted sound pressure level (AS 1055.2-1997)

<table>
<thead>
<tr>
<th>Areas with negligible transportation</th>
<th>0700-1800</th>
<th>1800-2200</th>
<th>2200-0700</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 dBA</td>
<td>35 dBA</td>
<td>30 dBA</td>
</tr>
</tbody>
</table>
6.10.2 Potential impacts

Interim Construction Noise Guideline

The NSW EPA Interim Construction Noise Guidelines (DECCW 2009) is aimed at managing noise impacts from construction works. According to the guidelines, a quantitative construction noise assessment is warranted when works are likely to impact an individual or sensitive land use for more than three weeks in total. As construction will occur over one week, a quantitative noise assessment is not warranted.

Construction and decommissioning

Construction will generate noise due to the operation of plant and machinery. Potential impacts will be minor and temporary because construction will take about two weeks to complete and work will generally be undertaken within standard construction hours. Work will be undertaken outside standard construction hours on Saturdays and Sundays due to the criticality of the proposal (refer to 3.3.3).

The nearest sensitive receivers are a residence adjacent to the work site at the Duck and Crooked Creek regulators, and visitors to the Warren Weir reserve. These receivers will be impacted by construction noise. WaterNSW will consult with potentially affected stakeholders and this will involve advising of the extended working hours and the measures that will be implemented to minimise noise impacts.

The main noise sources will include machinery such as excavators and trucks that generate similar levels of noise to farm machinery that operates in the surrounding area. Construction mitigation measures are detailed in section 6.10.3 and will be implemented where reasonable and feasible.

Out of hours works

As discussed in section 3.3.3, construction and decommissioning is likely to be undertaken during standard working hours defined by the ICNG. If out of hours work is required, the Contractor will request permission from WaterNSW to undertake the work and consultation will be undertaken with the relevant affected stakeholders. The Contractor would need to provide a strong justification for the works to be undertaken outside standard construction hours and would implement all feasible and reasonable practices in accordance with the ICNG (DECC, 2009) to minimise noise impacts. Potentially affected residents and stakeholders will be notified if out of hours works are required.

Local residents will be informed of the timing and duration of the work likely to affect their locality before it begins.

Traffic noise

As discussed in section 6.2 relatively low levels of traffic will be generated during construction and there is likely to be a minor increase in overall traffic movements. Vehicles will access the proposal sites via the existing roads and tracks. As such, the impact of increased noise associated with construction traffic is considered insignificant.

Vibration

Vibration impacts resulting from the proposal are considered to be negligible because activities such as piling that typically result in vibration that has the potential to impact on human amenity or the structural integrity of buildings are not proposed.
Operation

The only noise source during operation will be from vehicles associated with monitoring and occasional maintenance activities, and the use of aerators in selected pools. This will have negligible impact on the noise environment.

6.10.3 Mitigation measures

Table 23 Noise and vibration mitigation measures

<table>
<thead>
<tr>
<th>Noise and vibration mitigation measures</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works would be undertaken during standard working hours only. Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Operate plant and equipment in a quiet and efficient manner, including:</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>• Turn off plant and equipment that is not being used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ensure plant is regularly maintained and any equipment that becomes noisy is repaired or replaced.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All residences within 200 metres of the project site should be notified of potential construction works at least 7 days prior to the commencement of works.</td>
<td>Contractor</td>
<td>Prior to construction</td>
</tr>
</tbody>
</table>

6.11 Visual amenity

6.11.1 Existing environment

Construction will take place at sites that have already been developed and feature structures that are maintained and operated by WaterNSW. The nearest sensitive receptors are located:

- Warren Weir – visitors to the public reserve that the weir is located within, and a residence located about 250 metres to the north west
- Duck and Crooked Creek regulators – a residence located about 50 metres to the south
- Gunningbar Creek Weir regulator – a residence located about 365 metres to the north east
- Marebone regulator – a residence located about 200 metres to the south.

Views to each of these structures is partially screened by riparian vegetation.

6.11.2 Potential impacts

The works will result in some minor changes to visual appearance of the Warren Weir by temporarily increasing its height. There will also be minor changes to the visual appearance of the Duck and crooked Creek fishways as shutters would be installed on the baffles and walkways would be installed over the baffles. The additional infrastructure will be viewed in the context of the existing structures and partially screened by riparian vegetation so there is likely to be negligible impact on visual amenity.
Temporary impacts to visual amenity will occur during construction in the immediate vicinity of the works due to the presence of construction vehicles and equipment at works sites. Visual impacts are not considered to be significant due to the one week construction period.

### 6.11.3 Mitigation measures

#### Table 24 Visual amenity mitigation measures

<table>
<thead>
<tr>
<th>Mitigation required</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works area to be kept clean at all times</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Area to be returned to pre-construction condition at the end of construction period</td>
<td>Contractor</td>
<td>Completion of works</td>
</tr>
<tr>
<td>Any property or infrastructure that has been damaged during works shall be repaired or replaced in consultation with WaterNSW.</td>
<td>Contractor</td>
<td>Completion of works</td>
</tr>
</tbody>
</table>

### 6.12 Waste, contamination and resource minimisation

#### 6.12.1 Existing environment

A search of the NSW EPA Contaminated sites register indicated one listed contaminated site within the Warren LGA – the Former Mobile Depot, 16 Dubbo Street Warren. The site is located more than five kilometres from the proposal area.

The environment surrounding each site is typical of a rural area that is used for agricultural purposes. The sites are existing structures operated by WaterNSW and there are no activities undertaken at these sites that suggest there is an obvious risk of contamination.

#### 6.12.2 Potential impacts

**Construction**

Waste produced during construction would be managed in accordance with the waste management hierarchy. This provides that waste avoidance is a priority, followed by reuse and recycling/reprocessing, with disposal as a last resort.

Small quantities of waste (packaging, material off cuts, consumables etc) will be generated during construction. The majority of construction activities will use pre-fabricated elements that are delivered to site which reduces the likelihood of substantial volumes of waste being generated. Vehicles and machinery will be serviced off-site, other than minor repairs following breakdown.

Significant volumes of liquid wastes, including oils or fuels are unlikely to be generated during construction. Liquid and non-liquid waste would be assessed for reuse potential in accordance with the EPA’s general resource recovery exemptions before considered for disposal. If no reuse potential exists, the waste would be classified and managed in accordance with the *Waste Classification Guidelines* (EPA, 2014).

Domestic waste generated by construction personnel will be collected in separate waste bins for collection by a licensed contractor.

Material used to construct the coffer dam will be used to reinstate the bank once the shutters have been installed on the Duck and Crooked Creek fishways. This material will not be disposed off-site.
The proposal is unlikely to involve activities that pollute land or lead to environmental concerns associated with storing, transporting or handling waste. All waste will be classified and disposed of in accordance with the Waste Classification Guidelines (EPA, 2014).

**Operation**

The proposal will result in minimal waste during operation. Waste to be generated would be associated with maintenance activities and consist of packaging, offcuts and redundant pieces of infrastructure.

**Decommissioning**

The proposal will be decommissioned when the areas are no longer identified as being drought affected. Decommissioning will remove the shutters/boards and channels used to secure them and the walkways on the Duck and Crooked Creek fishways, along with the temporary boards and support structure on Warren Weir. The concrete strengthening of the weir crest will remain in place as it is required to provide strengthening to the crest regardless of the temporary works. Any infrastructure that is unable to be reused will be classified and managed in accordance with the *Waste Classification Guidelines* (EPA, 2014).

### 6.12.3 Mitigation measures

**Table 25 Waste, contamination and resource management mitigation measures**

<table>
<thead>
<tr>
<th>Mitigation required</th>
<th>Responsibility</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>All waste generated by the proposal would be classified and disposed of in accordance with the NSW Waste Classification Guidelines Part 1: Classifying Wastes (DECCW 2008).</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Resource management hierarchy principles are to be followed:</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>1. Avoid unnecessary resource consumption as a priority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Avoidance is followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Disposal is undertaken as a last resort.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All waste material will be removed from site once the works have been completed.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>If the contractor is working at the same location for more than one day, self-contained portable ablution and toilet facilities shall be provided, unless negotiated otherwise with WaterNSW. These facilities shall be located at least 20 m from any natural or built drainage line or wetland. The portaloo will be pumped out and disposed offsite by a licensed provider.</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
<tr>
<td>If any previously unidentified contamination (e.g. sheets of asbestos, discoloured soil, strong chemical or petrol odours, refuse or leachate) is identified during the works, all of these materials shall be classified and managed in accordance with the Waste Classification Guidelines (EPA, 2014).</td>
<td>Contractor</td>
<td>During construction</td>
</tr>
</tbody>
</table>
Waste, contamination and resource management mitigation measures

| discovered during works, works would halt and WaterNSW would be notified immediately to determine appropriate response measures. |

### 6.13 Cumulative impacts

Cumulative environmental impacts of the proposal include the combined effect of individual impacts associated with the proposal in addition to the impacts of other activities in the locality. The locality is characterised as agricultural land with broad acre cropping and grazing dominating the land use. The proposal is unlikely to result in a cumulative impact due to other activities in the locality.

As indicated in section 2.2, a range of actions have been and will continue to be implemented to provide water for critical human need in the Macquarie Valley in accordance with a Stage 4 critical drought / water shortage as defined in the Macquarie-Castlereagh IRG. This includes:

- **Stage 2** - Bulk transfers from Windamere Dam storage to increase the storage in Burrendong Dam.

- **Stage 3** - Pumping from Burrendong Dam deep storage to access 20 – 30 GL of water that cannot be accessed under normal operating conditions. This water would be discharged to the Macquarie River downstream of the Burrendong Dam to supply cities and towns including Dubbo, Wellington, Nyngan, Cobar and Warren.

- **Temporary changes to water delivery arrangements**, including:
  - Reduced or suspended licence allocations
  - Suspension of the operation of the Water Sharing Plan for the *Macquarie and Cudgegong Regulated Rivers Water Source 2016* with respect to planned environmental releases, available water determinations and water allocation account management in relation to the Macquarie Regulated River due to an extreme dry period. The concurrence of the Commonwealth Minister for Energy and Environment was obtained before making this order.

- **Using ground water source as an alternative supply source.** Towns such as Dubbo currently use groundwater sources as a supplement to water supply from Burrendong Dam. There is the potential for additional bores to be installed to access groundwater to further supplement surface water supplies.

As indicated in section 2.2.2, the cumulative impact of proposal, in addition to Stages 2 and 3 is predicted to be to conserve surface water supplies in Burrendong Dam to delay a cease to flow event in the main channel of the Macquarie River by about 11 months. This is likely to lead to significant positive socio-economic and environmental outcomes compared to the do-nothing scenario.

The proposal will contribute to the water management works for drought security by increasing the duration that the Macquarie River is able to be operated to supply water to the towns and cities downstream of Burrendong Dam.
7. **Environmental management**

7.1 **Construction Environmental Management Plan**

The proposal will be delivered in accordance with a comprehensive suite of environmental mitigation measures and controls that are designed to mitigate the potential environmental impacts. These measures will be documented in a CEMP and applied during construction and operation of the proposal.

The CEMP will describe safeguards and management measures identified in section 6 of this REF and any additional measures required by licences, permits or approvals that are required to construct the proposal. This will provide a framework for establishing how measures will be implemented and who will be responsible for their implementation.

The CEMP will be prepared prior to commencement of construction and be reviewed and endorsed by WaterNSW. The CEMP will be a working document, subject to ongoing change and updated as necessary.

The key objective of the CEMP will be to ensure that environmental commitments made in the REF, and conditions imposed by any licences and approvals, are implemented throughout the construction period. The CEMP will include the following information:

- Details of all positions and contact details of all key personnel
- Audit and reporting program to ensure all actions/measures are implemented
- Training requirements, including site induction requirements to ensure that all personnel understand the principles of environmental management
- Emergency and incident response procedures
- List of approvals to be obtained before work commences.
- Consultation requirements (government and community) and complaint handling procedures.
- Actions for meeting environmental objectives based on the mitigation measures identified in this REF and any statutory or regulatory obligations.
- Details of person responsible for the implementation of each action.

7.2 **Operational environmental management**

The proposal will be operated by WaterNSW in accordance with procedures that apply to the remainder of its water supply network, including arrangements to implement temporary works during droughts. Specific measures that will be developed in consultation with relevant government agencies and implemented relate to:

- Adaptive management of tributary flows as outlined in section 3.4.3
- Water quality monitoring plan as indicated in sections 3.4.1 and 6.4.
8. Conclusion

8.1 Justification of the proposal

The current drought is having a severe impact on water storages in the Macquarie River valley, including Burrendong Dam which is the main storage within the system. Inflows to Burrendong Dam between May 2017 – April 2019 were 38 % of the previous drought of record and the dam is predicted to fall below 5% of its total capacity by 1 September 2019. The Macquarie River is projected to cease to flow downstream of Burrendong Dam in November 2019 if there are no inflows to the system.

The Macquarie River provides water to cities and towns that include Dubbo, Wellington, Narromine, Warren, Nyngan and Cobar. High security water users in the Macquarie Valley which include major urban centres, permanent plantings, stock and domestic water supply schemes, industry, and other uses such as the Western Plains Zoo at Dubbo.

The towns of Nyngan and Cobar are reliant upon water that is sourced from the Macquarie River at Warren and diverted to weir pools on the Bogan River at Nyngan via the Albert Priest Channel. If the Macquarie River ceases to flow, WaterNSW will not be able to operate the river to deliver water to the weir pool on the Macquarie River at Warren to supply water to Nyngan and Cobar.

WaterNSW, local water utilities (Councils) and DPIE-W, are jointly and individually planning to implement projects and actions in stages to conserve water and provide emergency water supplies to affected communities. This includes implementing temporary works to supply water to towns, communities and high security water users downstream of Burrendong Dam.

The proposed works to temporarily raise Warren Weir and close fishways at Warren Weir, Duck Creek, Crooked Creek, Gunningbar Creek and Marebone regulators will conserve water by retaining it in the main channel of the Macquarie River upstream of Warren. The proposal will delay a cease to flow event in the Macquarie River by three months which provides time for WaterNSW to transfer additional water from Lake Windamere to Lake Burrendong, and install infrastructure to access water that is below the current offtake level at Burrendong Dam. The combined effect of these works is predicted to delay a cease to flow event in the Macquarie River downstream of Burrendong Dam by about 11 months.

The proposal is justified because it will prioritise water for critical human water needs. The Minister for Water has issued an order to suspend part of the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016 with respect to planned environmental releases, available water determinations and water allocation account management due to the extreme dry period. This reflects a NSW Government decision, with concurrence from the NSW Minister for Energy and Environment, that environmental releases are to cease and water is to be prioritised for critical human need. This prioritisation of water for critical human need is consistent with the intent of the Macquarie-Cudgegong IRG.

The proposal would provide a significant benefit by securing a temporary water supply for critical human needs to Nyngan and Cobar, as well as cities and towns downstream of Burrendong Dam including Wellington, Dubbo, Narromine and Warren.

The proposal is also justified because it would delay a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will extend the duration that fish are able to move between refuge habitat within the river and reduce the risk of adverse water quality conditions developing within the river. This is a beneficial impact compared to the do-nothing scenario which is predicted to result in a cease to flow event that...
would affect a 260 kilometre long section of the Macquarie River between Burrendong Dam and the Macquarie Marshes in November 2019.

The proposal is designed to:

- be cost effective by maximising the use of existing infrastructure and minimising the need to invest in new infrastructure
- enable it to be constructed and commissioned within a short timeframe in response to the current drought
- enable it to be decommissioned within a short timeframe in advance of inflows to Lake Burrendong
- minimise environmental impacts by limiting construction to existing disturbed areas and enabling tributary flows to be passed downstream. It will also result in a 180 kilometre reduction in the length of the Macquarie River that is affected by a cease to flow event compared to the do-nothing scenario.

Section 8.2 demonstrates that the proposal is consistent with the principles of ESD.

The proposal will be constructed and operated in accordance with an approval that would be issued under the Water Management Act 2000 and permits issued under the Fisheries Management Act 1994. Operational impacts would be monitored by implementing water quality and aquatic ecology monitoring plans that would be developed in consultation with DPIE-W, and DPIE-BC and the DPIF.

**8.2 Principles of Ecological Sustainable Development**

**8.2.1 The precautionary principle**

The precautionary principle states that:

> ‘if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation’

Environmental assessments have been undertaken to prepare this REF to ensure that the potential environmental impacts can be understood with a high degree of certainty.

The proposal is required to maintain water supply for critical human needs in the Macquarie River downstream of Burrendong Dam. It will occur in a highly regulated river system and civil works will be limited to areas that have been previously disturbed by construction and operation of water supply infrastructure. Potential environmental impacts have been assessed and mitigation measures and safeguards are proposed to protect the environment.

The proposal has evolved to avoid environmental impact where practicable and mitigation measures can be implemented to minimise impacts. No mitigation measures have been deferred due to a lack of scientific certainty. A mitigation program would be implemented to monitor water quality and the response of the aquatic environment along Duck and Crooked Creeks and between Warren and Marebone Weirs. This would enable the direct impacts of the proposal to be monitored and allow the mitigation measures to be implemented according to the observed environmental responses. The proposal is therefore considered to be consistent with the precautionary principle.
8.2.2 Inter-generational equity

The principle of inter-generational equity states that:

‘the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations’

The proposal is unlikely to impact on natural or cultural features to a level that will compromise the health, diversity or productivity of the environment to a level that will impact on future generations.

The proposal is temporary and will be decommissioned when substantial flows in the system recommence. It is unlikely to adversely impact on the health, diversity or productivity of the environment for future generations.

The proposal would benefit the present and future generations as it will water supply for critical human needs in the Macquarie River downstream of Burrendong Dam.

8.2.3 Conservation of biological diversity and ecological integrity

The principle of biological diversity and ecological integrity states that:

‘conservation of biological diversity and ecological integrity should be a fundamental consideration’

The proposal will have negligible direct impact on vegetation as the only vegetation to be removed would be a small area of River Cooba and juvenile River Red Gum at the coffer dam location.

The Macquarie River is a highly regulated system and waterways have been impacted by and responded to, changes to flow regimes that include cease to flow events. Due to current drought conditions, the Macquarie River, Duck and Crooked Creeks ceased to flow downstream of the Macquarie Marshes in December 2018. The Macquarie River is predicted to cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if there are no inflows to Burrendong Dam.

The proposal will have adverse biodiversity impacts as flows will temporarily cease downstream of Warren Weir, and regulators at Duck Creek, Crooked Creek, Gunningbar Creek and Marebone. This cease to flow event would occur two months earlier than is predicted under the do-nothing scenario. Water will only be discharged to these waterways if there are tributary flows downstream of Burrendong Dam. Ceasing flows to these waterways will result in water retreating into pools. The water quality within those pools will decline as the volume decreases and this would impact on the quality and extent of habitat for biota. These adverse impacts would be limited to the sections that are downstream of the control structures and management measures will be implemented to minimise these adverse impacts.

The proposal will have positive impacts by delaying a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will:

- Extend the duration that aquatic habitat is maintained in this section of the river, and the duration that fish are able to move between refuge habitat within the river compared to the do-nothing scenario
- Reduce the risk of adverse water quality conditions developing within this section of the river compared to the do-nothing scenario

The beneficial biological impacts of deferring a cease to flow event in the main channel of the Macquarie River are considered to outweigh the adverse impacts that will occur from bringing forward the date of the cease to flow event downstream of these structures.
A mitigation program is to be implemented to monitor water quality and the response of the aquatic environment along the Macquarie River and Duck and Crooked Creeks. This would enable the direct impacts of the proposal to be monitored and allow for the mitigation measures to be implemented according to the observed environmental responses.

8.2.4 Appropriate valuation of environmental factors

The principle of improved valuation of environmental resources states that:

‘environmental factors should be included in the valuation of assets and services’

This principle relates to giving monetary values to environmental resources. The cost of environmental resources includes costs incurred to protect the environment. The safeguards imposed to minimise adverse impacts would result in economic costs to WaterNSW. The proposal has been designed to minimise adverse environmental impacts on the environment by implementing appropriate mitigation measures where impacts are likely.

The proposal would assist to ensure that water is delivered in a safe and sustainable way for critical human need. These factors ensure that the development would conform to the principles of “ecologically sustainable development”.

8.3 Conclusion

The REF assesses the potential impacts of the proposal. It has been prepared in accordance with Part 5 of the EP&A Act and considers the factors listed in clause 228 of the Regulation (refer Appendix C). The REF documents the potential environmental impacts of the proposal, considering both potential positive and negative impacts and recommends management and mitigation measures to protect the environment where required.

There will be short term, temporary, minor adverse impacts during construction. The main issues would be associated with impacts on:

- soil and water due to erosion and sedimentation
- air quality due to dust from exposed surfaces
- noise due to the operation of machinery and equipment
- traffic and access to neighbouring properties.

Operational impacts will be temporary as the proposal will be decommissioned following substantial inflows to Burrendong Dam and the drought declaration being lifted by the Minister.

The proposal will provide a significant benefit to the community as it would provide a water supply for critical human needs to towns and communities along the Macquarie River downstream of Burrendong Dam.

Overall, potential negative impacts associated with the proposal can be adequately managed by implementing the mitigation measures in section 6, and the beneficial impacts are considered to outweigh the adverse impacts. The proposal is unlikely to have a significant impact on the environment and does not require an EIS to be prepared, or a referral to the Commonwealth under the EPBC Act.

If the scope of work or study area assessed in this REF change, WaterNSW would determine whether additional environmental assessment is needed to ensure that their obligations under the EP&A Act are addressed.
Appendix A - WaterNSW Community Media Release – June 2019 Operations Update
Operations update

Macquarie valley drought response: Water outage and temporary works

14 June 2019

WaterNSW is in the final stage investigations to install temporary and removable modifications at Warren Weir and at Duck Creek and Crooked Creek regulators. Investigations began in early May 2019 for short-to-medium term projects that would extend the existing, limited water supplies in the Macquarie Valley.

Installation of the temporary modifications is expected to start in mid July 2019 and would take about two weeks to complete, weather permitting. Works will be in accordance with relevant approvals and environmental guidelines.

During the installation of these works, we will need to cease flows and water deliveries for seven to ten days. The water outage is expected from mid July 2019: This will reduce water levels to allow for safe access around the weir and regulators. When works are completed, current conditions will return with minimal flows and normal drought operations will continue.

If the current drought conditions continue into spring 2019, the temporary modifications will be used to raise the weir pool restricting flows past Warren Weir. We are also planning to close the fish passage at Duck Creek and Crooked Creek regulators to further manage flows.

These temporary changes will allow us to conserve water for town water supply and high security users and effectively manage storage and minimise system losses in the supply of water to the regional towns of Nyngan and Cobar. When rain events occur, the temporary modification can be removed efficiently, allowing flows to be directed to downstream customers when possible.

Under the assumption of no significant rainfall, no inflow to the river system, and no drought relief measures in place, the river and all flows are expected to cease by the end of March 2020. These modifications will assist with extending the water supply.

Timeframes are being finalised. We will notify you again when works and water outages are scheduled.

What we suggest you do now

Water users are advised to place orders now if they are considering extracting water before the end of the 2018/19 water year. Department of Industry -Water has advised potential restrictions to water allocation from 1 July 2019, the start of the 2019-20 water year. To view your current water allocation statement and water availability outlook for 2019-20

Update on River Operations Stakeholder Consultation Committee (ROSCo)

The new ROSCCo recently met in Narromine on 16 May to discuss and continue drought contingency planning and relief measures. We are working closely with government agencies and key stakeholders to ensure the options meet the critical water needs of regional towns and that the social, environmental and economic impacts are being monitored and effectively managed. For more information and to see the presentation, visit our webpage

Authorised by

Sri Sritharan,
Water System Operations Manager - Central
Appendix B - Concept design for works at Warren Weir, and Duck and Crooked Creek regulators
RIDGE 1, FRONT VIEW
CLIENT TO APPROVE DIMENSIONS

SIDE VIEW

RIDGEC 1, FRONT VIEW
CLIENT TO APPROVE DIMENSIONS

SIDE VIEW

712 (TYP.)
1105 (TYP.)
1250
1631
200
836
2401
836

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A CONCEPT
HA DMH 20/06/2019

B GENERAL ARRANGEMENT
HA DMH 26/05/2019

C VARIOUS CHANGES, CONCEPT
HA DMH 07/06/2019

D E IFR
HA DMH 20/06/2019

N.T.S 110-ERT-2019-0000 E
ERTECH/WATERNSW-WARREN WEIR CONCEPT FOR STOPBOARD WARREN WEIR SEG. STOPBOARDS GENERAL ARRANGEMENT

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HANDLE
6mm THICK
Aluminum 5083-H116

SEALING RUBBER, PVC
3mm THICK
Rubber
FACES SIDE POST H-BEAM

CSK
CSK M10x25-SS 336-gr
Stainless Steel AISI 336

SIE BARRIER PLATE
6mm THICK
Aluminum 5005 H34

PLATE BARRIER ANGLE
E A 50X9X685
Aluminum 6061

SEALING RUBBER*
3mm THICK
Rubber
CUT EXTRA TO COVER THE VOID BETWEEN P SEAL AND SIDE POST

FLUSH ANCHOR
HILTI HSD-SR M10X40 Stainless Steel

GROUT, NON SHRINK

DRILL Ø15 THRU (x11)

WEIGHT: 12kg

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Rubber
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WEIGHT: 12kg
GENERAL NOTES

1. WORKSHOPS AND MACHINERY TO BE PROVIDED ON SITE BY CONTRACTOR.
2. SITE SECURITY AND SAFETY TO BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR TO PROVIDE SAMPLES FOR APPROVAL.
4. ALL WORK IS TO BE IN ACCORDANCE WITH DRAWINGS AND SPECIFICATIONS.

DEFINITIONS

- SCAFFOLDING
- STEEL
- CONCRETE
- WATER
- SAFETY
- HEAT

REINFORCING

1. ALL REINFORCEMENT SHALL BE PLACED IN ACCORDANCE WITH DRAWINGS AND SPECIFICATIONS.
2. ALL REINFORCEMENT IS TO BE PROTECTED FROM CORROSION.
3. ALL REINFORCEMENT IS TO BE F or greater.

CONCRETE GENERAL

1. CONCRETE SHALL BE PROPORTIONED AS SHOWN.
2. CONCRETE SHALL MEET OR EXCEED THE SPECIFIED STRENGTH.
3. CONCRETE SHALL BE PLACED IN ACCORDANCE WITH DRAWINGS AND SPECIFICATIONS.
4. CONCRETE SHALL BE CURED IN ACCORDANCE WITH DRAWINGS AND SPECIFICATIONS.

CONCRETE CONTINUED

1. CONCRETE SHALL BE PLACED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS.
2. CONCRETE SHALL BE CURED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS.
3. CONCRETE SHALL MEET OR EXCEED THE SPECIFIED STRENGTH.

WARNING

BEFORE YOU DIG, CALL 811 TO LOCATE ALL CONCEALED SERVICES.

DIAL BEFORE YOU DIG www.1100.org
Appendix C - Clause 228 of the EP&A Act
**Clause 228 Factor**  

<table>
<thead>
<tr>
<th>(a) Any environmental impact on a community?</th>
<th>Minor adverse</th>
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</thead>
<tbody>
<tr>
<td>The proposal would have minor, short term impacts on the community due to amenity-based impacts during construction relating to noise, traffic, access and visual amenity. These impacts will be very localised and the mitigation measures in section 6 of the REF will be implemented to minimise impacts.</td>
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<tr>
<th>(b) Any transformation of a locality?</th>
<th>Minor adverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposal would not transform a locality because the works would be temporary and would be removed once the drought declaration is lifted. The temporary works would be viewed in the context of the existing water supply infrastructure.</td>
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<tr>
<th>(c) Any environmental impact on the ecosystem of the locality?</th>
<th>Positive impact upstream of Warren</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 6.3.1 of the REF indicates that the proposal would result in both positive and adverse hydrological impacts within this highly regulated catchment, and this is likely to have associated positive and adverse ecological impacts as discussed in section 6.4.4. The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. This would affect about 260 kilometres of the Macquarie River from Burrendong Dam to the Macquarie Marshes and potential impacts of this event would include declining water quality and quantity, and associated consequences such as fish kills and declining health of vegetation communities and terrestrial species due to water stress. In the absence of significant inflows and with the onset of warmer weather, the potential ecological impacts downstream of the affected structures is likely to occur regardless of whether the proposal is implemented or not because flow downstream of these structures is predicted to be so small that it would be insufficient to connect pools within these watercourses. As a result, the proposal represents an incremental impact compared to the do-nothing scenario. The proposal would have a beneficial impact as it would minimise the extent of the Macquarie River, and therefore aquatic and riparian habitat that is affected by a cease to flow event. Under the do-nothing scenario, about 260 kilometres of the Macquarie River would be affected by a cease to flow event in November 2019, whereas the proposal would limit this to about 80 kilometres of the river downstream of Warren. This would extend the duration that refuge habitat is provided within the river upstream of Warren and reduce the risk of adverse water quality conditions developing within this section of the river. This is a beneficial impact compared to the do-nothing scenario.</td>
<td></td>
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<table>
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<tr>
<th>(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</th>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposal would have a short term impact on the aesthetic and recreational value of the locality because construction would be required on the Warren weir which is within a public reserve. This impact would be temporary because construction would take two weeks to complete would affect a small portion of the reserve. The proposal is temporary and would be decommissioned once the drought declaration is lifted.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</th>
<th>Nil</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposal would not impact on any places of heritage significance.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(f) Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?</th>
<th>Positive impact upstream of Warren</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposal would result in flows ceasing downstream of the affected structure and this would impact on the habitat of protected fauna. This</td>
<td></td>
</tr>
<tr>
<td>Clause 228 Factor</td>
<td>Impacts</td>
</tr>
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</tr>
<tr>
<td>has the potential to result in reduce the quality and quantity of water in downstream watercourses and may lead to fish kills. Potential impacts on protected terrestrial and aquatic fauna downstream of the affected structures would be similar to that which is predicted to occur under the do-nothing scenario which would result in the Macquarie River ceasing to flow between Burrendong Dam and the Macquarie Marshes in November 2019. The proposal would have a positive impact on protected terrestrial and aquatic fauna by delaying a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren which provide riparian habitat for a range of species. The mitigation measures outlined in section 6 would be implemented to minimise the risk of adverse impacts.</td>
<td>Minor change to adverse impacts downstream of Warren relative to the do-nothing scenario</td>
</tr>
<tr>
<td>(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The proposal would result in flows ceasing downstream of the affected structure and this would impact on flora, fauna and ecological communities. This has the potential to result in reduce the quality and quantity of water in downstream watercourses and may lead to fish kills. Potential impacts on protected terrestrial and aquatic fauna downstream of the affected structures would be similar to that which is predicted to occur under the do-nothing scenario which would result in the Macquarie River ceasing to flow between Burrendong Dam and the Macquarie Marshes in November 2019. The proposal would have a positive impact on protected terrestrial and aquatic fauna by delaying a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren which provide riparian habitat for a range of species. The mitigation measures outlined in section 6 would be implemented to minimise the risk of adverse impacts.</td>
<td>Positive impact upstream of Warren Minor change to adverse impacts downstream of Warren relative to the do-nothing scenario</td>
</tr>
<tr>
<td>(h) Any long-term effects on the environment? The proposal is unlikely to have long-term effects on the environment as it would be temporary and would be decommissioned once the drought declaration is lifted. The ecosystem downstream of the affected structures would recover over time once higher flow conditions return. The adverse impacts downstream of the affected structures are likely to be similar to that which would have occurred during previous cease to flow events, and similar to the cease to flow event that is likely to occur in November 2019 under the do-nothing scenario.</td>
<td>Minor</td>
</tr>
<tr>
<td>(i) Any degradation of the quality of the environment? The proposal has the potential to result in poor water quality developing in residual pools downstream of the affected structures. Water quality would be monitored and mitigation measures would be implemented to reduce the risk of declining water quality resulting in impacts such as fish kills.</td>
<td>Minor</td>
</tr>
<tr>
<td>(j) Any risk to the safety of the environment? The proposal is unlikely to result in risks to the safety of the environment provided the recommended mitigation measures are implemented. The proposal is temporary and construction would be limited to localised areas.</td>
<td>Minor</td>
</tr>
<tr>
<td>(k) Any reduction in the range of beneficial uses of the environment? The proposal is unlikely to have any reduction in the range of beneficial uses of the environment compared to the do-nothing scenario. The proposal is temporary and would be decommissioned once the drought declaration is lifted. Construction would be short term and limited to existing disturbed sites that contain water supply infrastructure.</td>
<td>Nil</td>
</tr>
<tr>
<td>(l) Any pollution of the environment? The proposal is unlikely to cause any pollution of the environment provided the recommended mitigation measures are implemented.</td>
<td>Nil</td>
</tr>
<tr>
<td>(m) Any environmental problems associated with the disposal of waste? The proposal is unlikely to cause any environmental problems associated with the disposal of waste.</td>
<td>Minor</td>
</tr>
<tr>
<td>Clause 228 Factor</td>
<td>Impacts</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>All waste would be managed and disposed of in accordance with the Waste</td>
<td>Positive impact upstream of Warren</td>
</tr>
<tr>
<td>Classification Guideline (EPA, 2014).</td>
<td>Minor change to adverse impacts downstream of Warren relative to the do-nothing scenario</td>
</tr>
<tr>
<td>(n) Any increased demands on resources (natural or otherwise) that are, or</td>
<td>Positive impact upstream of Warren</td>
</tr>
<tr>
<td>are likely to become, in short supply?</td>
<td>Minor change to adverse impacts downstream of Warren relative to the do-nothing scenario</td>
</tr>
<tr>
<td>The proposal is a temporary measure that would prioritise water for</td>
<td></td>
</tr>
<tr>
<td>critical human water needs and would be decommissioned once the drought</td>
<td></td>
</tr>
<tr>
<td>declaration is lifted. The proposal would not impact on any other resources</td>
<td></td>
</tr>
<tr>
<td>that are likely to be or become in short supply.</td>
<td></td>
</tr>
<tr>
<td>(o) Any cumulative environmental effect with other existing or likely future</td>
<td></td>
</tr>
<tr>
<td>activities?</td>
<td></td>
</tr>
<tr>
<td>The proposal would have positive impacts as it would be the first of a three</td>
<td></td>
</tr>
<tr>
<td>stage schedule of temporary works that would be implemented to delay a cease</td>
<td></td>
</tr>
<tr>
<td>to flow event in the 180 kilometre long section of the Macquarie River between</td>
<td></td>
</tr>
<tr>
<td>Burrerrendong Dam and Warren. Delaying the cease to flow event reduces the risk</td>
<td></td>
</tr>
<tr>
<td>that WaterNSW is unable to operate the river to deliver water to meet critical</td>
<td></td>
</tr>
<tr>
<td>human water needs. The proposal would result in a cease to flow event</td>
<td></td>
</tr>
<tr>
<td>downstream of the affected structures. The impacts of this cease to flow event</td>
<td></td>
</tr>
<tr>
<td>are likely to be similar to that which would have occurred during previous</td>
<td></td>
</tr>
<tr>
<td>cease to flow events, and would occur during the cease to flow event that is</td>
<td></td>
</tr>
<tr>
<td>predicted to occur in November 2019 under the do-nothing scenario.</td>
<td></td>
</tr>
<tr>
<td>(p) Any impact on coastal processes and coastal hazards, including those under</td>
<td>Nil</td>
</tr>
<tr>
<td>projected climate change conditions? The proposal would not affect or be</td>
<td></td>
</tr>
<tr>
<td>affected by any coastal processes or hazards.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D - Macquarie River Water Delivery Operations Update 1 July 2019
Operations update

Water Delivery Arrangements

Macquarie River

1 July 2019

Update

The severe and ongoing drought conditions across NSW are having a significant impact on the ability of WaterNSW to deliver water to customers.

Over the last two years, rainfall across northern NSW has been well below average and in many areas are now the lowest ever recorded. This, combined with higher than average temperatures, has resulted in record low inflows to the storages. Inflows to Burrendong Dam are 36% of the previous low record.

While allocations for the Macquarie River system have been announced by the NSW Department of Planning, Industry and Environment, the delivery of water is restricted due to the ongoing drought.

The Macquarie River system is currently being operated under drought contingency measures with water delivery restrictions.

The water delivery restrictions and operational arrangements are outlined in the tables below and are specifically outlined for each river section to best assist landholders and customers with information relevant to their specific circumstances.

Access to water this year will be highly dependent on further inflows into the catchment and associated tributary inflows downstream from WaterNSW storages.

We encourage our customers and community to stay up to date with the latest information via the options below.

Stay informed

1. Early Warning Network (EWN)
   
   Customers will be notified of access arrangements through our EWN. If you have not already signed up to the system, please phone us on 1300 662 077 or email us at Customer.Helpdesk@watemsw.com.au
2. **eNewsletters**

Customers can stay up to date through weekly email communications sent by WaterNSW. Visit [waternsw.com.au/subscribe](http://waternsw.com.au/subscribe) to choose which reports you would like to receive.

3. **Website**


### AWDs for Macquarie River 1 July 2019

<table>
<thead>
<tr>
<th>Licence Category</th>
<th>AWD</th>
<th>Deliverability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic and Stock</td>
<td>80%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Domestic and Stock (Domestic)</td>
<td>80%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Domestic and Stock (Stock)</td>
<td>80%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Local Water Utility</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>Regulated River (General Security)</td>
<td>0%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Regulated River (General Security) Carryover allocations</td>
<td>n/a</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Regulated River (High Security)</td>
<td>70%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Regulated River (High Security) (Research)</td>
<td>35%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Regulated River (High Security) (Town Water Supply)</td>
<td>35%</td>
<td>Restricted – please see details below</td>
</tr>
<tr>
<td>Supplementary Water</td>
<td>100%</td>
<td>Subject to availability</td>
</tr>
</tbody>
</table>

### Deliverability of ordered water

<table>
<thead>
<tr>
<th>River section</th>
<th>Licence category</th>
<th>Type of restriction</th>
<th>Period of applicability</th>
<th>Method of placing water order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burrendong Dam to Warren Weir</td>
<td>All licence categories</td>
<td>Unrestricted delivery of account water. Water orders to be placed as normal.</td>
<td>Until further notice</td>
<td>IWAS and customer help desk.</td>
</tr>
<tr>
<td>Burrendong Dam to Warren Town Weir (ESD: 2159)</td>
<td>Local Water Utility</td>
<td>Unrestricted delivery of account water. Water orders to be placed as normal.</td>
<td>Until further notice</td>
<td>IWAS and customer help desk.</td>
</tr>
<tr>
<td>Warren Weir to Marebone Weir</td>
<td>All licence categories</td>
<td>Delivery of account water only with tributary flows and not with dam releases.</td>
<td>Until further notice</td>
<td>Only via customer help desk.</td>
</tr>
<tr>
<td>River section</td>
<td>Licence category</td>
<td>Type of restriction</td>
<td>Period of applicability</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td>Downstream of Marebone Weir</td>
<td>All licence categories</td>
<td>Delivery of account water only with tributary flows and not with dam releases. Water order is required to be placed and need to be approved by WaterNSW.</td>
<td>Until further notice Only via customer help desk. Confirmation of water order from WaterNSW is required.</td>
<td></td>
</tr>
<tr>
<td>Downstream of Marebone Break and Bulgeragar Creek</td>
<td>All licence categories</td>
<td>Delivery of account water only with tributary flows and not with dam releases. Water order is required to be placed and need to be approved by WaterNSW.</td>
<td>Until further notice Only via customer help desk. Confirmation of water order from WaterNSW is required.</td>
<td></td>
</tr>
<tr>
<td>Gunningbar Creek offtake to Gunningbar Weir</td>
<td>All licence categories</td>
<td>Unrestricted delivery of account water. Water orders to be placed as normal.</td>
<td>Until further notice iWAS and customer help desk.</td>
<td></td>
</tr>
<tr>
<td>Gunningbar Weir to Bogan River confluence</td>
<td>All licence categories</td>
<td>Unrestricted delivery of account water. Water orders to be placed as normal.</td>
<td>Until further notice iWAS and customer help desk.</td>
<td></td>
</tr>
<tr>
<td>Downstream of Duck Creek offtake</td>
<td>All licence categories</td>
<td>Delivery of account water only with tributary flows and not with dam releases. Water order is required to be placed and need to be approved by WaterNSW.</td>
<td>Until further notice Only via customer help desk. Confirmation of water order from WaterNSW is required.</td>
<td></td>
</tr>
<tr>
<td>Downstream of Crooked Creek offtake</td>
<td>All licence categories</td>
<td>Delivery of account water only with tributary flows and not with dam releases. Water order is required to be placed and need to be approved by WaterNSW.</td>
<td>Until further notice Only via customer help desk. Confirmation of water order from WaterNSW is required.</td>
<td></td>
</tr>
</tbody>
</table>

Trade restrictions

<table>
<thead>
<tr>
<th>River section</th>
<th>Licence category</th>
<th>Type of restriction</th>
<th>Period of applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macquarie River</td>
<td>General Security</td>
<td>Trading from general security licences in the Macquarie River to any licences in Macquarie or Cudgegong rivers is suspended</td>
<td>Until further notice</td>
</tr>
<tr>
<td>Macquarie River</td>
<td>High security and Supplementary licences</td>
<td>Trading is unaffected</td>
<td>Until further notice</td>
</tr>
</tbody>
</table>
**Cudgegong River to Macquarie River**

| All licence categories | Trading of allocations is suspended | Until further notice |

**Macquarie River to Cudgegong River**

| High security and Supplementary licences | Trading is unaffected | Until further notice |

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**More information**


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**Authorised by**

Sri Stharan
Water System Operations Manager Central
Appendix E - Likelihood of occurrence table
## Likelihood of occurrence and impact on threatened fauna known or predicted to occur within the locality of the proposal

<table>
<thead>
<tr>
<th>Class</th>
<th>Scientific name</th>
<th>Common name</th>
<th>BC Status</th>
<th>EPBC Status</th>
<th>Source</th>
<th>Habitat description</th>
<th>Likelihood of occurrence/impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td><em>Crinia sloanei</em></td>
<td>Sloane's Froglet</td>
<td>V</td>
<td>E</td>
<td>BioNet</td>
<td>Recorded from sites across the Murray-Darling basin with majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions. Typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
<td>Source</td>
<td>Habitat description</td>
<td>Likelihood of occurrence/impact</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Anseranas semipalmata</em></td>
<td>Magpie Goose</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs in the tropics, increasing numbers in central and northern NSW and vagrants to south-east NSW. Inhabits shallow wetlands containing dense rushes or sedges, and nearby dry land used for grazing. It feeds on grasses, bulbs and rhizomes and roosts in tall vegetation within wetland areas. Breeding occurs predominately in monsoonal areas and is unlikely in SE NSW. Nests are formed in trees over deep water.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators in the vicinity of the construction sites. It is known to occur in the Macquarie Marshes, in larger pools in the Macquarie River upstream of Dubbo, and has been recorded breeding in the Narromine weir pool. Low likelihood of impact during construction given the small size construction footprint, short construction duration, and that impacts relating to noise would be of a short duration and similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts downstream of the affected structures will be temporary, this species is mobile, and similar to conditions experienced during historical</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
<td>Source</td>
<td>Habitat description</td>
<td>Likelihood of occurrence/impact</td>
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<td>--------------------------------</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Ardeotis australis</em></td>
<td>Australian Bustard</td>
<td>E</td>
<td>BioNet</td>
<td></td>
<td>Occurs in inland Australia. In NSW mainly found in the north-west corner, less often in the lower western and central west plains regions, with occasional vagrants east to the western slopes and riverine plain. Breeding confined to the north-west region. Mainly inhabits tussock and hummock grasslands, also occurs in low shrublands and low open grassy woodlands. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and shrubland cover. Travels long distances, presumably in response to habitat and climatic conditions.</td>
<td>Unlikely at construction sites and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
<td>Source</td>
<td>Habitat description</td>
<td>Likelihood of occurrence/impact</td>
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</tr>
<tr>
<td>Birds</td>
<td><em>Artamus cyanopterus cyanopterus</em></td>
<td>Dusky Woodswallow</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>Widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (<em>Manorina</em>).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May occur in habitats in the vicinity of the construction sites, upstream and downstream of regulators. Low likelihood of impact during construction given the small size construction footprint, short construction duration, and that impacts relating to noise would be of a short duration and similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between...</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
<td>Source</td>
<td>Habitat description</td>
<td>Likelihood of occurrence/impact</td>
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</tr>
<tr>
<td>Birds</td>
<td><em>Botaurus poiciloptilus</em></td>
<td>Australasian Bittern</td>
<td>E</td>
<td>E</td>
<td>PMST; BioNet</td>
<td>Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly <em>Typha</em> spp. and <em>Eleocharis</em> spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Low likelihood of impact during construction given the small size construction footprint, short construction duration, and that impacts relating to noise would be short term and similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
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</tr>
<tr>
<td>Birds</td>
<td>Burhinus grallarius</td>
<td>Bush Stone-curlew</td>
<td>E</td>
<td>-</td>
<td>BioNet</td>
<td>Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td>Calidris ferruginea</td>
<td>Curlew Sandpiper</td>
<td>E</td>
<td>M (C,J,K)</td>
<td>PMST</td>
<td>Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW, mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.</td>
<td>Unlikely: no suitable habitat Unlikely to be impact from construction or operation.</td>
</tr>
<tr>
<td>Birds</td>
<td>Calyptorhynchus lathami</td>
<td>Glossy Black-Cockatoo</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat.</td>
</tr>
<tr>
<td>Class</td>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
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<td><em>Allocasuarina</em> species. Prefers woodland and open forests, rarely away from <em>Allocasuarina</em>. Roost in leafy canopy trees, preferably eucalypts, usually &lt;1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).</td>
<td>May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Circus assimilis</em></td>
<td>Spotted Harrier</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Climacteris picumnus victoriae</em></td>
<td>Brown Treecreeper</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs from Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell to the east coast, in</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat.</td>
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<td>Class</td>
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<td>areas such as the Snowy River Valley, Cumberland Plain, Hunter Valley and parts of the Richmond and Clarence Valleys. Most common on the inland slopes and plains. Inhabits eucalypt woodlands and dry open forest, usually dominated by stringybarks or rough-barked species with open grassy understorey. Fallen timber is important foraging habitat. Nests in hollows in standing trees or stumps.</td>
<td>May possibly occur in terrestrial habitats in the vicinity of the construction sites upstream and downstream of regulators. Low likelihood of impact during construction given the small size construction footprint, short construction duration, and that impacts relating to noise would be similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of</td>
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<tr>
<td>Birds</td>
<td><em>Daphoenositta chrysoptera</em></td>
<td>Varied Sittella</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. No operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Ephippiorhynchus asiaticus</em></td>
<td>Black-necked Stork</td>
<td>E</td>
<td>0</td>
<td>BioNet</td>
<td>In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators.</td>
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<tr>
<td>Birds</td>
<td><em>Epthianura albifrons</em></td>
<td>White-fronted Chat</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation &lt;1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often surrounded by vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events.</td>
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<tr>
<td>Birds</td>
<td><em>Falco hypoleucos</em></td>
<td>Grey Falcon</td>
<td>E</td>
<td></td>
<td>BioNet</td>
<td>Inhabits shrubland, grassland and wooded watercourses of arid and semi-arid regions, and occasionally open woodlands throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Breeding only occurs within arid areas of the Great Dividing Range. Its diet consists of other birds, especially parrots and pigeons, reptiles and small mammals. Nesting occurs in disused nests of other birds of prey and ravens, high in a living eucalypt near water or a watercourse. Breeding occurs in late winter and early spring.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat which provides potential habitat for this species and its prey.</td>
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<tr>
<td>Birds</td>
<td><em>Falco subniger</em></td>
<td>Black Falcon</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of ‘Black Falcons’ on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in inland areas.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May occur in terrestrial habitats in the vicinity of construction sites upstream and downstream of regulators and DPIE advised that the species occurs in similar habitats to the Warren weir pool elsewhere along the Macquarie River. Low likelihood of impact during construction given the small size construction footprint, short construction duration, and that impacts relating to noise would be similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events.</td>
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<tr>
<td>Birds</td>
<td><em>Grantiella picta</em></td>
<td>Painted Honeymooner</td>
<td>V</td>
<td>V</td>
<td>PMST; BioNet</td>
<td>Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Grus rubicunda</em></td>
<td>Brolga</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>In NSW occurs west of the Great Dividing Range and on the north coast. Dependent on wetlands, especially shallow swamps. Often feed in dry grassland, ploughed paddocks or desert claypans.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators.</td>
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<tr>
<td>Birds</td>
<td><em>Haliaeetus leucogaster</em></td>
<td>White-bellied Sea-eagle</td>
<td>V</td>
<td>0</td>
<td>BioNet</td>
<td>Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events.</td>
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<tr>
<td>Birds</td>
<td><em>Hamirostra melanosternon</em></td>
<td>Black-breasted Buzzard</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Sparsely distributed in areas of less than 500mm rainfall, north from north-western NSW. Inhabits a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Breeds from August to October near water in a tall tree.</td>
<td>Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat. Unlikely within construction sites due to absence of suitable habitat May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Hieraaetus morphnoides</em></td>
<td>Little Eagle</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat May possibly occur in terrestrial habitats upstream and downstream of regulators.</td>
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<tr>
<td>Birds</td>
<td>Leipoa ocellata</td>
<td>Malleefowl</td>
<td>E</td>
<td>V</td>
<td>PMST</td>
<td>Occurs in semi-arid to arid mallee country in the south-west of NSW. Its NSW stronghold is centred on Mallee Cliffs NP, extending east to Balranald and with scattered records north to Mungo NP. There are also populations in the Scotia mallee (W of the darling River), central NSW (chiefly Yathong, Nombinnie and Round Hill NR), and Dubbo (Goonoo forest). Occasional records exist from the Pilliga, around Cobar and Goulburn River NP. Inhabits predominately mallee communities, apparently preferring areas of sandy soil, abundant leaf litter, dense canopy and an abundance of food shrubs and herbs (especially legumes). Less frequently found in other eucalypt woodlands such as Eucalyptus microcarpa, Ironbark and E. populnea woodlands with thick understorey, and Mulga and native Cypress Pine communities.</td>
<td>Unlikely to be significant operational impacts on areas of potential habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Lophochroa leadbeateri</em></td>
<td>Major Mitchell’s Cockatoo</td>
<td>V, P, 2</td>
<td></td>
<td>BioNet</td>
<td>Occupies habitat in arid semi-desert scrublands, savannahs and sparse woodlands, where there is fresh surface water and large hollow trees for nesting. These birds have been recorded in forest, woodland and shrub land, including mulga, mallee, Acacia, Eucalyptus and Callitris associations. It has also been recorded in cropping areas throughout its range (Queensland Government EPA Agency, 2007). Large areas of suitable habitat are required for a viable population to exist (Webster et al undated).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Lophoictinia isura</em></td>
<td>Square-tailed Kite</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100 m of ephemeral/permanent</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Melanodryas cucullata cucullata</em></td>
<td>Hooded Robin</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Melithreptus gularis gularis</em></td>
<td>Black-chinned Honeyeater</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of &gt;5 ha. Tend</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Neophema pulchella</em></td>
<td>Turquoise Parrot</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in the South Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understory. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.</td>
<td>Unlikely within the construction sites due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Ninox connivens</em></td>
<td>Barking Owl</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat.</td>
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<td>and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.</td>
<td>May occur in terrestrial habitats in the vicinity of the construction sites upstream and downstream of regulators. Low likelihood of impact during construction given the small size of the construction footprint, short construction duration at each location, and that impacts relating to noise would be of a short duration and similar to that associated with operation of farm machinery that occurs on adjacent land as part of ongoing agricultural activities. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam</td>
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<tr>
<td>Birds</td>
<td><em>Oxyura australis</em></td>
<td>Blue-billed Duck</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.</td>
<td>and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat which provides potential habitat for this species and its prey. Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur on occasion in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Polytelis swainsonii</em></td>
<td>Superb Parrot</td>
<td>V</td>
<td>V</td>
<td>PMST; BioNet</td>
<td>Occurs as a single population I the South-west Slopes and Riverina bioregions. Two core breeding areas: between Cowra and Yass – Grenfell, Cootamundra and Coolac in the SW Slopes, and along the Murray, Edward and Murrumbidgee Rivers in the Riverina. Birds breeding in the SW slopes migrate north to the Namoi/Gwydir Rivers for winter. Inhabits Box Gum, Box – Cypress Pine and Boree woodlands and River Red Gum Forest. Nest in hollow trees, in tall riparian River Red Gum communities (Riverina area) or open Box Gum woodland or isolated paddock trees (SW Slopes). Mainly forages in grassy box woodlands, up to 10km from breeding sites.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. Unlikely to be operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Pomatostomus temporalis temporalis</em></td>
<td>Grey-crowned Babbler</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs on western slopes and plains , as well as in the Hunter Valley and several locations on the north coast. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Family groups have territories between 1-50 (generally around 10) hectares.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. Unlikely to be operational impacts on areas of potential habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Rostratula australis</em></td>
<td>Painted Snipe (was Australian Painted Snipe)</td>
<td>E</td>
<td>E, M</td>
<td>PMST; BioNet</td>
<td>Nests typically built in shrubs or sapling eucalypts. Normaly found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur on occasion in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrencong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
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<tr>
<td>Birds</td>
<td><em>Stagonopleura guttata</em></td>
<td>Diamond Firetail</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.</td>
<td>Unlikely within the construction footprints due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Birds</td>
<td><em>Stictonetta naevosa</em></td>
<td>Freckled Duck</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of</td>
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<tr>
<td>Birds</td>
<td><em>Tyto novaehollandiae</em></td>
<td>Masked Owl</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (&gt;40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Fish</td>
<td><em>Bidyanus bidyanus</em></td>
<td>Silver Perch</td>
<td>V</td>
<td>CE</td>
<td>DPI</td>
<td>In NSW now absent from much of their former range across the Murray-Darling. Most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries including the Edward River - an anabranch of the Murray River.</td>
<td>Known occurrence Habitat for this species occurs in the Macquarie River downstream of Warren Weir. Recent records in the lower reaches of the Macquarie River and incidental evidence from anglers suggests a</td>
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<tr>
<td>Fish</td>
<td><em>Ambassis agassizii</em></td>
<td>Olive Perchlet</td>
<td>EP</td>
<td>-</td>
<td>DPI</td>
<td>Occur in both eastern (coastal) and western (Murray-Darling) drainages, but these populations may be genetically distinct. Inhabit rivers, creeks, ponds and riffles. See <em>Ambassis sp</em> for further details.</td>
<td>Unlikely Not known to occur in the Macquarie River (DPI 2014). Positive downstream impact as water continues to be clear.</td>
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<tr>
<td>Fish</td>
<td>Tandanus tandanus</td>
<td>Eel-tailed Catfish</td>
<td>EP</td>
<td>-</td>
<td>DPI</td>
<td>Once widespread and abundant throughout the Murray-darling system, has declined rapidly and in NSW is currently only regularly observed in the Macquarie catchment upstream of Warren, the Castlereagh catchment upstream of Mendooran, the Namoi catchment upstream of Wee Waa, the Gwydir catchment upstream of Moree and the Border Rivers catchment upstream of Goondiwindi. Present in a range of riverine and lake habitats, preferring sluggish or still waters. Found in both clear and turbid waters, in areas ranging from mud to gravel to rock substrates. Now rare in riverine habitats in inland NSW and Queensland but can be found in farm dams (DPI 2011b).</td>
<td>Known occurrence Suitable habitat present within the immediate area and downstream of the proposed action Operational impacts downstream of the affected structure will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
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<tr>
<td>Gastropod</td>
<td>Notopala sublineata</td>
<td>Darling River Snail</td>
<td>CE</td>
<td>-</td>
<td>DPI</td>
<td>Endemic to the Murray/Darling Basin. The species is now restricted to a few populations in</td>
<td>Unlikely Restricted to a small number of irrigation pipelines and</td>
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<tr>
<td>Fish</td>
<td><em>Macullochella macquariensis</em></td>
<td>Trout Cod</td>
<td>E</td>
<td>E</td>
<td>PMST/DPI</td>
<td>There are 3 known breeding populations in NSW: a naturally occurring population below Yarrawonga Weir in the Murray River, a stocked population in the Murrumbidgee River at Narrandra and a translocated population in Cataract Dam in coastal NSW. There are stocked (breeding unconfirmed) populations within the Murray, Murrumbidgee and Macquarie Rivers, and in Talbingo Dam in Kosciusko NP (NSW DPI 2006b). The species occurs in a range of habitats, but is strongly associated with the presence of woody debris and snags (NSW DPI 2006b).</td>
<td>Known occurrence</td>
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<td>Artificial habitat in the lower Darling River downstream of the Macquarie Marshes. Unlikely to be significant impact</td>
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<tr>
<td>Fish</td>
<td><em>Macullochella peeli</em></td>
<td>Murray Cod</td>
<td>-</td>
<td>V</td>
<td>PMST</td>
<td>Occurs throughout the Murray-Darling Basin. Can live in a wide range of habitats, from clear, rocky streams in the upper western slopes regions of New</td>
<td>Known occurrence</td>
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<td>Most records upstream of the affected regulators, however DPI Fisheries has advised that</td>
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<tr>
<td>Fish</td>
<td><em>Macquaria australasica</em></td>
<td>Macquarie Perch</td>
<td>V</td>
<td>E</td>
<td>PMST</td>
<td>Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their branches.</td>
<td>Unlikely There are no known ‘self-sustaining native populations or ‘translocated and stocked populations’ within the lower Macquarie.</td>
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<tr>
<td>Mammals</td>
<td><em>Chalinolobus</em> <em>picatus</em></td>
<td>Little Pied Bat</td>
<td>V</td>
<td></td>
<td>BioNet</td>
<td>Found in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings in dry open forest and woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, and Bimble box communities. They feed on moths and other flying invertebrates.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Mammals</td>
<td><em>Dasyurus</em> <em>maculatus</em></td>
<td>Spotted-tailed Quoll</td>
<td>V</td>
<td>E</td>
<td>BioNet</td>
<td>Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Mammals</td>
<td><em>Myotis macropus</em></td>
<td>Southern Myotis</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
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<tr>
<td>Mammals</td>
<td><em>Nyctophilus corbeni</em></td>
<td>South-eastern Long-eared Bat</td>
<td>0</td>
<td>V</td>
<td>PMST</td>
<td>Little known about the biology or social structure of these bats - rarely recorded and scattered distribution (DotE 2014b). Limited</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat.</td>
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<tr>
<td>Mammals</td>
<td><em>Phascolarctos cinereus</em></td>
<td>Koala</td>
<td>V</td>
<td>V</td>
<td>BioNet</td>
<td>distribution that is restricted to the Murray-Darling Basin and western slopes in south-eastern Australia. Occur in a wide range of habitats including River Red Gum, Black Box, Allocasuarina, Belah, Mallee, open woodlands and savannas, but are most common in box, ironbark and cypress open forests and buloke woodlands of inland northern NSW (Churchill 2008). In SA, known to roost in tree hollows less than 3 m above the ground with multiple small entrances, elsewhere they roost in fissures in branches and under exfoliating bark. Tree hollows used as maternity sites (Churchill 2008).</td>
<td>May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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<tr>
<td>Mammals</td>
<td><em>Phascolarctos cinereus</em> (combined populations of Qld, NSW and the ACT)</td>
<td>Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)</td>
<td>-</td>
<td>V</td>
<td>PMST</td>
<td>The listed species range extends from north-eastern Queensland to the Victorian border.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Mammals</td>
<td><em>Saccolaimus flaviventris</em></td>
<td>Yellow-bellied Sheathtail-bat</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Migrates from tropics to SEAus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in terrestrial habitats upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
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</tbody>
</table>
Likelihood of occurrence and impact on threatened flora species known or predicted to occur within the locality of the proposal

<table>
<thead>
<tr>
<th>Scientific name</th>
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<th>Habitat description</th>
<th>Likelihood of occurrence/Impact</th>
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</thead>
<tbody>
<tr>
<td><strong>Austrostipa wakoolica</strong></td>
<td>Austrostipa wakoolica</td>
<td>E</td>
<td>E</td>
<td>PMST</td>
<td>Confined to floodplains of the Murray River tributaries of central and south western NSW, in open woodland on grey, silty clay or sandy loam soils. Habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise. Associated species include White Cypress Pine, Grey Box, Bimble Box, Austrostipa eremophila, A. drummondii, Austrodanthonia eriantha and Climbing Saltbush.</td>
<td>Unlikely</td>
</tr>
<tr>
<td><strong>Cheilanthes sieberi subsp. pseudovellea</strong></td>
<td>Cheilanthes sieberi subsp. pseudovellea</td>
<td>E</td>
<td>-</td>
<td>BioNet</td>
<td>One NSW specimen was recorded in 1952 from Mount Foster NW of Warren. Recent re-examination of specimens suggest a wide former distribution across NSW. Very widely distributed across Australia, e.g. Mount Olga and the Kimberley, MacDonnell and Musgrave Ranges. Grows in soil pockets in rocky areas of arid mountain ranges. Specific habitats include shaded rock crevices, under rock ledges and between boulders in damp, shallow soils. The fern is usually common where it grows.</td>
<td>Unlikely</td>
</tr>
<tr>
<td><strong>Diuris tricolor</strong></td>
<td>Pine Donkey Orchid</td>
<td>V</td>
<td>V</td>
<td>BioNet</td>
<td>Sporadic distribution on the western slopes of NSW, from south of Narrandera to the Queensland border. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (Callitris spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Associated species include White Cypress Pine, Bimble Box, Gum Coolibah, Ironbark and Acacia shrubland.</td>
<td>Unlikely</td>
</tr>
<tr>
<td><strong>Pterostylis cobarensis</strong></td>
<td>Greenhood Orchid</td>
<td>V</td>
<td>-</td>
<td>BioNet</td>
<td>Recorded from Bourke, Nyngan, Cobar, Nymagee, Warren, Gilgandra, Narrabri and Coonabarabran districts. Grows in eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges in skeletal sandy loam soils. Associated species include Grey Mallee, Eucalyptus viridis, Gum Coolibah, Eucalyptus vicina, White Cypress Pine, Wiltga,</td>
<td>Unlikely</td>
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<tr>
<td><em>Swainsona murrayana</em></td>
<td>Slender Darling Pea</td>
<td>V</td>
<td>V</td>
<td>PMST</td>
<td>Appears to prefer clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams, and appears in association with bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.</td>
<td>Unlikely</td>
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<td></td>
<td>No suitable habitat will be affected</td>
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<td></td>
<td></td>
<td></td>
<td>No impact anticipated</td>
</tr>
<tr>
<td><em>Swainsona recta</em></td>
<td>Mountain Swainson Pea</td>
<td>E</td>
<td>E</td>
<td>PMST; BioNet</td>
<td>Current populations exist in the Queanbeyan and Wellington-Mudgee areas, previous populations thought extinct include Carcoar, Culcairn and Wagga Wagga. Also known from ACT and Victoria. Inhabits grassy woodlands and open-forests dominated by Blakely's Red Gum, Yellow Bloodwood, Candlebark and Long-leaved Box and in association with understorey dominants that include Themeda australis, Poa spp. and Austrostipa spp.</td>
<td>Unlikely</td>
</tr>
<tr>
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<td></td>
<td>No suitable habitat will be affected</td>
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<td>No impact anticipated</td>
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</tbody>
</table>
Likelihood of occurrence and impact on migratory species known or predicted to occur within the locality of the proposal

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>BC Status</th>
<th>EPBC Status</th>
<th>Source</th>
<th>Habitat description</th>
<th>Likelihood of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Apus pacificus</em></td>
<td>Fork-tailed Swift</td>
<td>-</td>
<td>Migratory</td>
<td>PMST</td>
<td>Recorded in all regions of NSW. Non-breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.</td>
<td>May possibly forage over habitats upstream and downstream of regulators. Unlikely to be significant construction or operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td><em>Motacilla flava</em></td>
<td>Yellow Wagtail</td>
<td>-</td>
<td>C,J,K</td>
<td>PMST</td>
<td>This species breeds in temperate Europe and Asia. Occurs within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat May possibly occur in terrestrial habitats in the locality upstream and downstream of regulators. Unlikely to be significant operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td><em>Actitis hypoleucos</em></td>
<td>Common Sandpiper</td>
<td>-</td>
<td>C,J,K</td>
<td>PMST</td>
<td>Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat May possibly occur in habitats in the locality upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the</td>
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<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>BC Status</th>
<th>EPBC Status</th>
<th>Source</th>
<th>Habitat description</th>
<th>Likelihood of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Calidris acuminata</em></td>
<td>Sharp-tailed Sandpiper</td>
<td>-</td>
<td>Migratory Wetland</td>
<td>PMST</td>
<td>Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.</td>
<td>Unlikely within the footprint of construction sites due to absence of suitable habitat. May possibly occur in habitats in the locality upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
</tr>
<tr>
<td><em>Calidris ferruginea</em></td>
<td>Curlew Sandpiper</td>
<td>E</td>
<td>M (C,J,K)</td>
<td>PMST</td>
<td>Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on</td>
<td>Unlikely to occur due to absence of suitable habitat</td>
</tr>
</tbody>
</table>

Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.
<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>BC Status</th>
<th>EPBC Status</th>
<th>Source</th>
<th>Habitat description</th>
<th>Likelihood of occurrence</th>
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</thead>
<tbody>
<tr>
<td><em>Calidris</em></td>
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<td></td>
<td>beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.</td>
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<tr>
<td><em>melanotos</em></td>
<td>Pectoral</td>
<td>-</td>
<td>J,K</td>
<td>PMST</td>
<td>Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.</td>
<td>Unlikely to occur due to absence of suitable habitat and known distribution</td>
</tr>
<tr>
<td><em>Gallinago</em></td>
<td>Latham’s</td>
<td>-</td>
<td>Migratory</td>
<td>PMST</td>
<td>Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabits permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown</td>
</tr>
<tr>
<td>hardwickii</td>
<td>Snipe</td>
<td></td>
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<td></td>
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<tr>
<td>Scientific name</td>
<td>Common name</td>
<td>BC Status</td>
<td>EPBC Status</td>
<td>Source</td>
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<tr>
<td>Hirundapus caudacutus</td>
<td>White-throated Needletail</td>
<td>-</td>
<td>V, M</td>
<td>BioNet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ardea ibis</td>
<td>Cattle Egret</td>
<td>-</td>
<td>M</td>
<td>BioNet</td>
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<thead>
<tr>
<th>Habitat description</th>
<th>Likelihood of occurrence</th>
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<tr>
<td>Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.</td>
<td>May possibly forage over habitats upstream and downstream of regulators. Unlike to be significant construction or operational impacts on areas of potential habitat.</td>
</tr>
<tr>
<td>Occurs across NSW. Principal breeding sites are the central east coast from Newcastle to Bundaberg. Also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes). Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Uses predominately shallow, open and fresh wetlands with low emergent vegetation and abundant aquatic flora. Sometimes observed in swamps with tall emergent vegetation and commonly use areas of tall pasture in moist, low-lying areas.</td>
<td>Unlikely within the construction footprint due to absence of suitable habitat. May possibly occur in habitats upstream and downstream of regulators. Operational impacts downstream of the affected structures, including the Macquarie Marshes, will be temporary and similar to conditions experienced during historical and anticipated low flow/cease to flow events. Beneficial impact upstream through maintenance of riparian habitat within the 180 kilometre long section of the Macquarie River between Warren and Burrendong Dam and reducing drawdown of the Marebone weir pool prolonging the duration that it provides refuge habitat.</td>
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<tr>
<td>Scientific name</td>
<td>Common name</td>
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</tr>
<tr>
<td>Plegadis falcinellus</td>
<td>Glossy Ibis</td>
</tr>
<tr>
<td>Tringa nebularia</td>
<td>Common Greenshank</td>
</tr>
<tr>
<td>Scientific name</td>
<td>Common name</td>
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<tr>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Tringa stagnatilis</td>
<td>Marsh Sandpiper</td>
</tr>
<tr>
<td>Hydroprogne caspia</td>
<td>Caspian Tern</td>
</tr>
<tr>
<td>Scientific name</td>
<td>Common name</td>
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<tr>
<td>-----------------</td>
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</tr>
<tr>
<td><em>Merops ornatus</em></td>
<td>Rainbow Bee-eater</td>
</tr>
</tbody>
</table>
Appendix F - Assessments of Significance
## Assessment of significance - Murray Cod (Maccullochella peelii peelii) – Vulnerable species

An ‘important population’ of a vulnerable species is defined by DotE (2013) as ‘…a population that is necessary for the species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species’ range.

### According to the DotE (2013) ‘significant impact criteria’ for a vulnerable species, an action is likely to have a significant impact on an vulnerable species if there is a real chance or possibility that it will:

### Lead to a long-term decrease in the size of an important population

The proposed action is not located within an important population of Murray Cod (Commonwealth of Australia, 2016) however it is identified as a population under threat.

DPI Fisheries sampled fish communities as part of a Short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- Zone 1: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- Zone 2: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and included sampling between the Warren Weir and Gin Gin Weir.
- Zone 3: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- Zone 4: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some sites in Zone 4 during two of the three sampling events because the river was dry.

DPI Fisheries recorded the highest abundances of Murray Cod in Zone 2. The proposal would benefit Murray Cod by retaining water in the section of the river where the highest abundances of this species were recorded. This would provide refuge habitat so the species can persist and recover once flows return to watercourses downstream of the affected structures. There is likely to be a lag in population recovery downstream of these structures.

### Reduce the area of occupancy of the species

As indicated above, the proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained upstream of Warren and refuge habitat is provided for aquatic species, including threatened fish. Monitoring undertaken by DPI Fisheries (2016) recorded the Murray Cod in the survey Zone 2 and Zone 3, and the successful recruitment of Murray Cod was almost entirely constrained to Zone 2 (Gin Gin to Warren), where the highest abundances of mature Murray cod were recorded. In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long term change in the area of occupancy of the species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework.
Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain habitat for Murray Cod.

The Macquarie River has already ceased to flow downstream of the Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow downstream of Burrendong Dam in November 2019 if the proposal is not implemented in August 2019 and this will result in the approximately 260 kilometre long section of Macquarie River between Burrendong Dam and the Macquarie Marshes ceasing to flow. This would result in the Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. From a hydrological perspective, the proposal will:

- Bring forward by two months the cease to flow on watercourses that would affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures
- Enable a cease to flow event in approximately 180 kilometre long section of the main channel of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal will result in flow ceasing along about 80 kilometres of the Macquarie River downstream of the affected structures. If the proposal is not implemented, approximately 260 kilometres of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

In the absence of significant inflows, the hydrological, water quality and aquatic ecology impacts downstream of the affected structures are likely to occur regardless of whether the proposal is implemented or not.

Hydrological data reflects that the Macquarie River, Duck Creek and Crooked Creek have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the years 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal is unlikely to lead to the long term reduction in the area of occupancy of Murray Cod as it would maintain water in and delay a cease to flow event in the section of the Macquarie River upstream of Warren Weir where DPI Fisheries recorded the highest abundances of Murray Cod. This would assist to maintain the presence of the species in the river system so it can recolonise and disperse throughout the river system following a return to higher flow conditions return to watercourses downstream of the affected structures. There is likely to be a lag in population recovery downstream of these structures.

**Fragment an existing important population into two or more populations**

The proposed action is not located within a listed important population of Murray Cod and would not fragment a listed important population into two or more populations.

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to result in additional fragmentation impacts compared to those that would occur in November 2019 under the do-nothing scenario. The proposal would maintain water in the section of the river upstream of Warren where DPI recorded the greatest abundance of Murray Cod (DPI 2016). The proposal would also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which is known to contain Murray Cod. A fish monitoring plan would be implemented by DPIF to minimise impacts on fish that remain in residual pools.

**Adversely affect habitat critical to the survival of a species**

As the proposed action is not located within a listed important population of Murray Cod it is unlikely that the habitat affected is likely to be critical to the survival of the species.

As indicated above, the proposal would retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the 180 kilometre long
section of the Macquarie River between Burrendong Dam and Warren. This would prolong the duration that flow is maintained in this section of the river and that refuge habitat is provided for Murray Cod. This would enhance the likelihood of fish persisting in the system during the drought.

Disrupt the breeding cycle of an important population

The proposed action is not located within a listed important population of Murray Cod. The proposal is unlikely to disrupt the breeding cycle of the Murray Cod any more than would occur in November 2019 under the do-nothing scenario.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action will result in both upstream and downstream impacts to the extent and quality of habitat for this species, however this would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event downstream of Warren, but not whether this occurs. As described above, the Macquarie River has already ceased to flow downstream of the Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will affect approximately 260 kilometres of the river between Burrendong Dam and the Macquarie Marshes. It will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. The proposal would prolong the duration that habitat for Murray Cod is available in the main channel of the Macquarie River upstream of Warren Weir which is the section of the river where DPI Fisheries recorded the highest abundances of mature Murray Cod relative to the section downstream of the weir.

The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Murray Cod to the extent that the species is like to decline. By maintaining flow in a 180 kilometre long section of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat

Through making conditions more favourable for introduced species, the proposed action may result in the further establishment of the invasive species, *Cyprinus carpio* (European Carp) and *Gambusia affinis* (Mosquitofish) due to reduced water quality within the downstream reaches and the loss of competitive native populations of the Murray Cod.

However, cease to flow (CTF) periods are a normal and important aspect of the flow regime. In many cases through the regulation of waterways these events have become rare. Cease to flow periods allow the development of a diversity of biofilms and aquatic plants, and periods of stress that promote resilience and can control the population of invasive species such as carp that are not as well adapted to the highly variable flow regime of Australia's semi-arid rivers (Rolls et al. 2012; Stubbington et al. 2011; Dewson et al. 2007).

A Fish Monitoring Plan will be implemented by DPIF in key pools downstream of the affected structures and this will enable action to be taken to manage invasive species such as European Carp and Mosquitofish if required.

Introduce disease that may cause the species to decline

The proposed action is unlikely to introduce disease that may cause the species to decline.

Interfere with the recovery of the species

The proposed action is within a population identified under the recovery plan for Murray Cod as a “population under threat” as a result of “River regulation (including water extraction for irrigation), no or low levels of recruitment, inappropriate fish stocking (loss of unique genetic identity), exotic fish, illegal fishing”.

The proposal would not interfere with the recovery of the species in the context of the current drought, and given that the Macquarie River has already ceased to flow in the southern reaches of the Macquarie Marshes, and that the entire 260 kilometre long section of the Macquarie River downstream
of Burrendong Dam is predicted to cease to flow in November 2019 if the proposal is not implemented and there are no inflows.

The aim of the proposed action is to retain water within the Macquarie River channel upstream of Warren Weir which is the section of the river where DPI Fisheries recorded the highest abundance of Murray Cod. The Warren Weir pool is likely to provide refuge habitat for the Murray Cod and maintaining flow in this 180 kilometre long section of the Macquarie River and water in this weir pool is likely to enhance the ability of the species to persist during the current drought conditions and recover in the event that sufficient flows return to the system to enable the temporary works to be decommissioned. There would be a lag in population recovery in watercourses downstream of the affected structures once flows return.

Conclusion

The impact of the proposed action on the Murray Cod is unlikely to be significant because:

- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.
- The proposal would retain water in the section of the Macquarie River where DPI Fisheries recorded the greatest abundance of Murray Cod. This would provide refuge habitat and enable Murray Cod to recolonise downstream areas when higher flows return.
- The proposal will enable stages 2 and 3 of the temporary works for the drought response strategy described in Section 2 of the Review of Environmental Factors to be implemented delaying the Macquarie River cease to flow between Burrendong Dam and the Macquarie Marshes from November 2019 to October 2020 if there are no inflows. The section of the Macquarie River between Burrendong Dam and Warren provides important refuge habitat for biota, including Murray Cod. By deferring the cease to flow event in the Macquarie River upstream of Warren, the proposal will extend the duration that refuge habit is available in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.
- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these cease to flow events would have resulted in hydrological, water quality and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.
- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of the Minister’s conditions for installation of these regulators. Prior to 2004, the weir and regulators presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. During tributary flows or a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004.
- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan (developed by DPI-F) developed in consultation with relevant government agencies, such as the DPIE-W, DPIF and DPIE. The measures contained within these plans are likely to be
similar to those as those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of habitat for this species that would be affected by mitigative strategies.

Assessment of significance - Silver Perch (*Bidyanus bidyanus*) – Critically endangered species

**According to the DotE (2013) ‘significant impact criteria’ for endangered species, an action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:**

**Lead to a long-term decrease in the size of a population**

DPI Fisheries sampled fish communities as part of a short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- **Zone 1**: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- **Zone 2**: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir
- **Zone 3**: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- **Zone 4**: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

One Silver Perch was recorded during the sampling program and this was in the first round of sampling in Zone 2.

The proposal is unlikely to lead to a long term decrease in the size of the population of this species because although some habitat may be present in the upper reaches of Duck and Crooked Creek, and Macquarie River downstream of Warren Weir, habitat for this species becomes more limited further downstream due to the size and flow rate of this waterway. The proposal would benefit Silver Perch by retaining water in the section of the river where the species was recorded by DPI.

**Reduce the area of occupancy of the species**

As indicated above, the proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained in this section of the river and that refuge habitat is available for aquatic species, including threatened fish. Monitoring undertaken by DPI Fisheries (2016) recorded Silver Perch in the survey Zone 2 (Gin Gin to Warren). In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from 'poor' below Burrendong Dam to 'extremely poor' in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long term change in the area of occupancy of the species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain habitat for Silver Perch.

The Macquarie River has already ceased to flow downstream of the Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will affect the approximately
260 kilometre section of the river between Burrendong Dam and the Macquarie Marshes, including the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures. From a hydrological perspective, as part of a staged strategy the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures.
- Enable a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months.
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal will result in flow ceasing along about 80 kilometres of the Macquarie River downstream of the affected structures. If the proposal is not implemented, the 260 kilometre long section of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

In the absence of significant inflows, the hydrological, water quality and aquatic ecology impacts downstream of the affected structures are likely to occur regardless of whether the proposal is implemented or not.

Hydrological data reflects that the Macquarie River, Duck Creek and Crooked Creek have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

Based on the above considerations, the proposed action is unlikely to result or lead to the long term reduction in the area of occupancy of Silver Perch.

**Fragment an existing population into two or more populations**

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to result in additional fragmentation impacts compared to those that would occur in November 2019 under the do-nothing scenario. The proposal would maintain water in the section of the Macquarie River upstream of Warren where there is more favourable habitat for the Silver Perch and DPI recorded the species (DPI 2016). A Fish Monitoring Plan will be implemented by DPI Fisheries in key pools downstream of the affected structures and this will enable action to be taken should water levels or quality cause distress to fish species within the refuge.

**Adversely affect habitat critical to the survival of a species**

It is unlikely that the habitat affected is likely to be critical to the survival of the species.

As indicated above, the Macquarie River, Duck Creek and Crooked Creek have variable flows and in the absence of significant inflows these watercourses are predicted to cease to flow by November 2019, regardless of whether the proposal is implemented or not. As a result, the impact on habitat for Silver Perch downstream of the affected structures are likely to occur regardless of whether the proposal is implemented or not.

The proposal would retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This would prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for Silver Perch. This would enhance the likelihood of fish persisting in the system during the drought.

**Disrupt the breeding cycle of a population**

The proposed action has the potential to impact the breeding cycle of the species through the reduction in potential habitat downstream of the affected structures during the Spring and Summer breeding season (DPI 2017).

As indicated above, the Macquarie River, Duck Creek and Crooked Creek have variable flows and in the absence of significant inflows these watercourses are predicted to cease to flow by November 2019, regardless of whether the proposal is implemented or not. As a result, the impact on the breeding
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action will result in both upstream and downstream impacts to the extent and quality of habitat for this species, however the impacts downstream of the affected structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event downstream of Warren, but not whether this event occurs.

As described above, the Macquarie River has already ceased to flow downstream of the Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will affect the 260 kilometre long section of the river between Burrendong Dam and the Macquarie Marshes. It would result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures ceasing to flow.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. The proposal would prolong the duration that habitat for Silver Perch is available in the main channel of the Macquarie River upstream of Warren Weir which is the section of the river where Silver Perch were recorded by DPI during monitoring surveys.

The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Silver Perch to the extent that the species is like to decline. By retaining water in a section of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat

Through making conditions more favourable for introduced species, the proposed action may result in the further establishment of the invasive species, *Cyprinus carpio* (European Carp) and *Gambusia affinis* (Mosquitofish) due to reduced water quality within the downstream reaches and the loss of competitive native populations of the Silver Perch.

However, cease to flow (CTF) periods are a normal and important aspect of the flow regime. In many cases through the regulation of waterways these event have become rare. Cease to flow periods allow the development of a diversity of biofilms and aquatic plants, and periods of stress that promote resilience and can control the population of invasive species such as carp that are not as well adapted to the highly variable flow regime of Australia’s semi-arid rivers (Rolls et al. 2012; Stubbington et al. 2011; Dewson et al. 2007).

A Fish Monitoring Plans will be implemented by DPIF in key pools downstream of the affected structures and this will enable action to be taken should water levels or quality cause distress to fish species within the refuge.

Introduce disease that may cause the species to decline

The proposed action is unlikely to introduce disease that may cause the species to decline.

Interfere with the recovery of the species

The proposal would not interfere with the recovery of the species in the context of the current drought, the fact that the Macquarie River has already ceased to flow downstream of Warren in the southern extent of the Macquarie Marshes, and that the approximately 260 kilometre long section of the Macquarie River between Burrendong Dam and the Macquarie Marshes is predicted to cease to flow in November 2019 if the proposal is not implemented and there are no inflows.

The aim of the proposed action is to retain water within the Macquarie River channel upstream of Warren Weir which is the section of the river where DPI Fisheries recorded this species in 2016. The proposal would delay a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This would conserve refuge habitat for the Silver Perch and enhance the ability of the species to persist during the current drought conditions and recover in the event that sufficient flows return to the system to enable the temporary works to be decommissioned. There would be a lag in population recovery downstream of the affected structures once flows return.

Conclusion

The impact of the proposed action on Silver Perch is unlikely to be significant because:
- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck and Crooked Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.
- The proposal will enable stages 2 and 3 of the temporary works for the drought response strategy described in Section 3 of the Review of Environmental Factors to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and the Macquarie Marshes from November 2019 to October 2020 if there are no inflows. The main channel of the Macquarie River upstream of Warren provides important refuge habitat for biota, including Silver Perch. By deferring the cease to flow event in this section of the Macquarie River, the proposal will extend the duration that refuge habit is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.
- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these case to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.
- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of the Minister’s conditions to install the regulators. Prior to 2004, the weir and regulators presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. During tributary flows or a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004. Gunningbar Creek would retain flows through the fishway to deliver water to a critical water user. The fishway would be open during the warmer months but would be closed during the cooler months.
- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan (prepared by DPIF) developed in consultation with relevant government agencies, such as the DPI-W, DPIF and the DPIE. The measures contained within these plans are likely to be similar to those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow between Burrendong Dam and the Macquarie Marshes in November 2019. Compared to the do-nothing scenario, the proposal will reduce the overall length of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of habitat for this species that would be affected by mitigative strategies.

Assessment of significance – Trout Cod (Maccullochella macquariensis) Endangered species

According to the DotE (2013) ‘significant impact criteria’ for endangered species, an action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:
Assessment of significance – Trout Cod (*Maccullochella macquariensis*) Endangered species

**Lead to a long-term decrease in the size of a population**

This species has suffered catastrophic decline in both range and abundance, with only one natural population remaining. Historic Trout Cod records are present within the Lower Macquarie River and stocked population are present near Dubbo and a further population is maintained above Burrendong dam.

DPI Fisheries sampled fish communities as part of a short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- Zone 1: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- Zone 2: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir.
- Zone 3: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- Zone 4: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

DPI Fisheries recorded one Trout Cod during the monitoring program and this was in Zone 1. The proposal would benefit Trout Cod by delaying a cease to flow event between Burrendong Dam and Warren which is the section of the river where this species was recorded by DPI in 2016. This would provide habitat so the species can persist at its recently recorded location until flows return.

**Reduce the area of occupancy of the species**

As indicated above, the proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for aquatic species, including threatened fish. Monitoring undertaken by DPI Fisheries (2016) recorded the Trout Cod in Zone 1. In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long term change in the area of occupancy of the species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain habitat for the Trout Cod.

The Macquarie River has already ceased to flow downstream of Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow in November 2019 if the proposal is not implemented in August 2019 and this will affect the 260 kilometre long section of the river between Burrendong Dam and the Macquarie Marshes. It will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures ceasing to flow. From a hydrological perspective, as part of a staged program the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures
- Enable a cease to flow event in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal would result in a cease to flow event along about 80
Assessment of significance – Trout Cod (*Maccullochella macquariensis*) Endangered species

kilometres of the Macquarie River downstream of Warren. If the proposal is not implemented, the 260 kilometre section of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

In the absence of significant inflows, the hydrological, water quality and aquatic ecology impacts downstream of the affected structures are likely to occur regardless of whether the proposal is implemented or not.

Hydrological data reflects that the Macquarie River, Duck Creek and Crooked Creek have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal is unlikely to lead to the long term reduction in the area of occupancy of the Trout Cod as it would maintain water in and delay a cease to flow event in the section of the Macquarie River between Burrendong Dam and Warren where DPI Fisheries recorded this species. This would assist to maintain the presence of the species in the river system so it can recolonise following a return to higher flow conditions.

**Fragment an existing population into two or more populations**

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to result in additional fragmentation impacts compared to those that would occur in November 2019 under the do-nothing scenario. The proposal would maintain water in the main channel of the Macquarie River between Burrendong Dam and Warren where there is more favourable habitat for the Trout Cod, DPI recorded the species (DPI 2016), and there is a known stocked population near Dubbo. A fish monitoring plan would be implemented to minimise potential impacts.

**Adversely affect habitat critical to the survival of a species**

It is unlikely that the habitat affected is likely to be critical to the survival of the species.

As indicated above, the Macquarie River, Duck Creek and Crooked Creek have variable flows and in the absence of significant inflows these watercourses are predicted to cease to flow by November 2019, regardless of whether the proposal is implemented or not. As a result, the impact on habitat for Trout Cod downstream of the affected structures is likely to occur regardless of whether the proposal is implemented or not.

The proposal would retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren. This would prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for the Trout Cod, including in the section of the river near Dubbo where there is a stocked population. This would enhance the likelihood of fish persisting in the system during the drought.

**Disrupt the breeding cycle of a population**

The proposed action has the potential to impact the breeding cycle of the species through the reduction in potential downstream habitat during the Spring and Summer breeding season (DPI 2017). Trout Cod breeding is sensitive to temperature and the proposal may impact thermal regulation within remnant pools.

As indicated above, the Macquarie River, Duck Creek and Crooked Creek have variable flows and in the absence of significant inflows these watercourses are predicted to cease to flow by November 2019, regardless of whether the proposal is implemented or not. As a result, the impact on the breeding cycle for Trout Cod downstream of the affected structures is likely to occur regardless of whether the proposal is implemented or not. The proposal would delay a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren where there is more favourable habitat for the Trout Cod, DPI recorded species ((DPI 2016) and in the section of the river near Dubbo that contains a stocked population of Trout Cod.

**Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
The proposed action will result in both upstream and downstream impacts to the extent and quality of habitat for this species, however the downstream impacts would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event downstream of Warren, but not whether this event occurs.

As described above, the Macquarie River has already ceased to flow downstream of the Macquarie Marshes and it is not currently hydraulically connected to the Bogan River. The Macquarie River will cease to flow along the approximately 260 kilometre long section between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. The proposal would prolong the duration that habitat for Trout Cod is available in the main channel of the Macquarie River upstream of Warren Weir which includes a stocked population near Dubbo.

The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Trout Cod to the extent that the species is like to decline. By retaining water in a section of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought.

**Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat**

Through making conditions more favourable for introduced species, the proposed action may result in the further establishment of the invasive species, *Cyprinus carpio* (European Carp) and *Gambusia affinis* (Mosquitofish) due to reduced water quality within the downstream reaches and the loss of competitive native populations of the Trout Cod.

Cease to flow (CTF) periods are a normal and important aspect of the flow regime. In many cases through the regulation of waterways these event have become rare. Cease to flow periods allow the development of a diversity of biofilms and aquatic plants, and periods of stress that promote resilience and can control the population of invasive species such as carp that are not as well adapted to the highly variable flow regime of Australia's semi-arid rivers (Rolls et al. 2012; Stubbington et al. 2011; Dewson et al. 2007).

A Fish Monitoring Plan will be implemented in key pools downstream of the affected structures and this will enable action to be taken should water quality or availability cause stress to fish.

**Introduce disease that may cause the species to decline**

The proposed action is unlikely to introduce disease that may cause the species to decline.

**Interfere with the recovery of the species**

The proposal would not interfere with the recovery of the species in the context of the current drought, the fact that the Macquarie River has already ceased to flow downstream of Warren in the southern Macquarie Marshes, and that the approximately 260 kilometre long section of the Macquarie River downstream of Burrendong Dam is predicted to cease to flow in November 2019 if the proposal is not implemented and there are no inflows.

The aim of the proposed action is to retain water within the Macquarie River channel upstream of Warren Weir and delay a cease to flow event in the 180 kilometre long section of the river between Burrendong Dam and Warren. This would conserve refuge habitat for the Trout Cod which includes a stocked population near Dubbo and enhance the ability of the species to persist during the current drought conditions and recover in the event that sufficient flows return to the system to enable the temporary works to be decommissioned.

**Conclusion**

The impact of the proposed action on the Trout Cod is unlikely to be significant because:

- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing
the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.

- The proposal will enable stages 2 and 3 of the drought response strategy described in Section 3 of the Review of Environmental Factors to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and Warren from November 2019 to October 2020 if there are no inflows. The main channel of the Macquarie River provides important refuge habitat for biota, including Trout Cod. By deferring the cease to flow event in the Macquarie River upstream of Warren, the proposal will extend the duration that refuge habit is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.

- The proposal would defer a cease to flow event in the main channel of the Macquarie River upstream of Warren. This would benefit the stocked population of Trout Cod that is known to exist near Dubbo.

- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these case to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.

- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of the Minister’s conditions for installation of the regulators. Prior to 2004, the weir and regulators presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. During tributary flows or a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004. Gunningbar Creek would retain flows through the fishway to deliver water to a critical water user. The fishway would be open during the warmer months but would be closed during the cooler months.

- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed in consultation with relevant government agencies, such as the DPI-W, DPIF and the DPIE. The measures contained within these plans are likely to be similar to those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of habitat for the Trout Cod that would be affected by mitigative strategies.
Assessment of significance – Trout Cod (*Maccullochella macquariensis*) Endangered species

Trout Cod (*Maccullochella macquariensis*) is a moderately large predatory freshwater fish endemic to the Murray-Darling River system (DSE 2008). The Trout Cod is listed as an endangered species under both NSW and Commonwealth legislation. This species has suffered catastrophic decline in both range and abundance, with only one natural population remaining (DSE 2008). Historic Trout Cod records are present within the Lower Macquarie with populations supported by breeding programs near Dubbo and above Burrendong Dam.

**a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The proposal would cease flows to the Macquarie River, Duck Creek, Crooked Creek and Gunningbar downstream of the affected structures and this has the potential to impact on habitat for the Trout Cod.

The proposal would be undertaken in a severe drought. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

The Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the years 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

From a hydrological perspective, as part of a staged program the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures
- Enable a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal would result in flow ceasing along about 80 kilometres of the Macquarie River downstream of Warren. If the proposal is not implemented, the 260 kilometre long section of the Macquarie River between Burrendong Dam and the Macquarie Marshes will cease to flow during November 2019.

The proposal would prolong the duration that habitat for Trout Cod is available in the main channel of the Macquarie River upstream of Warren Weir which includes a stocked population near Dubbo. By retaining water in a section of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought. This would assist to maintain the presence of the species in the river system so it can recolonise following a return to higher flow conditions.
Assessment of significance – Trout Cod (*Maccullochella macquariensis*) Endangered species

DPI Fisheries sampled fish communities as part of a short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- **Zone 1**: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- **Zone 2**: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir.
- **Zone 3**: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- **Zone 4**: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

DPI Fisheries recorded one Trout Cod in the survey program and this was in Zone 1. The proposal would benefit Trout Cod by delaying a cease to flow event between Burrendong Dam and Warren which includes habitat for the stocked population near Dubbo and is the section of the river where this species were recorded by DPI in 2016.

**b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

**(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

**i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed**

Not applicable.

**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable

**d) in relation to the habitat of a threatened species, population or ecological community:**

**(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

As indicated above, the proposal would impact on waterways with variable flows and any habitat for Trout Cod downstream of the affected structures would have experienced similar impacts during previous no-flow events and that would occur in November 2019 under the do-nothing scenario.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren which includes a stocked population of Trout Cod near Dubbo. This will prolong the duration that flow is maintained in this section of the river and that refuge habitat is provided for aquatic species, including Trout Cod. Monitoring undertaken by DPI Fisheries (2016) recorded the Trout Cod in Zone 1. In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long term change in the availability of habitat for this species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be replenished maintaining aquatic habitat.

**ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to result in additional fragmentation impacts compared to those that would occur in November 2019 under the do-nothing scenario. The proposal would maintain water in the main channel of the Macquarie River between Burrendong Dam and Warren where there is more favourable habitat for the Trout Cod, DPI recorded
### Assessment of significance – Trout Cod (*Maccullochella macquariensis*) Endangered species

The proposal is unlikely to remove, fragment or isolate habitat in the long-term for this species. As indicated above, the proposal is temporary and will not result in a long term change in the availability of habitat for species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain aquatic habitat.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren which includes a stocked population of Trout Cod near Dubbo. This will prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for aquatic species, including Trout Cod.

#### (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The proposed action is not likely to have an adverse effect on critical habitat (either directly or indirectly).

#### (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The cessation of flows downstream of the affected structures is not consistent with the objectives of the Trout Cod recovery plan (DSE 2008) as it is commensurate with a key threatening process. However, as indicated above, the proposal would impact on waterways that have variable flows and any habitat for Trout Cod downstream of the affected structures would have experienced similar impacts during previous no-flow events and that would during November 2019 under the do-nothing scenario.

#### (g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The proposed action constitutes as part of the key threatening process, “Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.” The proposed action is unlikely cause a significant increase in the impact of this key threatening process because it would be undertaken in a severe drought and the Water Sharing Plan has been suspended such that there will be no environmental water deliveries in the 2019/2020 water year. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

As indicated above, the Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.

### Conclusion

The impact of the proposed action on the Trout Cod is unlikely to be significant because:

- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar...
Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing 
the proposal in August 2019 will bring forward the date that the cease to flow event occurs 
downstream of these structures by about two months.

- The proposal will enable stages 2 and 3 of the drought response strategy described in Section 
3 of the Review of Environmental Factors to be implemented and the combined effect of the 
three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong 
Dam and the Macquarie Marshes from November 2019 to October 2020 if there are no 
inflows. The 180 kilometre long section of the Macquarie River between Burrendong Dam and 
Warren provides important refuge habitat for biota, including Trout Cod. By deferring the 
 cease to flow event in this section of the Macquarie River, the proposal will extend the 
duration that refuge habit is provided in the system. It will also enable water to continue to be 
delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for 
threatened biota. The proposal will reduce the overall area of the Macquarie River system that 
is affected by a cease to flow event compared to the do-nothing option.

- The proposal would defer a cease to flow event in the main channel of the Macquarie River 
between Burrendong Dam and Warren. This would benefit the stocked population of Trout 
Cod that is known to exist near Dubbo.

- Historical gauging records indicate that the affected waterways have variable flows and have 
all experienced very low flow or cease to flow events downstream of the regulating structures. 
It is likely that these case to flow events would have resulted in hydrological, water quality and 
ecological impacts downstream of the affected structures similar to that which is likely to result 
from the proposal.

- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, 
and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of 
the Minister’s conditions to for installation of the regulators. Prior to 2004, the weir and 
regulators presented a barrier to fish passage that impeded fish movement. The proposal will 
temporarily reinstate barriers to fish passage at the same location that barriers were present 
before 2004. During tributary flows or a return to higher flow conditions, the fishways will be 
reopened to reinstate fish passage. This will provide the opportunity for fish to move past 
these structures and recolonise downstream areas in a similar manner to that which would 
have occurred following low flow periods that occurred before the fishways were installed in 
2004.

- All reasonable and feasible management measures will be implemented to minimise potential 
impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed 
in consultation with relevant government agencies, such as the DPI-W, DPIF and DPIE. The 
measures contained within these plans are likely to be similar to those that would be 
implemented if the proposal is not implemented and the NSW government needs to take 
action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the 
do-nothing scenario, the proposal will result in a 180 kilometre reduction in the overall length 
of the Macquarie River system that is affected by a cease to flow event, thereby reducing the 
area of habitat for this species that would be affected by mitigative strategies.
Assessment of significance – Silver Perch (*Bidyanus bidyanus*) Vulnerable species

Silver Perch (*Bidyanus bidyanus*) are endemic to the Murray-Darling River system (TSSC 2013). Silver Perch are listed as Critically Endangered under the EPBC Act and as Vulnerable under the FM Act. Silver Perch are found in a wide range of habitats and climates across the Murray-Darling Basin. They are generally found in faster-flowing water including rapids and races and more open sections of river. Individuals sometimes form large shoals in open water.

The proposal would cease flows to the Macquarie River, Duck Creek, Crooked Creek and Gunningbar downstream of the affected structures and this has the potential to impact on habitat for Silver Perch, although this species is generally found in faster flowing water including rapids, races and more open sections of river. These environments are more prevalent upstream of the affected structures compared to the slow moving watercourse that typify the downstream sections, including the Macquarie Marshes.

The proposal would be undertaken in a severe drought. The Macquarie River ceased to flow downstream of Warren in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

The Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

From a hydrological perspective, as part of a staged program the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures
- Enable a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal will result in flow ceasing in about 80 kilometres of the Macquarie River downstream of Warren. If the proposal is not implemented, the approximately 260 kilometre long section of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

The proposal would prolong the duration that habitat for Silver Perch is available in the main channel of the Macquarie River upstream of Warren Weir. By retaining water in a section of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought. This would assist to maintain the presence of the species in the river system so it can recolonise following a return to higher flow conditions.

DPI Fisheries sampled fish communities as part of a short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:
Assessment of significance – Silver Perch (*Bidyanus bidyanus*) Vulnerable species

- Zone 1: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- Zone 2: Macquarie River Gin Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir.
- Zone 3: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- Zone 4: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

DPI Fisheries recorded one Silver Perch in the survey program and this was in Zone 2. The proposal would benefit Silver Perch by delaying a cease to flow event between Burrendong Dam and Warren which is the section of the river where this species was recorded by DPI in 2016.

**b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

**c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

**i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

**ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

**d) in relation to the habitat of a threatened species, population or ecological community:**

**(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

As indicated above, the proposal would impact on waterways that have variable flows and any habitat for Silver Perch downstream of the affected structures would have experienced similar impacts during previous no-flow events.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained upstream of Warren and that refuge habitat is provided for aquatic species, including Silver Perch. Monitoring undertaken by DPI Fisheries (2016) indicates that Silver Perch was recorded in Zone 2. In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long term change in the availability of habitat for species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain aquatic habitat.

**(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to result in additional fragmentation impacts compared to those that would occur in November 2019 under the do-nothing scenario. The proposal would maintain water in the section of the Macquarie River between Burrendong Dam and Warren where there is more favourable habitat for the Silver Perch and DPI recorded the species (DPI 2016).

**(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The proposal is unlikely to remove, fragment or isolate habitat in the long-term for this species. As indicated above, the proposal is temporary and will not result in a long term change in the availability of habitat for species. The action will only be in place until there are significant flows in the catchment.
Assessment of significance – Silver Perch (*Bidyanus bidyanus*) Vulnerable species

and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain aquatic habitat.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained in the main channel and that refuge habitat is provided for aquatic species, including Silver Perch.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The proposed action is not likely to have an adverse effect on critical habitat (either directly or indirectly)

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A recovery plan has not been developed for the Silver Perch.

The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The proposed action constitutes the key threatening process, "Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams." The proposed action is unlikely cause a significant increase in the impact of this key threatening process because it would be undertaken in a severe drought and the Water Sharing Plan has been suspended such that there is no allocation for environmental water deliveries. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also cease to flow and is not connected to Marra Creek at its downstream end.

As indicated above, the Macquarie River will cease to flow between Burrendong Dam and Warren in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.

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- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.

- The proposal will enable stages 2 and 3 of the drought response strategy described in Section 3 of the Review of Environmental Factors to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and Warren from November 2019 to October 2020 if there are no inflows. This section of the Macquarie River provides important refuge habitat for biota, including Silver Perch. By |
### Assessment of significance – Silver Perch (Bidyanus bidyanus) Vulnerable species

deferring the cease to flow event in the Macquarie River, the proposal will extend the duration that refuge habit is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.

- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these case to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.
- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of the Minister’s conditions for installation of the regulators. Prior to 2004, the weir and regulators presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. During tributary flows or a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004.
- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed in consultation with relevant government agencies, such as the DPIE-W, DPIF and the DPIE. The measures contained within these plans are likely to be the same as those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of habitat for this species that would be affected by mitigative strategies.

### Assessment of significance – Eel Tailed Catfish (Tandanus tandanus)) Endangered population

The Eel Tailed Catfish (Tandanus tandanus) is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 km range (DPI 2015). The western population was once highly abundant and widespread throughout the Murray Darling River System in NSW, however, in NSW most riverine populations have declined significantly since the 1970s, and the species is no longer common in many areas where it was formally abundant DPI 2015). Eel Tailed Catfish are listed as an Endangered Population under FM Act.

#### a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

#### b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

The proposal would cease flows to the Macquarie River, Duck Creek, Crooked Creek and Gunningbar Creek downstream of the affected structures and this has the potential to impact on habitat for the Eel Tailed Catfish.

The proposal would be undertaken in a severe drought. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically...
connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

The Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

From a hydrological perspective, as part of a staged program the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures.
- Enable a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months.
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal would result in flow ceasing along about 80 kilometres of the Macquarie River downstream of Warren. If the proposal is not implemented, approximately 260 kilometres of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

The proposal would prolong the duration that habitat for Eel Tailed Catfish is available in the main channel of the Macquarie River upstream of Warren Weir and within the Marebone weir pool downstream of Warren Weir. By retaining water in sections of the Macquarie River that provides refuge habitat, the proposal is likely to assist the species to persist during the current severe drought. This would assist to maintain the presence of the species in the river system so it can recolonise and disperse following a return to higher flow conditions.

DPI Fisheries sampled fish communities as part of a short-term intervention monitoring of a fish community response to an environmental flow in the mid and lower Macquarie River: 2014/15 water year (DPI, 2016). This involved sampling in four spatially, geomorphologically and hydrologically different zones at a landscape scale:

- Zone 1: Macquarie River Burrendong Dam to Dubbo – about a 100 kilometre long stretch of river.
- Zone 2: Macquarie River Gin to Warren – about a 100 kilometre long stretch of river upstream of the Macquarie Marshes. The majority of Zone 2 is upstream of the Warren Weir and is included sampling between the Warren Weir and Gin Gin Weir.
- Zone 3: Macquarie Marshes. The majority of this zone is downstream of the Marebone regulator.
- Zone 4: Lower Macquarie River (below the Macquarie Marshes). This is about a 100 kilometre long stretch of the river between Bells Bridge and the Barwon River confluence. Sampling was not undertaken at some site in Zone 4 during two of the three sampling events because the river was dry.

DPI Fisheries recorded Eel Tailed Catfish in patchy, low abundances. A total of 27 Eel Tailed Catfish were recorded, of which 24 were in Zone 1 and three in Zone 2. None were recorded in Zones 3 or 4 which are the two zones that would be affected by a cease to flow event associated with the proposal.
Assessment of significance – Eel Tailed Catfish (Tandanus tandanus) Endangered population

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

1. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed

Not applicable.

2. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

As indicated above, the proposal would impact on waterways that have variable flows and any habitat for Eel Tailed Catfish downstream of the affected structures would have experienced similar impacts during previous no-flow events.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained upstream of Warren and that refuge habitat is provided for aquatic species, including Eel Tailed Catfish. Monitoring undertaken by DPI Fisheries (2016) recorded the Eel Tailed Catfish in Zones 1 and 2. In general, this study concluded that native fish species richness was significantly lower within, and downstream of, the Macquarie Marshes compared with sites sampled upstream. The overall condition of the fish community within the Macquarie River declined along a downstream gradient from ‘poor’ below Burrendong Dam to ‘extremely poor’ in the Macquarie Marshes and downstream to the Barwon River confluence.

As the proposed action is temporary, it will not result in a long-term change in the availability of habitat for species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain aquatic habitat.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The Macquarie River, Duck Creek and Crooked Creek have variable flows and temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to change the effects of fragmentation that would occur in November 2019 if the proposal is not implemented. The proposal would maintain water in the main channel of the Macquarie River upstream of Warren which is where DPI recorded the species (DPI 2016). DPI did not record this species in Zones 3 or 4 which cover the section of the Macquarie River from Marebone to the confluence with the Barwon River.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The proposal is unlikely to remove, fragment or isolate habitat in the long term for this species. As indicated above, the proposal is temporary and will not result in a long term change in the availability of habitat for species. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways in accordance with an adaptive management framework. Depending on the frequency and volume of tributary flows, this may enable refuge pools to be topped up to maintain aquatic habitat.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained upstream of Warren and that refuge habitat is provided for aquatic species, including Eel Tailed Catfish.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The proposed action is not likely to have an adverse effect on critical habitat (either directly or indirectly). The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A recovery plan has not been developed for the Eel Tailed Catfish. The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.
Assessment of significance – Eel Tailed Catfish (Tandanus tandanus) Endangered population

**g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

The proposed action constitutes as part of the key threatening process, "Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams." The proposed action is unlikely cause a significant increase in the impact of this key threatening process because it would be undertaken in a severe drought and the Water Sharing Plan has been suspended such that there is no allocation for environmental water deliveries. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

As indicated above, the Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this species downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or quality of habitat downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the year 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal would maintain refuge habitat for this species in the Macquarie River to assist it to persist during the drought and allow for recovery once higher flows return.

**Conclusion**

The impact of the proposed action on the endangered population of Eel Tailed Catfish is unlikely to be significant because:

- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.

- The proposal will enable stages 2 and 3 of the drought response strategy described in Section 3 of the Review of Environmental Factors to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and Warren from November 2019 to October 2020 if there are no inflows. This section of the Macquarie River provides important refuge habitat for biota, including the Eel Tailed Catfish. By deferring the cease to flow event in the Macquarie River between Burrendong Dam and Warren, the proposal will extend the duration that refuge habitat is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.

- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these case to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.

- The Macquarie River has been regulated at Warren since 1896 and fishways at Warren Weir, and the Duck, Crooked, and Gunningbar Creek regulators were constructed in 2004 as part of the Minister's conditions for installation of the regulator. Prior to 2004, the weir and regulators
Assessment of significance – Eel Tailed Catfish (*Tandanus tandanus*) Endangered population

presented a barrier to fish passage that impeded fish movement. The proposal will temporarily reinstate barriers to fish passage at the same location that barriers were present before 2004. During tributary flows or a return to higher flow conditions, the fishways will be reopened to reinstate fish passage. This will provide the opportunity for fish to move past these structures and recolonise downstream areas in a similar manner to that which would have occurred following low flow periods that occurred before the fishways were installed in 2004.

- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed in consultation with relevant government agencies, such as the DPIE-W, DPIF and DPIE. The measures contained within these plans are likely to be the same as those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of habitat for this species that would be affected by mitigative strategies.

Assessment of significance – The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (Darling River EEC)

The Darling River EEC includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within the State of New South Wales, and including Menindee Lakes and the Barwon River. It includes the Macquarie River downstream of Burrendong Dam.

The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River has been greatly modified since European settlement, through activities such as river regulation, the introduction of non-native species, agricultural practices and over-fishing. Many aquatic habitats are now degraded, and many native species have experienced declines in their numbers and distribution - some to the point where they are now listed as threatened.

This ecological community is listed as an endangered ecological community in NSW under the FM Act, meaning that it is likely to become extinct in nature in this state, unless the circumstances and factors threatening its survival and evolutionary development cease to operate.

**a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

**b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable

**c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The proposal is unlikely to have an adverse effect on the Darling River EEC to the degree that its local extent is likely to be placed at risk of extinction. The proposal would be undertaken in a severe drought. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also ceased to flow and is not connected to Marra Creek at its downstream end.

The Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on the Darling River EEC downstream of these structures would occur.
Assessment of significance – The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (Darling River EEC)

regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability of water downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the years 2008 to 2010 millennium drought. The effect of these no-flow events on the Darling River EEC are likely to be similar to those that would be experienced during the proposal. The Darling River EEC would continue to be present downstream of the affected structures.

From a hydrological perspective, as part of a staged program the proposal will:

- Bring forward by two months the cease to flow on watercourses that would be affected by cease to flow events under the do-nothing scenario. It would result in the cease to flow point moving upstream to be immediately downstream of the affected structures
- Enable a cease to flow event in the approximately 180 kilometre long section of the Macquarie River between Burrendong Dam and Warren to be delayed by about 11 months
- Minimise the extent of the Macquarie River that is affected by a cease to flow event by restricting the cease to flow event to the sections of the watercourses that are downstream of the affected structures. The proposal will result in flow ceasing along about 80 kilometres of the Macquarie River downstream of Warren. If the proposal is not implemented, the approximately 260 kilometre long section of the Macquarie River downstream of Burrendong Dam will cease to flow during November 2019.

The proposal would prolong the duration that surface water is available in the main channel of the Macquarie River upstream of Warren Weir and within the Marebone weir pool downstream of Warren Weir. By retaining water in sections of the Macquarie River, the proposal is likely to assist to maintain the condition of this section of the Darling River EEC during the current severe drought.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The proposal is unlikely to modify the composition of the Darling River EEC to the extent that its local occurrence is likely to be placed at risk of extinction. The proposal would be undertaken in a severe drought. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also cease to flow and is not connected to Marra Creek at its downstream end. These cease to flow events are already affecting the Darling River EEC.

The Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on the Darling River EEC downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability of water downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It is likely that no flow events would have been experienced in previous years, such as during the years 2008 to 2010 millennium drought. The effect of these no-flow events on the Darling River EEC are likely to be similar to those that would be experienced during the proposal. The Darling River EEC would continue to be present downstream of the affected structures.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

As indicated above, the proposal would impact on waterways that have variable flows that are within the Darling River EEC that would have experienced similar impacts during current and previous no-flow events.
Assessment of significance – The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (Darling River EEC)

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren. This will prolong the duration that flow is maintained to the Darling River EEC upstream of Warren.

As the proposed action is temporary, it will not result in a long-term change in the availability of habitat for the Darling River EEC. The action will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream waterways that are part of the Darling River EEC in accordance with an adaptive management framework.

**ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

The Macquarie River, Duck Creek and Crooked Creek have variable flows and are part of the Darling River EEC. Temporary habitat fragmentation occurs naturally in the system. The proposal is unlikely to change the effects of fragmentation that would occur in November 2019 if the proposal is not implemented, or the effects of fragmentation that are currently occurring due to flow ceasing in December 2018 in the Macquarie River downstream of the Macquarie Marshes.

**(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The proposal is unlikely to remove, fragment or isolate the Darling River EEC in the long term. As indicated above, the proposal is temporary and will only be in place until there are significant flows in the catchment and the drought declaration is lifted. The proposal will enable tributary flows downstream of Burrendong Dam to be delivered to downstream sections of the Darling River EEC in accordance with an adaptive management framework.

The proposal will retain water in the main channel of the Macquarie River upstream of the Warren Weir and delay a cease to flow event occurring in the main channel of the Macquarie River between Burrendong Dam and Warren which is part of the Darling River EEC. This will prolong the duration that flow is maintained in this section of the river and that refuge habitat for aquatic biota is provided within this section of the Darling River EEC.

**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The proposed action is not likely to have an adverse effect on critical habitat (either directly or indirectly) as areas downstream of the affected structures are already affected by cease to flow events and would continue to be affected should the Macquarie River cease to flow downstream of Burrendong Dam in November 2019 under the do-nothing scenario.

**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

The proposal will temporarily cease flows along waterways, however there is unlikely to be a significant impact due to the temporary nature and natural fragmentation that occurs during low-zero flow events. The proposal would increase the area of drought refuge habitat for aquatic biota that persists in the system relative to the do-nothing scenario.

**(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

The proposed action constitutes a part of the key threatening process, “Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.” The proposed action is unlikely to cause a significant increase in the impact of this key threatening process because it would be undertaken in a severe drought and the Water Sharing Plan has been suspended such that there is no allocation for environmental water deliveries. The Macquarie River ceased to flow downstream of the Macquarie Marshes in December 2018 and it is not currently hydraulically connected to the Bogan River. Crooked Creek has also cease to flow and is not connected to Marra Creek at its downstream end.

As indicated above, the Macquarie River will cease to flow between Burrendong Dam and the Macquarie Marshes in November 2019 if the proposal is not implemented in August 2019 and this will result in the sections of Macquarie River, Duck and Crooked Creek downstream of the affected structures also ceasing to flow. As a result, the impacts on this community downstream of these structures would occur regardless of whether the proposal is implemented. The proposal would change the time of a cease to flow event occurring at the affected structures, but not whether this event occurs.

Although the proposal would temporarily reduce the availability or water to the Darling River EEC downstream of the affected structures, hydrological data reflects that the affected watercourses have variable flows and have experienced very low or no flows, including for periods that exceed 90 days. It
Assessment of significance – The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (Darling River EEC)

is likely that no flow events would have been experienced in previous years, such as during the years 2008 to 2010 millennium drought. The effect of these no-flow events are likely to be similar to those that would be experienced during the proposal.

The proposal would maintain water to the Darling River EEC between Burrendong Dam and Warren to enable it to persist during the drought and allow for recovery once higher flows return.

Conclusion

The impact of the proposed action on the Darling River EEC is unlikely to be significant because:

- The proposal will not result in an impact that is otherwise not predicted to occur in the short term. The Macquarie River, including effluent creeks such as Duck, Crooked and Gunningbar Creeks, will cease to flow in November 2019 if the proposal is not implemented. Implementing the proposal in August 2019 will bring forward the date that the cease to flow event occurs downstream of these structures by about two months.

- The proposal will enable stages 2 and 3 of the drought response strategy described in Section 3 of the Review of Environmental Factors to be implemented and the combined effect of the three stages is predicted to delay the Macquarie River ceasing to flow between Burrendong Dam and Warren from November 2019 to October 2020 if there are no inflows. By deferring the cease to flow event in the Macquarie River between Burrendong Dam and Warren, the proposal will extend the duration that refuge habitat is provided in the system. It will also enable water to continue to be delivered to the Nyngan upper weir pool on the Bogan River which provides habitat for threatened biota. The proposal will reduce the overall area of the Macquarie River system that is affected by a cease to flow event compared to the do-nothing option.

- Historical gauging records indicate that the affected waterways have variable flows and have all experienced very low flow or cease to flow events downstream of the regulating structures. It is likely that these cease to flow events would have resulted in hydrological and ecological impacts downstream of the affected structures similar to that which is likely to result from the proposal.

- All reasonable and feasible management measures will be implemented to minimise potential impacts. This will include a Water Quality Monitoring Plan and Fish Monitoring Plan developed in consultation with relevant government agencies, such as the DPIE-W, DPIF and DPIE. The measures contained within these plans are likely to be the same as those that would be implemented if the proposal is not implemented and the NSW government needs to take action to respond to the Macquarie River ceasing to flow in November 2019. Compared to the do-nothing scenario, the proposal will result in a 180 kilometre reduction in the overall length of the Macquarie River system that is affected by a cease to flow event, thereby reducing the area of the Darling River EEC that would be affected by mitigative strategies.
Appendix G – Water Sharing Plan Suspension Order
The New South Wales Government Gazette is the permanent public record of official NSW Government notices. It also contains local council, private and other notices.

From 1 January 2019, each notice in the Government Gazette has a unique identifier that appears in round brackets at the end of the notice and that can be used as a reference for that notice (for example, (n2019-14)).

The Gazette is compiled by the Parliamentary Counsel’s Office and published on the NSW legislation website (www.legislation.nsw.gov.au) under the authority of the NSW Government. The website contains a permanent archive of past Gazettes.

To submit a notice for gazettel – see Gazette Information.
Water Sharing Plan Part Suspension (Belubula Regulated River) Order 2019

under the

Water Management Act 2000

I, Melinda Pavey, Minister for Water, Property and Housing, in pursuance of section 49B of the Water Management Act 2000, and being satisfied that there is an extreme event in relation to the Belubula Regulated River Water Source, make the following Order.

Dated 3 July 2019

Melinda Pavey
Minister for Water, Property and Housing

Explanatory note

This Order suspends part of the operation of the Water Sharing Plan for the Belubula Regulated River Water Source 2012 with respect to end of system flow requirements due to an extreme dry period. The Order is made under section 49B of the Water Management Act 2000. The concurrence of the Minister for Energy and Environment was obtained before the making of this Order. This Order expires on 30 June 2020 unless sooner revoked.
Water Sharing Plan Part Suspension (Belubula Regulated River) Order 2019

under the

Water Management Act 2000

1 Name of Order

This Order is the Water Sharing Plan Part Suspension (Belubula Regulated River) Order 2019.

2 Commencement

This Order commences the day on which it is published in the Gazette.

Note. This order expires at the end of 30 June 2020 unless sooner revoked in accordance with section 49B (4) of the Water Management Act 2000.

4 Suspension

The operation of clause 26 of the Water Sharing Plan for the Belubula Regulated River Water Source 2012 is suspended.
Water Sharing Plan Part Suspension (Macquarie Regulated River) Order 2019

under the

Water Management Act 2000

I, Melinda Pavey, Minister for Water, Property and Housing, in pursuance of section 49B of the Water Management Act 2000, and being satisfied that there is an extreme event in relation to the Macquarie Regulated River, make the following Order.

Dated 3 July 2019

Melinda Pavey
Minister for Water, Property and Housing

Explanatory note

This Order suspends part of the operation of the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016 with respect to planned environmental releases, available water determinations and water allocation account management in relation to the Macquarie Regulated River due to an extreme dry period. The Order is made under section 49B of the Water Management Act 2000. The concurrence of the Minister for Energy and Environment was obtained before the making of this Order. This Order expires on 30 June 2020 unless sooner revoked.
Appendix H - Aboriginal Heritage Information Management System (AHIMS)
RESULTS OF THE AHIMS SEARCH HAVE BEEN REMOVED AS A CONDITION OF AHIMS DATABASE USE
If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazetal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazetal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.
RESULTS OF THE AHIMS SEARCH HAVE BEEN REMOVED AS A CONDITION OF AHIMS DATABASE USE
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- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.
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