TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

ARTC

INLAND RAIL – ALBURY TO ILLABO

Technical Paper 9—Aquatic Biodiversity Impact Assessment

Job No: 210323

Date: 21/06/2022

2-0008-210-EAP-00-RP-0016

COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

PO Box 3005 Wamberal NSW 2260

T: 0404 858573 E: kristy@coastecology.com.au W: www.coastecology.com.au

Kristy McQueen operates as a Sole Trader under registered business name Coast Ecology ABN: 24 924 674 371

Executive Summary

The proposal

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland. Inland Rail is a major national program that would enhance Australia's existing national rail network and serve the interstate freight market.

The proposal involves enhancement works to structures and sections of track along 185 kilometres of the existing operational standard gauge railway between Albury and Illabo. Enhancement works are required to provide the increased vertical and horizontal clearances required for double-stacked freight trains.

Works are proposed at 24 locations along the 'Main South Line' corridor, described as 'enhancement sites'. The enhancement sites have been broken down into four precincts which align with the local government areas (LGAs) of Albury, Greater Hume – Lockhart, Wagga Wagga and Junee. Australian Rail Track Corporation Ltd (ARTC) ('the proponent') is seeking approval to construct and operate the Albury to Illabo section of Inland Rail ('the proposal').

The proposal is Critical State Significant Infrastructure (CSSI) and is subject to approval by the NSW Minister for Planning under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal requires consideration of impacts on matters of national environmental significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), however following referral to the (then) Australian Minister for the Environment in June 2020 (EPBC Referral No 2020/8670), the Australian Government Department of Agriculture, Water and the Environment (DAWE) notified that the proposal is not a controlled action.

This report

This Aquatic Biodiversity Impact Assessment has been prepared on behalf of ARTC to support the environmental impact statement (EIS) for the proposal and responds to the Secretary's Environmental Assessment Requirements (SEARs) for the aquatic ecosystem.

The assessment presented in this report has included a review of relevant legislation, consideration of the existing conditions, an impact assessment to determine the significance of impacts to aquatic biodiversity as a direct result of the construction and operation of the proposal, a cumulative impact assessment and the potential impacts of the proposal on threatened aquatic species which are predicted to occur within the region. Recommended mitigation and management measures were identified in response to the impact assessment findings.

This report builds on findings of the Biodiversity Development Assessment Report (BDAR) (Technical paper 8) the Hydrology, Flooding and Water Quality Assessment (Technical paper 11) and the Groundwater assessment (Technical paper 12) prepared for the proposal, which are addressed in separate reports.

Existing aquatic environment

The proposal is located within the Murray River and Murrumbidgee River sub-catchments of the Murray Darling Basin. Within the study area, there are 26 mapped hydrolines, three waterbodies and 28 farm dams. The proposal site crosses six watercourses mapped by the Department of Primary Industries (DPI) as Key Fish Habitat (KFH), however only one of these, the Murray River, is permanently flowing. The remaining five watercourses mapped as KFH, along with all other named and unnamed watercourses within the study area, are

ephemeral, only flowing following rainfall events and receding rapidly, leaving very few remnant pools for fish refuge.

The Murray River and Oddies Creek both contained habitat features such as woody debris, instream macrophytes, riparian vegetation and bank overhang. Eight Mile Creek contained instream macrophytes and Buckaringah Creek contained large woody debris. The remaining watercourses lacked important fish habitat features. All watercourses and riparian zones were significantly modified by agricultural urban and or industrial land practices.

Impacts from the proposal during construction

Direct impacts from the proposal on aquatic biodiversity would include removal of riparian vegetation, temporary barriers to fish-passage and potential mortality to aquatic flora and fauna from instream works and or poor water quality. Potential indirect impacts to aquatic biodiversity relate to the mobilisation of poor-quality stormwater runoff from construction activities including vegetation removal, earthworks, establishment and use of construction compounds as well as riverbank and streambed disturbance that would result in sedimentation and pollution downstream and potential mortality to aquatic flora and fauna.

The potential impacts during construction are considered to be a moderate risk at three watercourses:

- Murray River (Murray River bridge) – this watercourse is defined as type 1 highly sensitive KFH and a class 1 perennial watercourse. Potential impacts on this watercourse relate mainly to indirect impacts to water quality during bridge modification.
- Sandy Creek (Uranquinty Yard clearances) – this watercourse is defined as type 1 highly sensitive KFH as it is within the mapped distribution of a threatened species (Flathead Galaxias (*Galaxias rostratus*)) and a class 2 ephemeral watercourse. Potential impacts on this watercourse relate to instream works required for the construction of a temporary crossing on this watercourse.
- Jeralgambeth Creek north arm (Junee to Illabo clearances) – this watercourse is defined as type 2 moderately sensitive KFH through the presence of some habitat features such as remnant pools and aquatic vegetation and a class 2 ephemeral watercourse. Potential impacts on this watercourse relate to instream works required for the proposed modification of an existing culvert.

All other watercourses within the study area were considered to have a low or negligible risk of impact from the proposal during construction due to the lack of KFH features and or the minor nature of works proposed at these watercourses.

Risks can be managed in ephemeral watercourses by undertaking construction when watercourses are dry and aquatic fauna species would not be present in addition to implementing appropriate erosion and sediment control measures. Risks to the perennial watercourse (Murray River) can also be managed through the implementation of appropriate erosion and sediment control measures, the use of a membrane fixed around the work area on the bridge to capture hazardous materials (i.e. lead paint) along with undertaking the work in stages to reduce the scale of any potential impacts.

Impacts from the proposal during operation

For the operational phase, the risks are related to permanent barriers to fish-passage due to modification of water crossing structures (i.e. culvert modification within Jeralgambeth Creek north arm), potential downstream pollution due to mobilisation of stormwater runoff from new impervious surfaces, as well as from possible leaks or spills from maintenance vehicles on the permanent access tracks or from cargo in train carriages. These potential risks were determined to be unlikely as the proposal consists mainly of modifications to the existing rail line, would not result in additional impacts to fish passage and results in only

minor increases in impervious surface areas (which could contribute to runoff). In addition, potential risks would be managed in accordance with ARTC standards and protocols.

Threatened species, populations and ecological communities

Following a likelihood of occurrence assessment, the study area was considered to provide possible or likely habitat for the following six threatened species listed under the *Fisheries Management Act 1994* (FM Act) and/or EPBC Act:

- Murray Cod (*Maccullochella peelii*) listed as vulnerable under the EPBC Act was considered likely to occur in the Murray River.
- Trout Cod (*Maccullochella macquariensis*) listed as endangered under FM Act and EPBC Act was considered likely to occur in the Murray River.
- Murray Crayfish (*Euastacus armatus*) listed as vulnerable under the FM Act was considered likely to occur in the Murray River.
- Silver Perch (*Bidyanus bidyanus*) listed as vulnerable under the FM Act and critically endangered under the EPBC Act was considered likely to occur in the Murray River.
- Flathead Galaxias (*Galaxias rostratus*) listed as critically endangered under the FM Act and EPBC Act was considered possible to occur in the Murray River and Sandy Creek (during flow events).
- Southern Pygmy Perch (*Nannoperca australis*) listed as endangered under the FM Act was considered possible to occur in Buckaringah Creek (during flow events).

In addition, the *Lowland Murray River aquatic ecological community*, which is listed as an endangered ecological community (EEC) under the FM Act, applies to all native fish and aquatic invertebrates within all natural creeks, rivers and associated waterbodies within the study area.

Fisheries Management Act

Assessment under the FM Act concluded that the proposal was unlikely to have an adverse effect on the life cycle of Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*), Trout Cod (*M. macquariensis*), Flathead Galaxias (*G. rostratus*) or Southern Pygmy Perch (*N. australis*) such that a viable local population of these species is likely to be placed at risk of extinction. This was based on the lack of important habitat features for these species within watercourses in the study area and the relatively minor nature of works, with instream works only proposed at one watercourse where a threatened species was considered possible to occur (Sandy Creek). Potential indirect impacts on water quality associated with the mobilization of sediments is relevant to all watercourses within the study area however this can be managed using standard erosion and sediment control measures during the construction and operation phase of the proposal. Thus, the level of impact to the aquatic environment and threatened aquatic species is considered minor.

The proposal is considered unlikely to have an adverse effect on the extent of the Lowland Murray River aquatic ecological community such that its local occurrence is likely to be placed at risk of extinction as no aquatic habitat would be permanently removed by the proposal and indirect impacts can be managed during construction and operation.

The composition of this EEC includes 23 species of fish and over 400 recorded native invertebrate species. The watercourses within the study area lack riffle sections, backwaters and billabongs which are habitat features of the EEC, as are remnant pools, large woody debris and aquatic vegetation. Remnant pools were observed only at Oddies Creek, Eight Mile Creek, Buckaringah Creek and Jeralgambeth Creek, large woody debris were recorded only at the Murray River, Oddies Creek and Buckaringah Creek and native aquatic vegetation was recorded only at the Murray River, Oddies Creek and Eight Mile Creek. The proposal is unlikely to alter the composition of this EEC as it will not permanently impact watercourses identified as containing large woody debris and proposed works at Eight Mile Creek and Jeralgambeth Creek are minor and include modifications to existing

culverts only, which is unlikely to permanently alter existing pools or aquatic vegetation at these locations. Watercourses within the study area had exotic flora species in the instream environment and exotic Mosquitofish (*Gambusia holbrooki*) are already known to occur in the study area. Thus, the composition of the EEC within the study area has been modified through past practices. The risk of impact from the proposal on watercourses associated with the EEC within the study area was determined to be negligible to low at most sites and moderate at three locations (Murray River, Sandy Creek and Jeralgambeth Creek). As the extent of instream works would be minor and any potential risks would be managed during construction and operation, the proposal is unlikely to further modify the composition of the EEC such that its local occurrence is at risk of extinction.

In relation to the habitat of threatened species and the EEC, three watercourses were identified as having potential habitat for threatened species (Murray River, Buckaringah Creek and Sandy Creek). The habitat at Buckaringah Creek and Sandy Creek is considered as low importance for the long-term survival of Southern Pygmy Perch (*N. australis*) and Flathead Galaxias (*G. rostratus*) populations (respectively) in the locality, mainly due to the absence of important habitat features (i.e., flowing oxygenated waters and macrophytes) while the habitat in the Murray River within the proposal site was considered as low importance for the long-term survival of Trout Cod (*M. macquariensis*), Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*) and Flathead Galaxias (*G. rostratus*) due to the lack of recent records, the disturbed nature of the habitat and the low abundance of habitat features (i.e. large woody debris and or aquatic macrophytes). The proposal would not result in further fragmentation of habitat nor would it reduce the habitat available for threatened species or the EEC, due to the minor nature of instream works proposed. As such, the proposal was considered unlikely to significantly impact the extent or composition or further fragment the habitat of threatened species or the EEC.

The proposal is not inconsistent with any priority action statements for the assessed threatened species and EEC as most recovery actions listed are not directly relevant to the proposal, except for habitat rehabilitation, which would be undertaken as part of the rehabilitation strategy for the proposal. The key threatening process (KTP) 'degradation of native riparian vegetation along NSW water courses' is the only KTP that would be impacted by the proposal. The loss of any riparian vegetation would be addressed in the rehabilitation strategy.

Environment Protection and Biodiversity Conservation Act

Assessment under the EPBC Act concluded that the proposal is unlikely to have a significant impact on Trout Cod (*M. macquariensis*) (listed as endangered under the EPBC Act), Silver Perch (*B. bidyanus*) (listed as critically endangered under the EPBC Act) or Flathead Galaxias (*G. rostratus*) (listed as critically endangered under the EPBC Act) as it would not:

- lead to a long-term decrease in the size of a population,
- reduce the area of occupancy of the species
- fragment an existing population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of a population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- introduce disease that may cause the species to decline, or
- interfere with the recovery of the species

Similarly, the proposal is unlikely to have a significant impact on an important population of Murray Cod (*M. peelii*) (listed as vulnerable under the EPBC Act).

Impacts on sensitive areas

KFH within the study area was based on existing KFH mapping by DPI (2007), watercourses sensitivity type (DPI, 2013) and watercourse class (Fairfull and Witheridge, 2003) which were defined following site inspection. Only instream habitat (top of bank to top of bank) is defined as KFH, therefore riparian vegetation is not included.

The following watercourses are defined as having moderately sensitive or highly sensitive KFH within the study area:

- Albury precinct
  - Murray River (type 1 highly sensitive)
  - Oddies Creek (type 2 moderately sensitive)
- Greater Hume to Lockhart precinct
  - Buckaringah Creek (type 1 highly sensitive)
- Wagga Wagga precinct
  - Sandy Creek (type 1 highly sensitive)
- Junee precinct
  - Jeralgambeth Creek north arm (type 2 moderately sensitive)

All other watercourses within the study area are defined as type 3 minimal KFH due to the absence of fish habitat features.

Potential impacts to KFH in watercourses include:

- A culvert modification at Jeralgambeth Creek. The modification to this instream structure is not in addition to what currently exists and would be in accordance with relevant design guidelines for water crossing structures and therefore not expected to impact fish-passage or disrupt habitat functionality in any way.
- Temporary instream disturbance and obstruction of fish passage at Sandy Creek (Uranquinty Yard clearances) for the temporary crossing.

KFH would not be permanently lost or disrupted provided the proposal implements the proposed design and alignment, construction methodology, mitigation measures, rehabilitation strategy and operational monitoring and management. As such, no aquatic biodiversity offset is required, however during consultation, DPI recommended habitat improvement opportunities such as the placement of removed riparian vegetation within the bed of the watercourse for re-snagging, log revetment works or other enhancement works where possible.

The construction and operation of the proposal would involve works on waterfront land which includes the bed and bank of watercourses and all land within 40 metres of the highest bank (DPI, 2012). Activities that are expected to impact waterfront land include:

- trimming of 50.4 square metres of native riparian vegetation (PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland) from the Murray River, Murray River bridge
- removal of native riparian vegetation:
  - 50.9 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Oddies Creek, Murray River bridge
  - 64.4 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Sandy Creek, Uranquinty Yard clearances
  - 168.8 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Reedy Creek, Harefield Yard clearances

- instream works at:
    - Sandy Creek (Uranquinty Yard clearances) for the temporary crossing
    - Jeralgambeth Creek north arm (Junee to Illabo clearances) for the proposed modification of an existing culvert
- earthworks, including cuttings and embankments and movement/use of vehicles across exposed soil
- construction compounds and associated activities.

Where possible, the construction footprint would be minimised to reduce clearing in the riparian corridor and practises would be implemented to minimise disturbance of the banks. Bank stabilisation processes would also be undertaken after removal of the temporary crossing at Sandy Creek, Uranquinty.

Aquatic groundwater dependent ecosystems (GDEs) in the study area are associated with the riparian vegetation along watercourses. The proposal is expected to cross two high priority aquatic GDEs at Sandy Creek and Jeralgambeth Creek, and one moderate priority aquatic GDE at the Murray River (BOM, 2021a). The assessment of the proposals impacts on aquifers and GDEs regarding the minimal impact considerations of the NSW Aquifer Interference Policy indicates the proposal complies with Level 1 criteria, which considers the potential impacts as acceptable (refer Groundwater Assessment (Technical paper 12) for further details).

Recommended mitigation measures

Potential impacts to aquatic ecosystems would be reduced if appropriate erosion and sediment controls are implemented, there are onsite spill kits for construction works within 100 metres of a watercourse and if instream construction works are conducted when watercourses are dry (where practicable) (i.e. in ephemeral watercourses Sandy Creek and Jeralgambeth Creek). Where works cannot be conducted in the dry, appropriate erosion and sediment control would be installed (i.e. a silt curtain or sediment boom around the work area and attached to the same side of the bank to maintain fish passage).

During operation, potential impacts would be reduced through the re-establishment of native riparian vegetation endemic to the region and aquatic habitat features within and on the banks of watercourses directly impacted.

Conclusion

The aquatic biodiversity impact assessment concludes that the impacts of the proposal would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area. Most of the potential construction impacts are associated with indirect impacts on water quality and would therefore be temporary and managed through the adoption of recommended mitigation measures. Potential operational impacts would not significantly increase from existing operation impacts and would be managed in accordance with ARTC standards and protocols. Impacts on threatened species and EEC's listed under the FM Act and/or EPBC Act are considered unlikely due to the minor nature of works and the highly ephemeral nature of most watercourses within the study area. The Murray River is the only perennial watercourse however direct instream impacts at this location are unlikely and potential indirect impacts can be managed. As such, the proposal is unlikely to significantly impact the habitat of threatened species or EEC's.

Glossary and abbreviations

A2I	Albury to Illabo section of Inland Rail
Active level crossing	At grade road crossing of the rail corridor which uses flashing lights and boom barriers for motorists, and automated gates for pedestrians. These devices are activated prior to and during the passage of a train through a level crossing.
ALA	Atlas of living Australia
ARTC	Australian Rail Track Corporation
AUSRIVAS	Australian River Assessment System
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
BDAR	Biodiversity Development Assessment Report (Technical paper 8)
CEMP	Construction Environmental Management Plan A site-specific plan developed for the construction phase of a project, to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and manage environmental risks properly.
CMA	Subregion Catchment Management Authority Subregion
Construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials and/or construction site offices and worker facilities.
Culvert	A structure that allows water to flow under a road, railway, track, or similar obstruction.
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts
CSSI	Critical State Significant Infrastructure
DAWE	Department of Agriculture, Water and the Environment
DPIE	(former) Department of Planning, Industry and Environment (N.B now referred to as the Department of Planning and Environment)
DPE	Department of Planning and Environment
DPI	Department of Primary Industries – Fisheries NSW
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
Enhancement site	Discrete sites within the proposal site that are proposed for infrastructure enhancement.
EPs	Endangered Populations
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

FM Act	*Fisheries Management Act 1994* (NSW)
Gantry	An overhead metal structure with a frame supporting equipment such as a signals, lighting or cameras.
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
Inland Rail program	The Inland Rail program comprises the design and construction of a new Inland Rail connection between Melbourne and Brisbane, via Wagga, Parkes, Moree, and Toowoomba. The route for Inland Rail is about 1,700 kilometres in length. Inland Rail will involve a combination of upgrades of existing rail track and the provision of new track.
KFH	Key Fish Habitat
KTP	Key Threatening Process
Locality	The Murrumbidgee and Murray River catchments
LEP	Local Environmental Plans
Main line	Primary track on which trains travel within a single track section of corridor
Main South Line	A major rail line between Sydney and Albury, passing through the Southern Highlands, Southern Tablelands, South West Slopes and Riverina regions of NSW.
MGA	Map Grid of Australia 94, Zone 55 (easting-northing)
MNES	Matters of national environmental significance
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NPW Act	*National Parks and Wildlife Act*
OEH	Office of Environment and Heritage (NSW) (NB. The functions of OEH were transferred to the Environment, Energy & Science Group within DPE and Heritage NSW.
Operational footprint	Area occupied by permanent infrastructure and required for the operation of the proposal
Overbridge	A bridge over a railway or road. For the proposal, overbridges refer to those structures which allow a road to pass over the railway.
Passive level crossing	At grade road crossing of the rail corridor which uses stop or give way signs for motorists, and 'look for trains' signs for pedestrians.
PCT	Plant Community Type
Pedestrian bridge	A bridge designed solely for pedestrians to cross a watercourse, rail corridor or road.
PMST	Protected Matters Search Tool
Precinct	Groupings of enhancement sites in line with the LGAs including Albury, Greater Hume – Lockhart, Wagga Wagga and Junee.

The proposal	Proposed enhancement works to structures and sections of track along 185 kilometres of the existing operational standard gauge railway between Albury and Illabo for the purpose of meeting Inland Rail specifications.
The proposal site	The areas that enhancement works are required to operate the Albury to Illabo section of Inland Rail. It includes the location of construction worksites, operational rail infrastructure, new bridge structures, level crossings and other ancillary infrastructure.
Rail corridor	The corridor within which the rail tracks and associated infrastructure are located
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it. Mapped at 1:50 000 scale
Study area	The wider area, including and surrounding the proposal site, with the potential to be directly or indirectly affected by the proposal. The extent of the study area varies according to the requirements of each assessment and the potential for impacts. For the sake of this assessment it includes a 200 metre buffer around the proposal site.
Survey Site	The location (100 metre reach along watercourses crossed by the study area) within which habitat assessments and surveys were undertaken.
TEC	Threatened Ecological Community
Track	The structure consisting of the rails, fasteners, sleepers and ballast, which conveys trains.
VRZ	Vegetated riparian zone

CONTENTS

1. Introduction....1
1.1 Overview....1
1.2 The proposal....1
1.2.1 Location....1
1.2.2 Key features....2
1.2.3 Timing....4
1.2.4 Construction....4
1.2.5 Operation....4
1.3 Purpose and scope of this report....5
1.4 Structure of this report....6
2. Legislative and policy context....7
2.1 Legislation....7
2.1.1 Commonwealth legislation....7
2.1.2 NSW legislation....7
2.1.3 Policy and guidelines....9
3. Methodology....15
3.1 Study area....15
3.2 Desktop assessment....15
3.3 Stream order mapping....16
3.4 Watercourse classification....16
3.4.1 Key fish habitat mapping....16
3.4.2 Key fish habitat sensitivity and class analysis....17
3.5 Determination of survey sites....17
3.6 Field survey....21
3.6.1 Habitat assessment....21
3.6.2 Targeted threatened species survey requirements....37
3.7 Riparian and aquatic vegetation survey and mapping....39
3.8 Fish community status mapping....39
3.9 Directory of important wetlands....39
3.10 Risk of impact criteria....40
4. Existing environment....41
4.1 Weather and climatic conditions....41
4.2 Murray Darling Basin....41
4.2.1 Murray River catchment and landscape....41
4.2.2 Murrumbidgee River catchment and landscape....42
4.3 Water Quality....43
4.4 Groundwater Dependent Ecosystems....43

CONTENTS (continued)

4.5 Aquatic habitat within the study area 43
4.5.1 Albury Precinct 46
4.5.2 Greater Hume – Lockhart Precinct 47
4.5.3 Wagga Wagga Precinct 48
4.5.4 Junee Precinct 49
4.5.5 Other waterbodies 50
4.6 Summary of aquatic habitat within the study area 50
4.7 Riparian vegetation 51
4.8 Target aquatic fauna survey results 52
4.9 Threatened species, populations and ecological communities 52
4.9.1 NSW BioNet 52
4.9.2 Atlas of Living Australia 52
4.9.3 Protected matters search tool 53
4.9.4 DPI website and Fisheries spatial data portal 54
4.9.5 Summary of database searches 55
4.9.6 Likelihood of occurrence summary 55
4.9.7 State listed threatened species and threatened ecological communities 57
4.9.8 Critical habitat 57
4.9.9 Matters of national environmental significance 57
5. Impact assessment 58
5.1 Construction 58
5.1.1 Potential impacts on water quality 58
5.1.2 Potential impacts on aquatic biodiversity 58
5.2 Operation 77
5.2.1 Potential impacts on water quality 77
5.2.2 Impacts to aquatic biodiversity 78
5.3 Threatened species, populations and aquatic ecological communities assessed under the FM Act 88
5.3.1 Impact on life cycle of a threatened species 88
5.3.2 Impact on the life cycle of an endangered population 89
5.3.3 Impacts on the extent and composition of an EEC 89
5.3.4 Impacts on the habitat of a threatened species or EEC 90
5.3.5 Impacts on critical habitat 90
5.3.6 Consistency with a recovery plan or threat abatement plan 90
5.3.7 Key threatening processes 90
5.4 Matters of National Significance assessed under the Commonwealth EPBC Act 91

CONTENTS (continued)

5.5 Sensitive areas 92
5.5.1 Key fish habitat 92
5.5.2 Waterfront land 93
5.5.3 Groundwater dependent ecosystems 93
6. Cumulative impact assessment 94
7. Mitigation and management measures 103
7.1 Summary of mitigation and management measures 104
7.2 Predicted effectiveness of the mitigation and management measures proposed 105
8. Conclusion 106
9. References 111

List of Figures

Figure 1-1. Location and key features of the proposal 3
Figure 3-1. Figure Murray River bridge (Murray River & Oddies Creek) 22
Figure 3-2. Billy Hughes bridge 23
Figure 3-3. Table Top Yard clearances 24
Figure 3-4. Culcairn Yard clearances 25
Figure 3-5. Henty Yard clearances 26
Figure 3-6. Yerong Creek Yard clearances 27
Figure 3-7. Uranquinty Yard clearances 28
Figure 3-8. Pearson Street bridge 29
Figure 3-9. Harefield Yard clearances 30
Figure 3-10. Kemp Street bridge 31
Figure 3-11. Junee Yard clearances 32
Figure 3-12. Olympic Highway underbridge 33
Figure 3-13. Junee to Illabo dual track clearances 34
Figure 3-14. Junee to Illabo dual track clearances 35
Figure 3-15. Junee to Illabo dual track clearances 36
Figure 6-1. Major projects in the vicinity of the proposal 95

List of Tables

Table 1-1. Enhancement sites....2
Table 1-2. Indicative construction activities 4
Table 1-3. SEARs relevant to the assessment of aquatic biodiversity 5
Table 2-1. Policy and guidelines referenced in the SEARs 9
Table 2-2. Key fish habitat and sensitivity classification scheme (DPI, 2013) .. 10
Table 2-3. Classification of waterways for fish passage (Fairfull & Witheridge, 2003) 11
Table 2-4. Recommended riparian corridor widths (DPI, 2018) 13
Table 3-1. Watercourse categories.... 18
Table 3-2. Watercourse priority 18
Table 3-3. Survey site identification, proposal site, co-ordinates, watercourse, Strahler stream order and catchment 20
Table 3-4. Summary of recommended survey techniques for target threatened species 37
Table 3-5. Fauna survey locations and sampling techniques.... 39
Table 3-6. Criteria for defining the risk of impact of the proposal on receiving watercourses 40
Table 4-1. BOM (2021a) aquatic GDE potential mapping summary 43
Table 4-2. Watercourses along the proposal site, type, class and presence of key fish habitat 44
Table 4-3. Riparian vegetation type and area within the proposal site.... 51
Table 4-4. Fauna survey results.... 52
Table 4-5. Threatened aquatic species records within the Murrumbidgee and Murray CMAs: Atlas of Living Australia.... 53
Table 4-6. Matters of National Environmental Significance within the locality 53
Table 4-7. Targeted Species.... 55
Table 4-8. Likelihood of occurrence of target threatened aquatic species in watercourses within the study area.... 56
Table 4-9. Proximity of Ramsar wetlands to the proposal site 57
Table 5-1. Potential construction impacts on water quality and aquatic biodiversity at each enhancement site and associated risk to receiving watercourses 63
Table 5-2. Summary of impact on watercourses within the study area.... 77
Table 5-3. Potential operation impacts on water quality and aquatic biodiversity at each enhancement site and associated risk to receiving watercourses 80
Table 6-1. Summary of potential cumulative impacts 96
Table 7-1. Summary of mitigation and management measures 104

Appendices

Appendix A. Results of desktop studies....113
Appendix B. Protected matters search tool report....124
Appendix C. Description of existing environment at survey sites....159
Appendix D. Likelihood of occurrence assessment 175
Appendix E. Assessment of significance (FM Act)....186
Appendix F. Assessment of significance (EPBC Act) 209
Appendix G. DPI Correspondence....214

1. Introduction

1.1 Overview

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland. Inland Rail is a major national program that would enhance Australia's existing national rail network and serve the interstate freight market.

The Inland Rail route, which is about 1,700 kilometres long, would involve:

- using the existing interstate rail line through Victoria and southern NSW
- upgrading about 400 kilometres of existing track, mainly in western NSW
- providing about 600 kilometres of new track in northern NSW and south-east Queensland.

Inland Rail has been divided into 13 projects, seven of which are located in NSW. Each of these projects can be delivered and operated independently with tie-in points on the existing railway.

Australian Rail Track Corporation Ltd (ARTC) ('the proponent') is seeking approval to construct and operate the Albury to Illabo section of Inland Rail ('the proposal').

The proposal is Critical State Significant Infrastructure (CSSI) and is subject to approval by the NSW Minister for Planning under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report has been prepared as part of the Environmental Impact Statement (EIS) for the proposal. The EIS has been prepared to support the application for approval of the proposal and address the Secretary's Environmental Assessment Requirements (SEARs) issued by the then NSW Department of Planning, Industry and Environment (the SEARs) (now the Department of Planning and Environment), dated 14 October 2020.

1.2 The proposal

The proposal involves enhancement works to structures and sections of track along 185 km of the existing operational standard gauge railway between Albury and Illabo. Enhancement works are required to provide the increased vertical and horizontal clearances required for double-stacked freight trains.

1.2.1 Location

The proposal is generally within the existing active rail corridor between the town of Albury on the Victorian-NSW border and around three kilometres to the north-east of Illabo. The alignment passes through two major regional towns, Albury and Wagga Wagga, NSW, and several smaller regional towns. Works are proposed at 24 locations along the 'Main South Line' corridor, described as 'enhancement sites'.

The enhancement sites have been broken down into four precincts which align with the local government areas (LGA) of Albury, Greater Hume – Lockhart, Wagga Wagga and Junee, as identified in Table 1-1 and shown in Figure 1-1.

Table 1-1. Enhancement sites

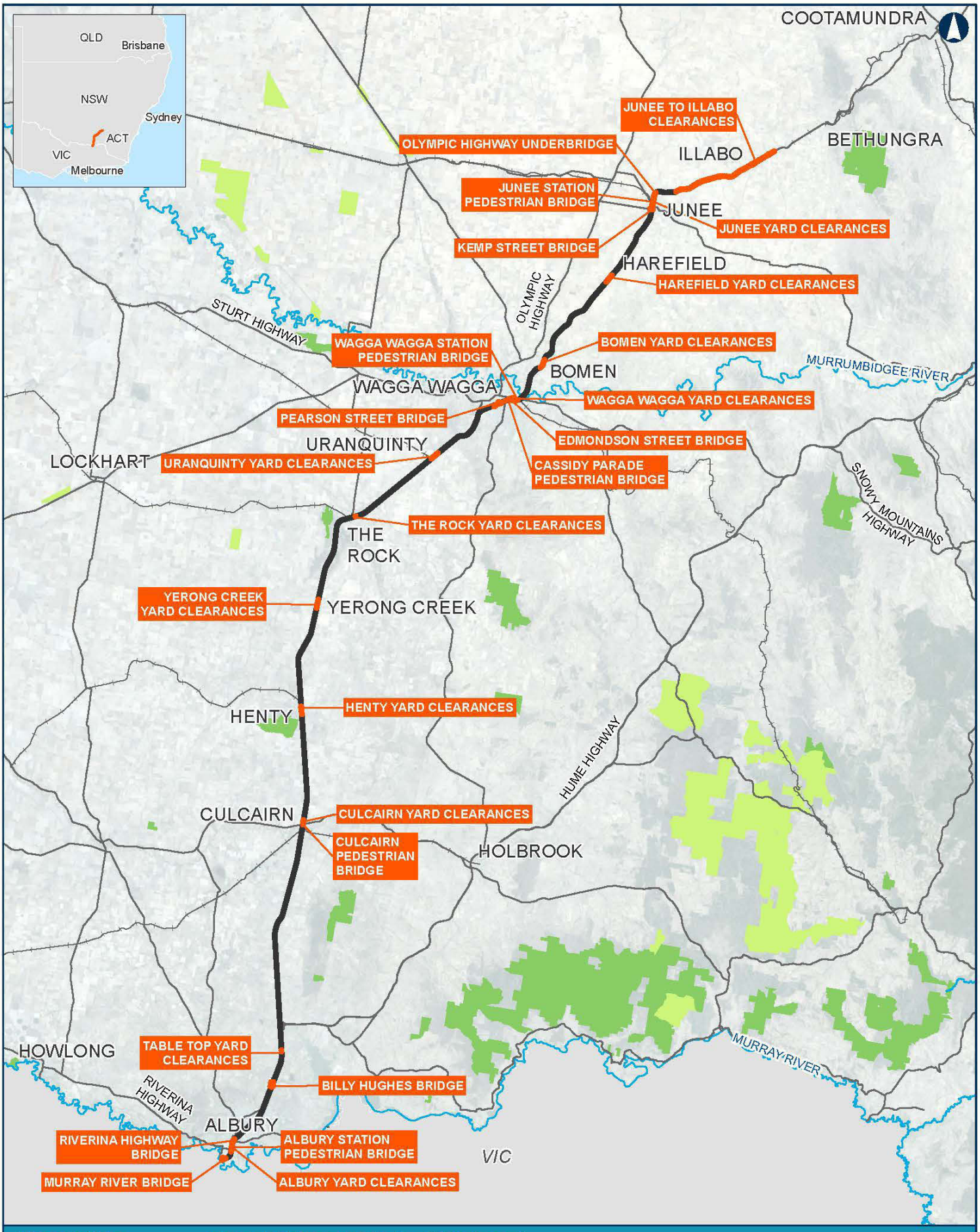
Precinct	Enhancement sites
Albury	Murray River bridge Albury Station pedestrian bridge Albury Yard clearances Riverina Highway bridge Billy Hughes bridge Table Top Yard clearances
Greater Hume – Lockhart	Culcairn pedestrian bridge Culcairn Yard clearances Henty Yard clearances Yerong Creek Yard clearances The Rock Yard clearances
Wagga Wagga	Uranquinty Yard clearances Pearson Street bridge Cassidy Parade pedestrian bridge Edmondson Street bridge Wagga Wagga Station pedestrian bridge Wagga Wagga Yard clearances Bomen Yard clearances
Junee	Harefield Yard clearances Kemp Street bridge Junee Station pedestrian bridge Junee Yard clearances Olympic Highway underbridge Junee to Illabo clearances

1.2.2 Key features

The key features of the proposal include:

- adjustments to approximately 44 kilometres of track across 14 enhancement sites to accommodate the vertical and horizontal clearances according to Inland Rail clearance specifications, comprising:
    - realignment of track within the rail corridor
    - lowering of track up to 1.6 metres at three enhancement sites.
- changes to bridges and culverts at enhancement sites to accommodate vertical clearances and track realignment as follows:
    - replacement of two road bridges and adjustments to adjoining intersections
    - replacement of three pedestrian bridges
    - removal of two redundant pedestrian bridges
    - modifications to four rail bridges
- ancillary works, including adjustments to nine level crossings, modifications to drainage and road infrastructure, signalling infrastructure, fencing, signage, and services and utilities.

No additional works would be required outside the enhancement sites identified in Figure 1-1 as they meet the clearance requirement for the Inland Rail program.



Albury to Illabo

Figure 1-1 Enhancement sites of the proposal

0 10 20 km

Coordinate System: GDA 1994 MGA Zone 55

Date: 4/11/2021 Paper: A3
Author: WSP Scale: 1:500,000
Data Sources: ARTC, NSWSS

- Proposal site
- Track alignment
- Existing railway
- Main road
- River
- National Park
- State Forest

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

1.2.3 Timing

Subject to approval, further design and procurement, construction of the proposal is planned to start in early 2024 and is expected to take about 16 months. The proposal would be fully operational in 2025 with enhancement sites progressively commissioned on completion of construction. Inland Rail as a whole would be operational once all 13 sections are complete, which is estimated to be in 2027.

1.2.4 Construction

An indicative construction methodology has been developed based on the current design to be used as a basis for the environmental assessment process. Overall, the construction strategy is based on an approach of dividing the proposal into four construction packages which align with the precincts: Albury, Greater Hume-Lockhart, Wagga Wagga and Junee.

Construction of the proposal would require:

- construction compounds, laydown areas and other areas needed to facilitate construction works
- temporary changes to the road network, including roads closures to undertake works on road bridges and level crossings
- other ancillary works.

Construction within each precinct would generally involve the site establishment and enabling works, main construction works as relevant to the enhancement site and finishing works as outlined in Table 1-2.

Further information on the construction of the proposal is provided in Chapter 8 of the EIS.

Table 1-2. Indicative construction activities

Construction stages	Indicative activities
Site establishment and enabling works	• Establishment of key construction infrastructure, work areas, access points and other construction facilities • Installation of environmental controls, fencing and site services • Preliminary activities including clearing/trimming of vegetation
Main Construction works	• Track works • Rail bridge works • Road bridge replacement • Pedestrian bridge works • Associated infrastructure works on level crossings, culverts and signalling
Finishing works	• Testing and commissioning of the new and modified infrastructure • Demobilisation and removal of construction compounds and other construction infrastructure • Restoration of disturbed areas, as required, including revegetation and landscaping, where required

1.2.5 Operation

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators.

The proposal would enable the use of double stacked trains along its entire length. Inland Rail would operate 24 hours per day and would initially accommodate double-stacked freight trains up to 6.5 metres high and up to 1,800 metres in length. The possible future use of the railway between Albury and Illabo by freight trains up to 3,600 metres long would be subject to separate assessment. Freight train speeds would range from 60 to 115 kilometres per hour, which is consistent with current train speeds.

The average number of freight trains movements between Albury and Illabo would increase from a current average of up to 12 per day in 2021 to 18 per day in 2025, further increasing to about 20 per day in 2040.

ARTC would continue to maintain the Main South Line. This would typically involve minor maintenance works, such as bridge and culvert inspections, rail grinding and track tamping, through to major maintenance, such as reconditioning of track and topping up of ballast as required. Maintenance works and schedule are not proposed to change as a result of the proposal.

Further information on the operation of the proposal is in Chapter 7 of the EIS.

1.3 Purpose and scope of this report

The aquatic biodiversity impact assessment specifically addresses the SEARs relevant to the assessment of the aquatic environment (refer Table 1-3).

Specifically, this assessment:

- Describes the existing aquatic environment in terms of ecological values, including type and condition of aquatic habitats.
- Determines the presence or likelihood of occurrence of threatened species, populations and endangered ecological communities (EECs) as listed under the *Fisheries Management Act 1994* (FM Act).
- Determines the presence or likelihood of occurrence of matters of national environmental significance (MNES) as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Identifies threatened fish species, populations and EECs within the locality that have the potential to be impacted by the proposal.
- Assesses the impact of the proposal on threatened fish species, populations and ecological communities.
- Assesses the impact of the proposal on protected and sensitive lands.

Table 1-3. SEARs relevant to the assessment of aquatic biodiversity

Key Issue	Assessment Requirement	Report Reference
6. Biodiversity The project design considers measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.	7. The Proponent must assess any impacts on biodiversity values not covered by the BAM. This includes a threatened aquatic species assessment (Part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the FM Act.	Section 5.3 includes a summary of the '7-part tests' which have been undertaken for threatened aquatic species, populations and ecological communities (listed under the FM Act) that are predicted in the study area. The '7-part tests' are detailed in Appendix E.
	8. The Proponent must identify whether the project, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the *Biodiversity Conservation Act 2016* (BC Act), FM Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).	Section 5.3.7 and Appendix E describe the activities that constitute a KTP as outlined in the FM Act. Proposed activities that constitute a KTP in the BC Act and EPBC Act are addressed in the Biodiversity Development Assessment Report (BDAR) (Technical paper 8)

1.4 Structure of this report

The structure of the report is outlined below:

Chapter 1 – provides an introduction to the report and outlines relevant SEARs to be addressed.

Chapter 2 – provides an overview of relevant legislation, policies and guidelines applicable to the assessment.

Chapter 3 – describes the methodology and approach for the assessment.

Chapter 4 – describes the existing environment with respect to catchments, watercourses and threatened aquatic species and ecological communities found within the study area.

Chapter 5 – provides an assessment of the impacts to aquatic biodiversity from the construction and operational of the proposal along with potential impacts on threatened species, populations and EECs.

Chapter 6 – considers cumulative impacts on adjacent Inland Rail projects and other major projects.

Chapter 7 - provides recommended avoidance and mitigation measures.

Chapter 8 – provides a summary of findings and conclusion

Chapter 9 - provides a full reference list.

2. Legislative and policy context

2.1 Legislation

2.1.1 Commonwealth legislation

2.1.1.1 Environment Protection and Biodiversity Conservation Act 1999

The objective of the EPBC Act is to protect and manage prescribed MNES. Under the EPBC Act, proposed 'actions' that have the potential to significantly impact on MNES, the environment of Commonwealth land, or that are being carried out by an Australian Government agency, must be referred to the Australian Minister for the Environment for assessment.

Preliminary environmental investigations identified threatened species under the EPBC Act which have the potential to be impacted by the proposal. As a result of the potential for impacts on protected matters, the proposal was referred to the (then) Australian Minister for the Environment in June 2020 (EPBC Referral No 2020/8670). On 29 June 2020, the Australian Government Department of Agriculture, Water and the Environment (DAWE) notified that the proposal is a not controlled action.

This aquatic biodiversity impact assessment concluded that there is unlikely to be any significant impacts to these MNES relevant to aquatic biodiversity due to the proposal (refer section 5.4).

2.1.2 NSW legislation

2.1.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act and Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) establish a framework for the assessment and approval of developments in NSW. They also provide for the making of environmental planning instruments, including state environmental planning policies (SEPPs) and local environmental plans (LEPs), which determine the permissibility and approval pathway for development proposals and form a part of the environmental assessment process. In accordance with the provisions of the EP&A Act, the proposal is State Significant Infrastructure (SSI).

SSI may also be declared to be Critical SSI (CSSI) in accordance with section 5.13 of the EP&A Act, if it is of a category that, in the opinion of the Minister for Planning, is essential for the State for economic, environmental or social reasons. The proposal was declared as CSSI in 2021.

Under section 5.14 of the EP&A Act, the approval of the Minister for Planning is required for State significant infrastructure (including CSSI), and an EIS has been prepared under Division 5.2 of the EP&A Act.

Section 5.23 of the EP&A Act identifies various authorisations which are not required for a CSSI project. Of relevance to this assessment, the following authorisations are not required for approved SSI (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

- a permit under section 201, 205 or 219 of the FM Act
- a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000* (WM Act).

2.1.2.2 Fisheries Management Act 1994

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The FM Act establishes mechanisms for:

- the listing of threatened species, populations and ecological communities or key threatening processes
- the declaration of critical habitat, and

- consideration and assessment of threatened species impacts in the development assessment process.

Part 7A, section 221ZT(b) of the FM Act relates to the environmental assessment under Part 5 of the EP&A Act. Section 4.9 of this report identified threatened species, populations and ecological communities listed under Schedule 4, 4A and 5 of the FM Act which are predicted to occur in the locality. In accordance with sections 221ZV and 221ZX of the FM Act, Appendix E of this report assesses likely impacts of the proposal (assessment of significance) on these listed species and Chapter 5 summaries the impacts of the proposal.

Construction works associated with some watercourse crossing structures would require 'dredging' or 'reclamation' as defined under section 198A of the FM Act. In addition, construction of the proposal would result in 'temporary blockage of fish passage within the watercourse' as defined under section 219 of the FM Act. Part 7 of the FM Act relates to the protection of aquatic habitats, including providing management of dredging and reclamation works within permanently or intermittently flowing watercourses, as well as the temporary or permanent blockage of fish passage within a watercourse. Any instream works and/or waterway structures/crossings need to consider fish habitat class and the use of an appropriately designed structure that does not obstruct fish passage. SSI projects (including CSSI projects) are however exempt from the need to obtain permits for these activities under section 5.23(1)(b) of the EP&A Act. Regardless of the exemption to obtain permits, any construction of watercourse structures and/or crossings have considered fish habitat class as defined in *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013), as well as the use of appropriately designed water crossing structures that do not obstruct fish passage (as recommended in *Why do Fish need to Cross the Road? Fish Passage Requirements for Watercourse Crossings (*Fairfull and Witheridge, 2003)).

Schedule 6 of the FM Act outlines the key threatening processes (KTPs) related to aquatic species and ecological communities. These are considered in section 5.3.7.

2.1.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) aims to avoid, minimise and offset impacts on biodiversity from development and conserve biodiversity at a bioregional and state scale. It lists a number of threatened species, populations and ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats.

A BDAR (Technical paper 8) has been prepared in accordance with Section 7.9 of the BC Act as part of the EIS. No threatened aquatic species listed under the BC Act were identified within the locality during database searches (section 4.9.1).

Of relevance to this assessment, aquatic groundwater dependent ecosystems (GDEs) that are protected under the BC Act have been identified within the study area and therefore have been considered (section 4.4 and section 5.5.3).

2.1.2.4 Water Management Act 2000

The WM Act recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with access to water. The object of the WM Act is the sustainable and integrated management of the state's water sources for the benefit of present and future generations.

Part 3 of the WM Act establishes three types of approvals that may be required to obtain. These are:

- water use approvals
- water management work approvals (water supply work approvals, drainage work approvals and flood work approvals)
- activity approvals (controlled activity approvals and aquifer interference approvals).

As noted above, under section 5.23(1) of the EP&A Act, approved SSI (including CSSI) does not require a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the WM Act. The aquifer interference approval provisions of the WM Act have not been activated in NSW at this stage, so there is no requirement for an aquifer interference approval.

The design and construction of the proposal would consider the *Guidelines for Controlled Activities on Waterfront Land: Riparian Corridors* (Department of Industry 2018; section 2.1.3.5) to enable the mitigation of potential impacts to water quality.

The impacts of the proposal on waterfront land are considered in section 5.5.2.

2.1.3 Policy and guidelines

Policy and guidelines utilised for the assessment include relevant documents referenced in the SEARs. Consideration of these guidelines and their relevance is provided in Table 2-1. Policy and guidelines, including additional guidelines to those referenced in the SEARs are discussed in the following sections.

Table 2-1. Policy and guidelines referenced in the SEARs

Policy and guidelines	Report reference
Policy and Guidelines for Fish Habitat Conservation and Management – Update 2013 (DPI, 2013)	Relevant to the assessment, discussed further below.
Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003)	Relevant to the assessment, discussed further below.
Aquatic Ecology in Environmental Impact Assessment – EIA Guidelines (NSW Department of Planning, 2003)	Relevant to the assessment, discussed further below.
Freshwater threatened species distribution maps	Relevant to the assessment, discussed in section 3.2 and Appendix A
Threatened Species Survey and Assessment Guidelines (Threatened Species Test of Significance Guidelines (OEH, 2018))	Relevant to the BDAR Technical paper 8) however also considered below.
NSW Sustainable design guidelines, version 4.0 (TfNSW, 2017)	Relevant to the assessment, discussed further below.
Biodiversity Assessment Method (BAM) (EES 2020)	Relevant to the BDAR Technical paper 8)
Biodiversity Assessment Method Operational Manual Stage 1 (EES, 2020)	Relevant to the BDAR Technical paper 8)
Biodiversity Assessment Method Operational Manual Stage 2 (OEH, 2019)	Relevant to the BDAR Technical paper 8)

2.1.3.1 Policy and Guidelines for Fish Habitat Conservation and Management

The *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) outlines policies and guidelines aimed at maintaining and enhancing fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments. It is applicable to all planning and development proposals and various activities that affect aquatic ecosystems in NSW.

One of the key objectives of the FM Act is to conserve 'key fish habitats' (KFH). KFH's are defined in the policy and guidelines to include all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank. Small headwater creeks and gullies (known as first and second order streams), that only flow for a short period after rain are generally excluded, as are farm dams constructed on such systems. Wholly artificial waterbodies such as irrigation

channels, urban drains and ponds, salt and evaporation ponds are also excluded except where they are known to support populations of threatened fish or invertebrates.

The Department of Primary Industries (DPI) assess activity and development proposals in relation to consideration for the 'sensitivity' of the affected fish habitat. In this context, 'sensitivity' is defined by the importance of the habitat to the survival of fish and ability to withstand disturbance.

If the aquatic habitat in question is defined as KFH, it is then assigned a fish habitat sensitivity ranking which is used within the policy and guideline statements to differentiate between permissible and prohibited activities or developments related to the importance of the 'type' of KFH. Table 2-2 defines those types of habitats that are considered KFH for the purpose of the application of the FM Act.

It is noted that for the purposes of the policy and guidelines, first and second order streams on gaining streams (streams where the channel bottom is lower than the level of the surrounding groundwater table so that water potentially moves from the ground into the channel) are not considered KFH. In addition, the definition of "fish" includes not only fin fish, but also crustaceans, molluscs, worms, insects and other invertebrates that spend all or part of their life cycle in aquatic habitats.

Table 2-2. Key fish habitat and sensitivity classification scheme (DPI, 2013)

Sensitivity Ranking	Waterway Description
TYPE 1 Highly sensitive key fish habitat	• Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants • Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act
TYPE 2 Moderately sensitive key fish habitat	• Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1 • Weir pools and dams up to full supply level where the weir or dam is across a natural waterway
TYPE 3 Minimally sensitive key fish habitat may include	• Coastal and freshwater habitats not included in TYPES 1 or 2 • Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

The impacts of the proposal on KFH are discussed in section 5.5.1.

The policy and guidelines also states that *"to ensure "no net loss" of aquatic habitats, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon KFH. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works"*.

The proposed design and alignment, construction methodology, mitigation measures, rehabilitation strategy and operational monitoring and management have minimised impacts on KFH. Mitigation should include re-establishing habitat that has been removed or otherwise damaged and improving water quality.

No offsetting is required under the FM Act as there will be no net loss of aquatic habitats, which was confirmed by DPI (Appendix G). During consultation, DPI requested that some habitat improvement opportunities be considered as part of the proposal. This is discussed in Chapter 7.

2.1.3.2 Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings

Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003*)* provides guidelines for the planning, design, construction and maintenance of watercourse crossings aimed at minimising impacts on fish passage and aquatic biodiversity. The guidelines outlines types of potential impacts from instream structures and subsequently provides guidance on suitable crossing structures to avoid barriers to fish passage.

DPI considers proposals in relation to habitat sensitivity type (Table 2-2) and also waterway class. The waterway classification scheme has been adapted from Fairfull and Witheridge (2003) and factors in the functionality of the waterway as fish habitat (Table 2-3). Watercourses are classified using indicators such as:

- hydraulic geometry (stream shape and size),
- frequency of stream flows (perennial, intermittent or ephemeral),
- presence of aquatic habitat units (pools, riffles, vegetation, snags),
- presence of threatened or protected fish species and other native fish, and
- connection to adjacent habitats (e.g. floodplain wetlands).

Waterway class can be used to assess the impacts of certain activities on fish habitats in conjunction with the habitat sensitivity type. The waterway class scheme can also be used to make management recommendations to minimise impacts on different fish habitats.

Table 2-3. Classification of waterways for fish passage (Fairfull & Witheridge, 2003)

Classification	Characteristics of waterway class	Minimum [1] Recommended Crossing type
Class 1 Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	Bridge, arch structure or tunnel
Class 2 Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	Bridge, arch structure, culvert [2] or ford.
Class 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.	Culvert [3] or ford
Class 4 Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).	Culvert [4], causeway or ford
Notes [1] In all cases bridges are preferred to arch structures, culverts, fords and causeways (in that order). [2] High priority given to the "High Flow Design" procedures presented for the design of these culverts - refer to Design Considerations section of this document, or engineering guidelines (Witheridge, 2002). [3] Minimum culvert design using the "Low Flow Design" procedures; however, "High Flow Design" and "Medium Flow Design" should be given priority where affordable (refer to Witheridge (2002)). [4] Fish friendly waterway crossing designs possibly unwarranted. Fish passage requirements should be confirmed with the local fisheries department/authority.		

KFH maps have been compiled by DPI and are considered in section 3.4.1.

Potential impacts of the proposal on fish passage are considered in section 5.1.2 and section 5.2.2.

2.1.3.3 Threatened Species Survey and Assessment Guidelines

The NSW threatened species survey and assessment guidelines are referred to as the *Threatened Species Test of Significance Guidelines* (OEH, 2018).

The objective of section 7.3 of the BC Act, the test of significance, is to provide standardised and transparent consideration of threatened species and ecological communities, and their habitats, through the development assessment process.

The guidelines help applicants or proponents of a development or activity to interpret and apply the factors in the test. They also provide guidance for consent authorities to encourage a consistent method of assessment for applications that may have an impact on threatened species and ecological communities or their habitats. The guidelines relate to the determination of whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats, within the meaning of that phrase in section 7.3.

No aquatic threatened species or ecological communities listed under the BC Act were identified in desktop studies, hence these guidelines were not required for the aquatic impact assessment. These guidelines are relevant and considered further in the BDAR (Technical paper 8).

2.1.3.4 Aquatic Ecology in Environmental Impact Assessment – EIA Guideline

The aim of the guideline *Aquatic Ecology in Environmental Impact Assessment - EIA guideline* (NSW Department of Planning, 2003) (the EIA guideline) is to:

- Encouraging a standardised, rigorous approach to aquatic investigations in environmental impact assessment.
- Providing information which can be used to understand and manage changes to the aquatic environment in NSW.

The guidelines provide reference for:

- The extent to which the existing environment needs to be described.
- The extent to which a proposal is likely to affect aquatic biodiversity.
- The minimal acceptable standard for assessment of potential impacts on aquatic biodiversity.
- Predicting cumulative impacts within a body of water.
- When monitoring should be done and what components of the aquatic environment (biotic and abiotic) should be monitored.
- Requirements for adequate information to manage potential impacts and initiate feedback from monitoring to management.

The existing environment, assessment and sampling methodology, potential impacts, as well as recommendations for mitigation measures which are outlined in this report have taken into consideration the EIA guidelines.

2.1.3.5 Guidelines for controlled activities on waterfront land

The *Guidelines for controlled activities on waterfront land: Riparian corridors* (DPI, 2018) include provision for the protection of waterfront land. Controlled activities include any works or any activity which affects the quantity or flow of water in a water source, carried out in, on, or under waterfront land.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40m of the highest bank of the river, lake or estuary.

A key objective of these guidelines is to establish and preserve the integrity of riparian corridors. Ideally, the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System.
- If a watercourse is present, define the riparian corridor/vegetated riparian zone (VRZ) on a map in accordance with Table 2-4.
- Seek to maintain or rehabilitate a riparian corridor/VRZ with fully structured native vegetation in accordance with Table 2-4.
- Seek to minimise disturbance and harm to the recommended riparian corridor/VRZ.
- Minimise the number of creek crossings and provide perimeter road separating development from the riparian corridor/VRZ.
- Locate services and infrastructure outside of the riparian corridor/VRZ. Within the riparian corridor/VRZ provide multiple service easements and/or utilise road crossings where possible.
- Treat stormwater run-off before discharging into the riparian corridor/VRZ.

Non-riparian corridor works such as infrastructure, can be authorised within the outer riparian corridor, so long as the average width of the VRZ can be achieved over the length of the watercourse within the development site.

While non-native vegetation may provide some bank stability, the objectives of the guidelines relate to the preservation and rehabilitation of native riparian vegetation in accordance with the minimum riparian corridor requirements.

Table 2-4. Recommended riparian corridor widths (DPI, 2018)

Watercourse type	VRZ width (each side of watercourse)	Total RC width
First order	10 metres	20 metres + channel width
Second order	20 metres	40 metres + channel width
Third order	30 metres	60 metres + channel width
Forth order and greater	40 metres	80 metres + channel width

Note: Where a watercourse does not exhibit the features of a defined channel with bed and banks, the Natural Resources Access Regulator (NRAR) may determine that the watercourse is not waterfront land for the purposes of the WM Act.

The impacts of the proposal on riparian vegetation are considered in section 5.1.

2.1.3.6 NSW Sustainable Design Guidelines

The Sustainable Design Guidelines (TfNSW, 2017) seek to deliver sustainable development practices by embedding sustainability initiatives into the planning, design, construction, operations and maintenance of transport infrastructure projects.

The development of the guidelines has been influenced by the Transport for NSW (TfNSW) Environment and Sustainability Policy and TfNSW Long Term Transport Master Plan. The guidelines incorporate the following key aims:

- Minimising impacts on the environment, whether through transport operations, infrastructure delivery or maintenance.
- Procuring, delivering and promoting sustainable transport options that achieve value for money and reduced life cycle costs.
- Developing, expanding and managing the transport network that is sustainable and climate resilient.

The guidelines identify significant biodiversity impacts as:

- Where proposed vegetation clearing is deemed 'significant' for the purposes of section 111 (now section 5.5) of the EP&A Act.
- Significant impact on threatened flora species, or ecological community, habitat of a threatened species listed under the NSW BC Act or EPBC Act.
- Significant impact on native vegetation that represents part of a wetland of international importance, or natural heritage values of a World Heritage property, natural heritage values of a National Heritage place.
- Where the Commonwealth Minister for the Environment has determined the project is a 'controlled action'.

Of relevance to this aquatic assessment, impacts on wetlands of international importance are considered in section 4.9.9.

3. Methodology

3.1 Study area

The study area for the assessment included watercourses either directly or indirectly affected by the proposal, which was identified by application of a 200 metre buffer around the proposal site. A broader area was applied for the desktop assessment and database searches (refer section 3.2).

Section 3.5 describes the criteria for the selection of watercourses considered suitable for habitat assessments and fauna surveys.

Survey sites included a 100m reach along each watercourse (subject to property access and other constraints), within which habitat assessments and surveys were undertaken.

3.2 Desktop assessment

A desktop review of relevant guidelines, previous species sighting records, documents and reports relevant to the proposal was undertaken from the locality using the following public ecological databases and websites:

- A search of the NSW Fisheries threatened species list (DPI, undated a) and Spatial Data Portal for the Murray Darling Basin South (DPI, undated b) including:
    - KFH mapping (section 3.4.1),
    - Threatened species distribution maps which provide the indicative (or known and expected) distributions for a number of NSW freshwater threatened species based on modelling. The indicative distribution means there is a high probability that the species would occur in a stream segment, given the species has been recorded there or the environmental conditions are the same as a stream segment where the species is already known to occur. Modelled indicative distribution maps are not available for all NSW freshwater threatened species due to the limited number of records for some species or the limited number of correlated environmental attributes (Appendix A).
    - Fish Community Status of NSW mapping and Fish Communities and Threatened Species Distribution of NSW Report prepared by DPI (DPI, 2016). The report rates the condition of fish communities as Very Good, Good, Moderate, Poor or Very Poor (section 3.8).
- A region search using Natural Resource Management Regions: Riverina and Murray, was undertaken on the Commonwealth Department of the Environment Protected Matters Search Tool (PMST) for MNES, accessed 18 May 2021 (section 4.9.3, Appendix B).
- Species Profile and Threats Database, profiles and references therein for federally listed threatened species were used to determine likely occurrence (Appendix D) and provide distribution and habitat information (Appendix F).
- For threatened species where distribution maps are not available, habitat assessment and review of Primefacts for each individual species were used to determine their likely presence (NSW DPI, undated c).
- An area search was conducted within the BioNet website for the Atlas of NSW Wildlife (OEH, 2021). BioNet is a portal for accessing government held information about plants and animals in NSW. It is supported by several NSW government held agencies. BioNet contains records for aquatic threatened species and EEC's listed under the BC Act, the FM Act and the EPBC Act which have been recorded within the locality. The search was conducted on 3 May 2021 within the Murrumbidgee and Murray Catchment Management Authority (CMA) geographic search areas for all protected species (threatened and non-threatened) (section 4.9.1).
- Atlas of Living Australia (ALA) records. ALA is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources. A search of the ALA was conducted on 3 May 2021 within the Murrumbidgee and Murray CMAs for target threatened species, platypus, and reptiles (section 4.9.2).

- Review of Survey Guidelines for Australia's threatened fish (DSEWPC, 2011) to determine the likelihood of a species presence or absence at a site. The guidelines are not mandatory however, and desktop analysis of historic data can be used as an alternative survey approach.
- Review of DAWE Directory of Important Wetlands (DAWE 2021)

The information obtained was used to inform survey design and assist in the description of ecological context, assessment of potentially occurring threatened species, endangered populations (Eps) and threatened ecological communities (TECs).

3.3 Stream order mapping

The Strahler ordering system (Strahler, 1952), as described in NSW Government Gazette no. 37 on 24 March 2006 was used to characterise the watercourses within the study area.

The Strahler ordering system is a hierarchical numbering system based on the degree of branching within a watercourse and provides an indication of the complexity of a creek system. For the purposes of this order, watercourses are deemed to be continuous even if they lose definition and then reappear downstream. The methodology used is as follows:

- Starting at the top of a catchment, any watercourse which has no other watercourses flowing into it is classed as a first order stream (1).
- Where two first order streams join, the stream becomes a second order stream (2).
- If a second order stream is joined by a first order stream - it remains a second order stream.
- When two second order streams join, they form a third order stream (3).
- A third order stream does not become a fourth order stream until it is joined by another third order stream and so on.

Strahler stream orders for watercourses within the study area are listed in Table 3-3 and shown in Figure 3-1 to Figure 3-15.

3.4 Watercourse classification

3.4.1 Key fish habitat mapping

To meet the objectives of the FM Act to 'conserve key fish habitats', DPI identified KFH as those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally, and the survival and recovery of threatened aquatic species.

A policy definition of the term KFH was developed to guide the compilation of maps. For freshwater environments, KFH was defined to include most permanent and semipermanent freshwater habitats including:

- Permanently flowing rivers and creeks including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Intermittently flowing rivers and creeks that retain water in a series of disconnected pools after flow ceases including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Billabongs, lakes, lagoons, wetlands associated with other permanent fish habitats (e.g. permanent rivers and creeks, estuaries etc.).
- Flood channels or flood runners that may normally be dry but would be used by fish to move/migrate across or along floodplains between habitats during high flow events.
- Any waterbody, if it is known to support or could be confidently expected (based on predictive modelling) to support threatened species, threatened populations or threatened communities listed under the provisions of Part 7A of the FM Act.

Small headwater creeks and gullies (known as first and second order streams), that only flow for a short period after rain were generally excluded, as were farm dams constructed on such systems. Wholly artificial waterbodies such as irrigation channels, urban drains and ponds, salt and evaporation ponds were also excluded except where they are known to support populations of threatened fish or invertebrates.

The study area crosses five watercourses mapped by DPI as KFH:

1. Jeralgambeth Creek (Junee to Illabo clearances)
2. Sandy Creek (Uranquinty Yard clearances)
3. Buckaringah Creek (Henty Yard clearances)
4. Oddies Creek (Murray River bridge)
5. Murray River (Murray River bridge).

3.4.2 Key fish habitat sensitivity and class analysis

Following site inspections, additional watercourses to those listed above in section 3.4.1, were determined to have KFH and assigned a sensitivity type accordingly (refer Table 4-2).

The *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) provides a framework to classify KFH types based on their aquatic habitat features as described in Table 2-2.

In addition to the habitat sensitivity type, DPI assesses proposals in relation to waterway class. The waterway classification scheme has been adapted from Fairfull and Witheridge (2003) and factors in the functionality of the waterway as fish habitat. The criteria by which the watercourse class is derived are defined in Table 2-3.

3.5 Determination of survey sites

Using electronic hydroline mapping, 26 mapped watercourses (including drainage lines) and three waterbodies (including an artificial wetland) were identified within the study area at the following enhancement sites:

1. Murray River bridge
2. Billy Hughes bridge
3. Table Top Yard clearances
4. Henty Yard clearances
5. Yerong Creek Yard clearances
6. Uranquinty Yard clearances
7. Pearson Street bridge
8. Harefield Yard clearances
9. Kemp Street bridge
10. Junee Yard clearances
11. Olympic Highway underbridge
12. Junee to Illabo clearances.

The 26 watercourses and three waterbodies at the above enhancement sites are shown in Figure 3-1 to Figure 3-15. The criteria in Table 3-1 was used to rank these watercourses into one of three categories – high, moderate and low priority. The 26 watercourses identified within the study area were assigned a priority ranking based on the criteria and are summarised in Table 3-2 for each precinct. Watercourses with a moderate or high priority ranking were used for the selection of survey sites and potential targeted threatened species survey.

Twenty eight farm dams occur within the study area on privately owned land, however as farm dams are not defined as KFH and were considered unlikely to provide habitat for threatened species, they were assigned a low priority ranking.

Table 3-1. Watercourse categories

Priority ranking	Criteria
High	• Key Fish Habitat (DPI, 2007a). • Threatened fish species predicted to occur based on DPI mapping (DPI, 2016) and results of database searches (Protected Matters Search Tool and ALA (2021) records).
Medium	• Key Fish Habitat (DPI, 2007a). • Third order or above (Strahler stream ordering system). • Identified as having nearby wetland habitat.
Low	• Threatened fish species unlikely to occur based on DPI (2016) mapping and results of database searches (Protected Matters Search Tool and ALA (2021) records). • Not Key Fish Habitat (DPI, 2007a). • First or second watercourses order based on Strahler stream order.

Table 3-2. Watercourse priority

Priority category	Watercourses
Albury Precinct	
High	Murray River (Murray River bridge)
Medium	Oddies Creek (Murray River bridge) Eight Mile Creek (Billy Hughes bridge)
Low	Two unnamed tributaries of Eight Mile Creek (Billy Hughes bridge) Unnamed unconnected tributary (Table Top Yard clearances)
Greater Hume – Lockhart Precinct	
High	Buckaringah Creek (Henty Yard clearances)
Medium	Sandy Creek (just outside of the Yerong Creek Yard clearances study area)
Low	Wetland (Culcairn Yard clearances)
Wagga Wagga Precinct	
High	Sandy Creek (Uranquinty Yard clearances)
Medium	Unnamed artificial drainage line (Pearson Street bridge)
Low	Unnamed tributary of Sandy Creek (Uranquinty Yard clearances) Artificial wetland (Pearson Street bridge)
Junee Precinct	
Medium	Reedy Creek (Harefield Yard clearances) Bucks Creek (Harefield Yard clearances) Unnamed tributary of Houlaghans Creek (Kemp Street bridge) Jeralgambeth Creek north (Junee to Illabo clearances) Jeralgambeth Creek south (Junee to Illabo clearances) Wetland west of Jeralgambeth Creek (Junee to Illabo clearances)

Priority category	Watercourses
Low	Unnamed tributary of Reedy Creek (Harefield Yard clearances)
	Two unnamed tributaries of Houlaghans Creek (Olympic Highway underbridge)
	Three unnamed unconnected tributaries (Junee to Illabo clearances)
	Four unnamed tributaries of Jeralgambeth Creek (Junee to Illabo clearances)

Three watercourses are mapped by DPI as KFH and within the indicative distribution mapping for a threatened species (DPI, 2016). These were defined as high priority watercourses. Nine watercourses were mapped by DPI as KFH, are third order or above watercourses based on the Strahler stream order mapping or were identified as important habitat during desktop review. These watercourses were defined as medium priority. The remaining 14 watercourses were not mapped as KFH, were not within the indicative threatened species mapping (DPI, 2016) and were first or second order watercourses which are generally not included as KFH (DPI, 2013). Three first order water courses were an exception to this:

1. Oddies Creek is a first order watercourse however it was mapped by DPI (2016) as KFH and was assigned a medium priority ranking.
2. Unnamed watercourses at Pearson Street bridge was not a mapped hydroline and is therefore assigned a zero Strahler stream order, but was included in assessment as desktop studies indicated there was a nearby (artificial) wetland (ERM, 2020).
3. Unnamed first order watercourse at Kemp Street bridge was assigned a medium priority as there is potential for direct impacts to this watercourse during construction.

Strahler stream orders have been mapped for each hydroline that crosses the study area (Figure 3-1 to Figure 3-15) and survey sites were selected where the study area intersected a medium or high priority watercourse or the closest point to the proposal site. Sandy Creek at Yerong yard clearances (including survey site 8), was within the study area at the time of survey, however following design changes, this watercourse and survey site now occur outside of the study area. This watercourse has been retained in this assessment for consideration of potential indirect impacts on Sandy Creek. Buckaringah Creek occurs within the study area, however following design changes, survey site 9 on Buckaringah Creek is located outside of the study area. The location of survey site 9 was selected based on accessibility to the watercourse as it is within the rail corridor, not on privately owned land.

Survey sites are summarised in Table 3-3, including coordinates, Strahler stream order and the respective catchment.

Table 3-3. Survey site identification, proposal site, co-ordinates, watercourse, Strahler stream order and catchment

Survey Site	Enhancement Site	Map Y [a]	Map X [a]	Watercourse	Strahler Stream Order	Catchment
12	Murray River bridge	491890.46	6004985.74	Murray River	9	Mid Murray
11	Murray River bridge	492135.90	6005119.73	Oddies Creek	1	Mid Murray
10	Billy Hughes bridge	499197.31	6016231.64	Eight Mile Creek	4	Mid Murray
9	Henty Yard clearances	503164.74	6069972.05	Buckaringah Creek	4	Murrumbidgee
8	Yerong Creek Yard clearances	505324.85	6083560.27	Sandy Creek (outside of study area)	3	Murrumbidgee
7	Uranquinty Yard clearances	522003.40	6105332.51	Sandy Creek	6	Murrumbidgee
6	Pearson Street bridge	531274.93	6112904.02	Unnamed	0	Murrumbidgee
5	Harefield Yard clearances	547486.32	6131149.49	Reedy Creek	4	Murrumbidgee
4	Harefield Yard clearances	547536.94	6131227.52	Bucks Creek	4	Murrumbidgee
3	Kemp Street bridge	553309.35	6140871.26	Unnamed	3	Murrumbidgee
2	Junee to Illabo clearances	569613.22	6148291.16	Jeralgambeth Creek	3	Murrumbidgee
1	Junee to Illabo clearances	569774.91	6148393.96	Jeralgambeth Creek	4	Murrumbidgee

[a] Coordinates taken from field Garmin GPS Map Datum GDA 1994 zone 55

3.6 Field survey

Preliminary mapping of the broad scale aquatic habitats within the study area was undertaken using recent aerial photography in conjunction with topographic maps prior to field surveys. Topographic maps were used to gain a broad understanding of catchment characteristics including adjacent land use, elevation, access routes and distance from source.

Two aquatic surveys were undertaken at high and moderate priority watercourses where access permitted.

Aquatic surveys were undertaken on:

- 2-3 February 2021 (by Aquatica Environmental, 2021)
- 24-25 May 2021

3.6.1 Habitat assessment

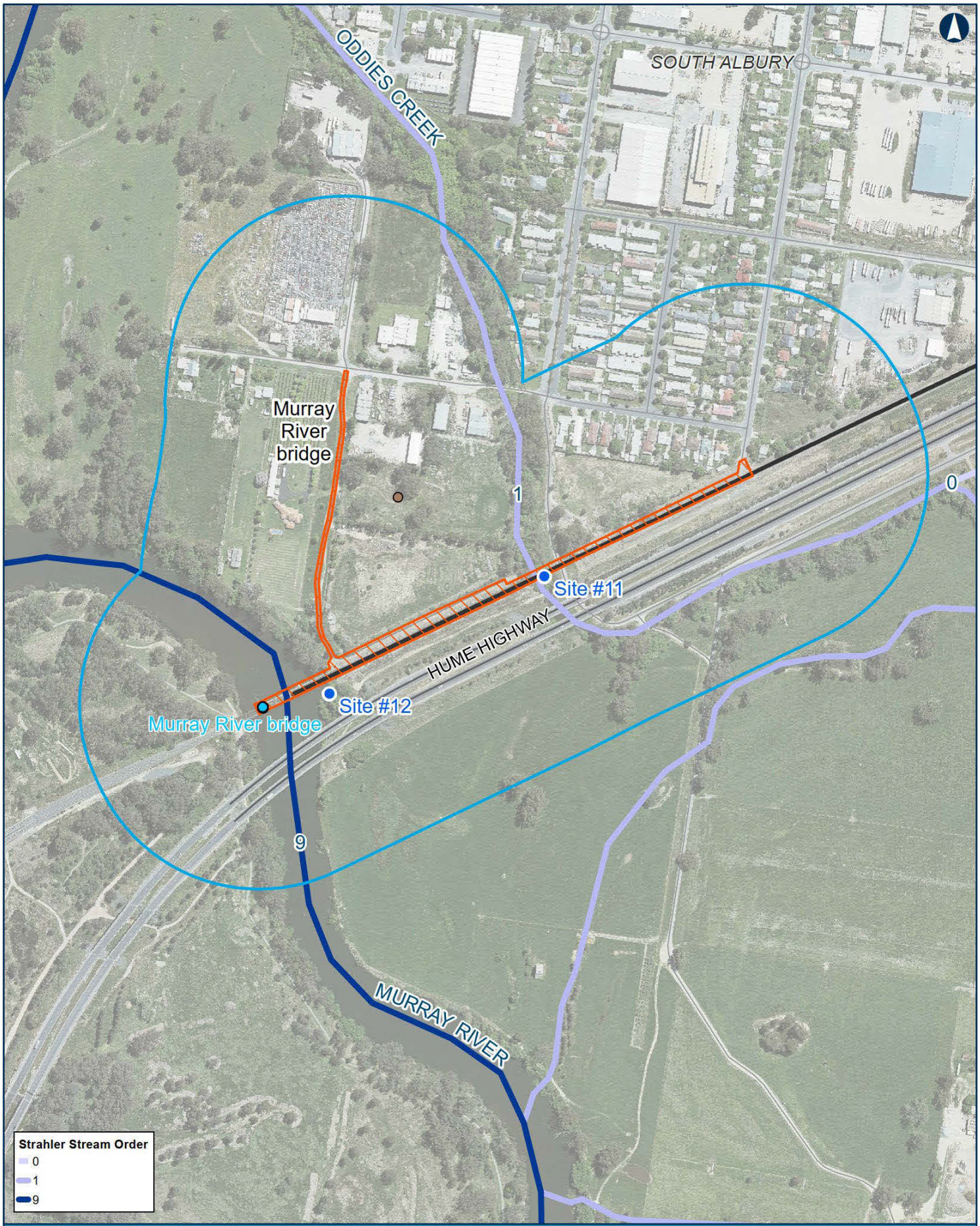
An assessment of the aquatic habitat at each of the survey sites was undertaken, and indicators of stream condition noted. The aquatic habitat characteristics were recorded using standard recording sheets (NSW AUSRIVAS, 2007) along with assessment of the suitability of the habitat for threatened species with potential to occur in the area.

Habitat features and stream condition indicators assessed include:

- Topography
- Water level (height of bank and evidence of erosion)
- Shading of the river
- Riparian vegetation (percent cover of upper, middle and lower stratum)
- Stream width (minimum, maximum., mode)
- Stream depth (minimum, maximum, mode)
- Identification of macrophytes
- Per cent cover of aquatic vegetation (algae, moss, macrophytes)
- Per cent cover of detritus
- Description of natural substrate (percent bedrock, boulder, cobble, clay etc)
- Per cent of total macrophytes that are submerged, emergent or floating
- Presence of drought and flood refuge areas
- Presence of pool, riffle and edge habitats
- Presence of natural or artificial barriers to fish passage upstream and downstream
- Visual assessment of disturbance related to human activities for:
    - water quality
    - instream habitat
    - riparian zone
    - catchment assessment

  Visual assessments are ranked using the following categories
    - no evidence of disturbance
    - little disturbance
    - moderate disturbance
    - high disturbance
    - extreme disturbance

Photographs were also taken upstream and downstream from the centre point of each survey site.



Albury to Illabo

Figure 3.1 Murray River bridge (Murray River & Oddies Creek)

0 100 m

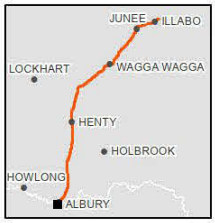
Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:4,000
Data Sources: ARTC, NSWSS

- Proposal site
- Existing railway
- Main road
- Local road
- Study area
- Survey sites
- Bridge modification / enhancement

Dams and wetlands

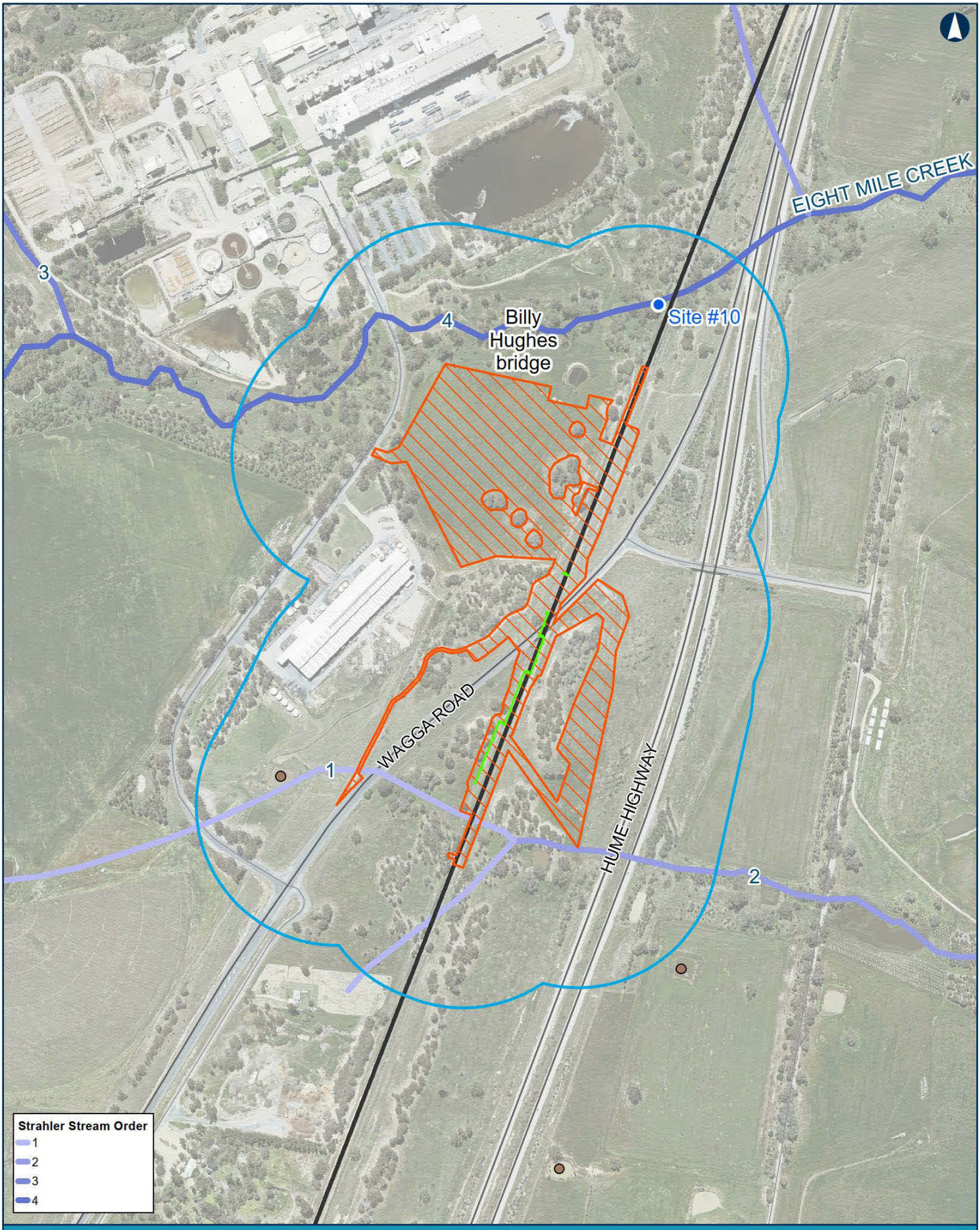
- Farm dam



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



Albury to Illabo Figure 3.2 Billy Hughes bridge

0 100 m

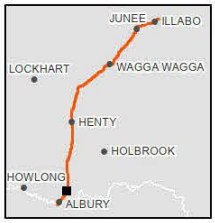
Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:5,000
Data Sources: ARTC, NSWSS

Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Survey sites

Dams and wetlands

Farm dam



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd

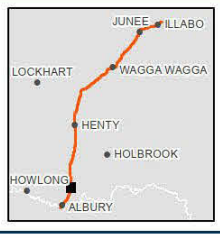
Albury to Illabo Figure 3.3 Table Top Yard clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:7,500
Data Sources: ARTC, NSWSS

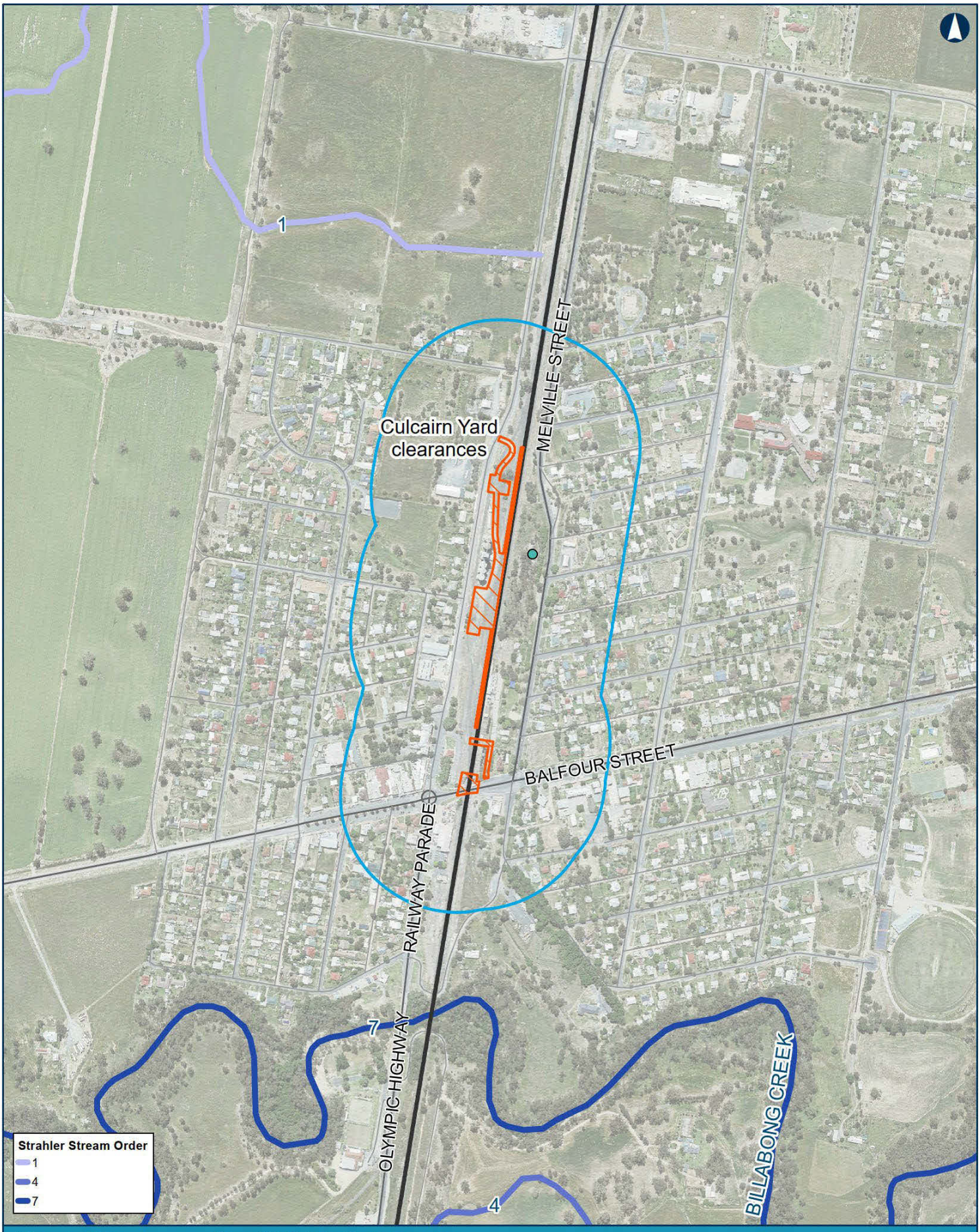
Proposal site
Existing railway
Main road
Local road
Study area
Dams and wetlands
Farm dam



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



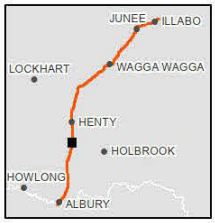
Albury to Illabo Figure 3.4 Culcairn Yard clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

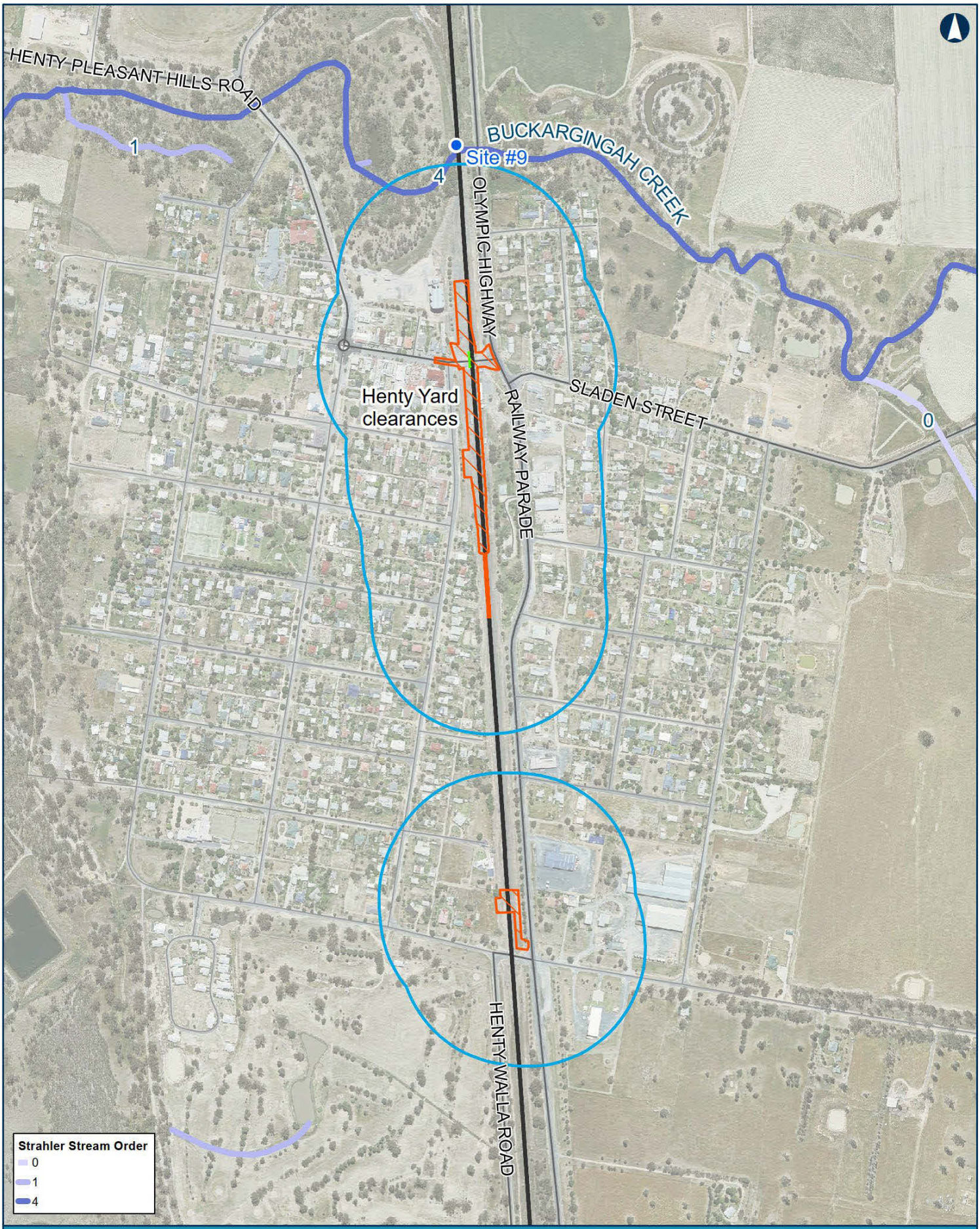
Proposal site
Existing railway
Main road
Local road
Study area
Dams and wetlands
Wetland



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



Albury to Illabo Figure 3.5 Henty Yard clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

Proposal site
Study area
Existing railway
Proposed culvert
Main road
Survey sites
Local road

Note: Survey site 9 was selected as it is within the rail corridor (not on privately owned land) however following design changes to the proposal, it occurs outside of the study area

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0305_AquaticAssessmentStudyArea_Henty_r1v8.mxd

Albury to Illabo Figure 3.6 Yerong Creek Yard clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

Proposal site
Existing railway
Main road
Local road
Study area
Survey sites

Dams and wetlands

Farm dam

Note: Sandy creek and survey site 8 occur outside of the study area following design changes to the proposal

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0306_AquaticAssessmentStudyArea_Yerong_r1v8.mxd

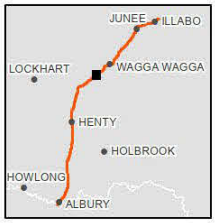
Albury to Illabo Figure 3.7 Uranquinty Yard clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Survey sites



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd

Albury to Illabo

Figure 3.8 Pearson Street bridge

0 100 m

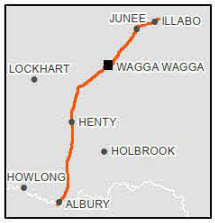
Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

- Proposal site
- Existing railway
- Main road
- Local road
- Study area
- Proposed culvert
- Survey sites

Dams and wetlands

- Artificial wetland



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP.O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd

Albury to Illabo Figure 3.9 Harefield Yard clearances

0 100 m

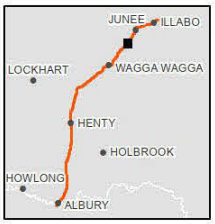
Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

Proposal site
Existing railway
Main road
Local road
Study area
Survey sites

Dams and wetlands

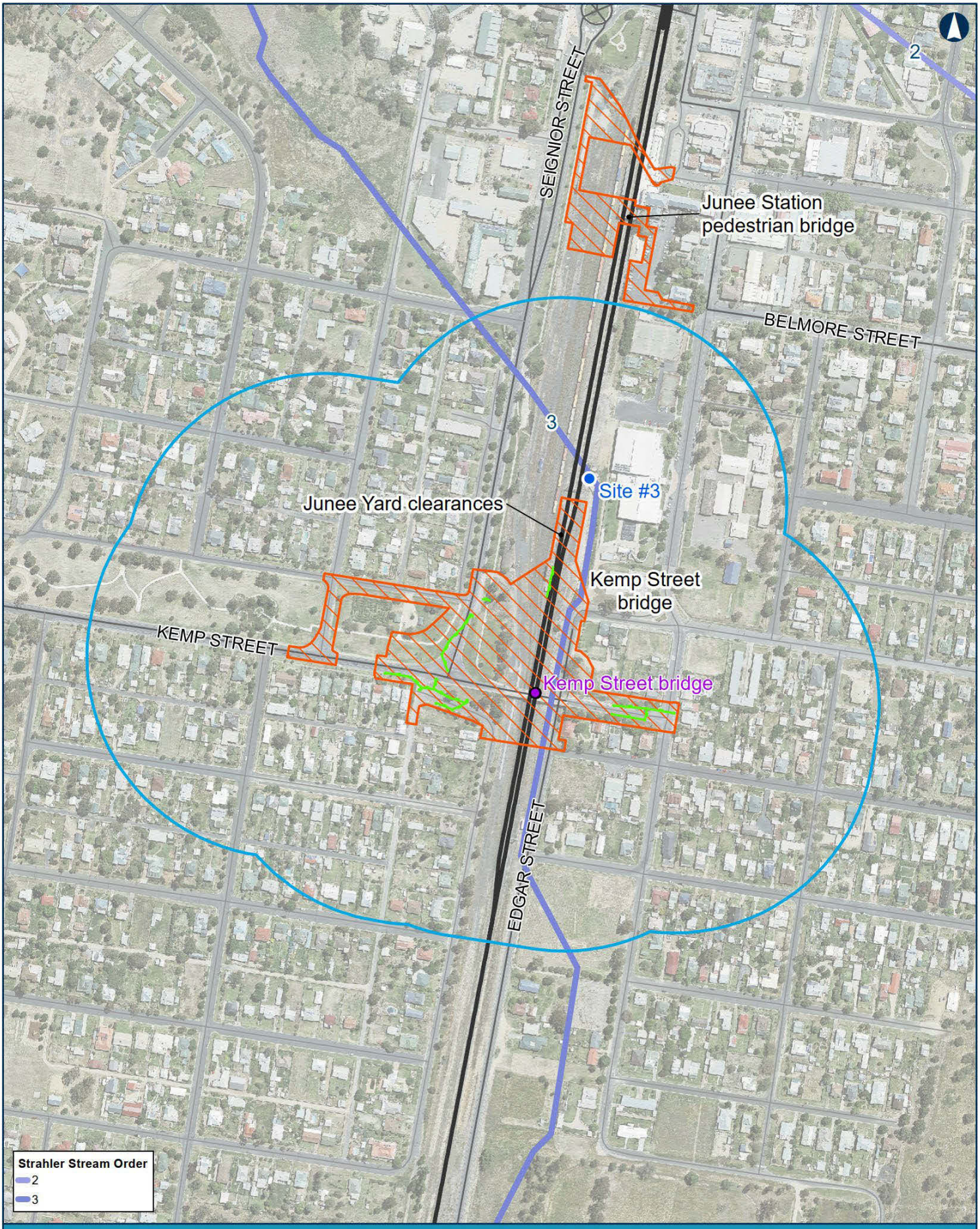
Farm dam



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



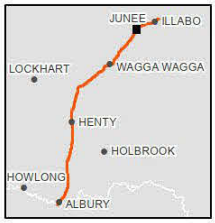
Albury to Illabo Figure 3.10 Kemp Street bridge

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:3,500
Data Sources: ARTC, NSWSS

- Proposal site
- Study area
- Existing railway
- Proposed culvert
- Main road
- Survey sites
- Local road
- Bridge replacement



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd

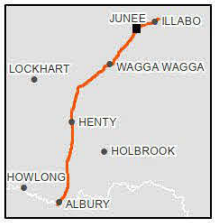
Albury to Illabo Figure 3.11 Junee Yard clearances and Junee Station sites

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:3,000
Data Sources: ARTC, NSWSS

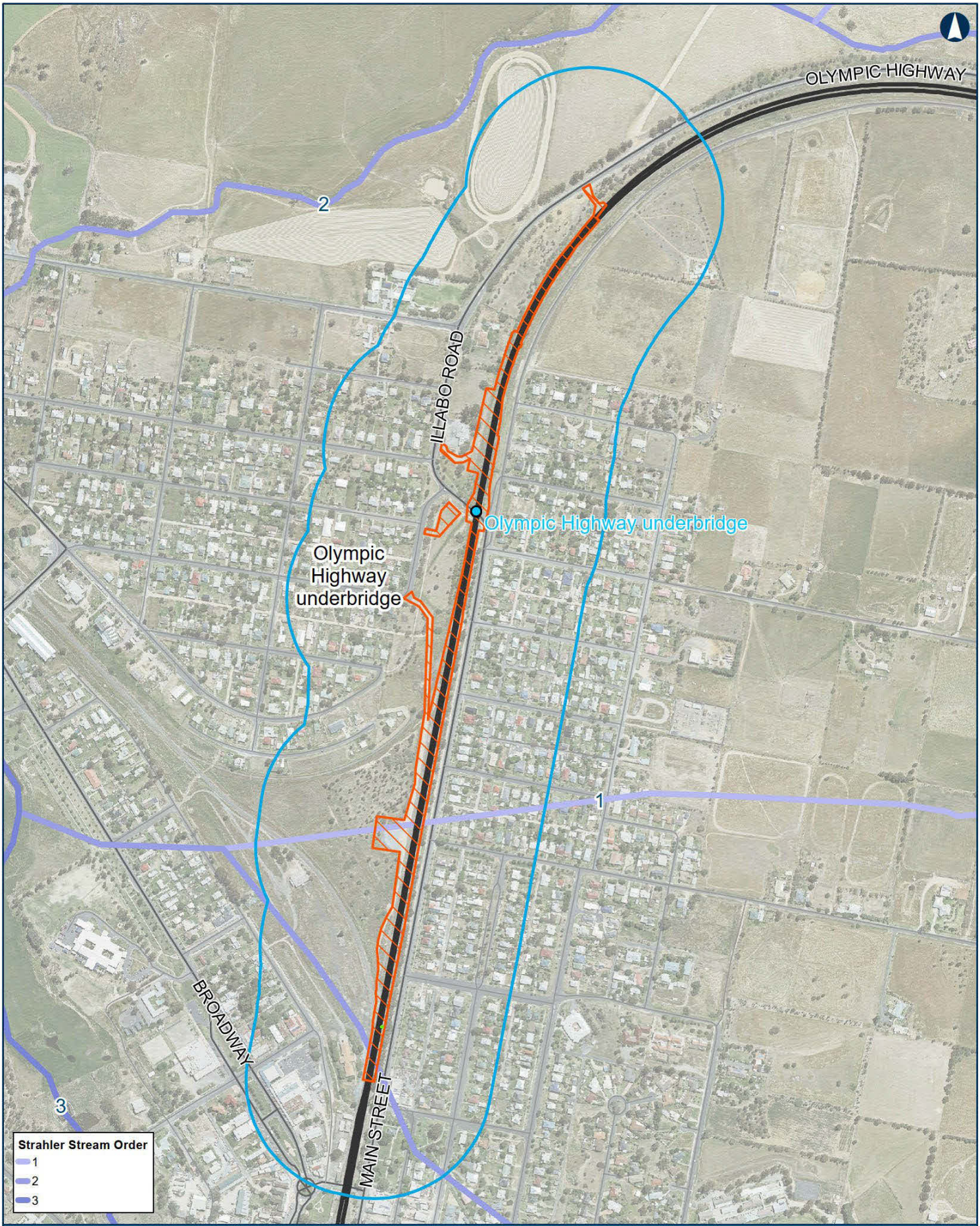
Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Survey sites
Bridge replacement



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



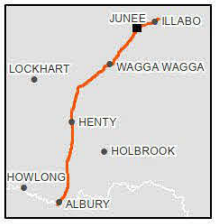
Albury to Illabo Figure 3.12 Olympic Highway underbridge

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:6,000
Data Sources: ARTC, NSWSS

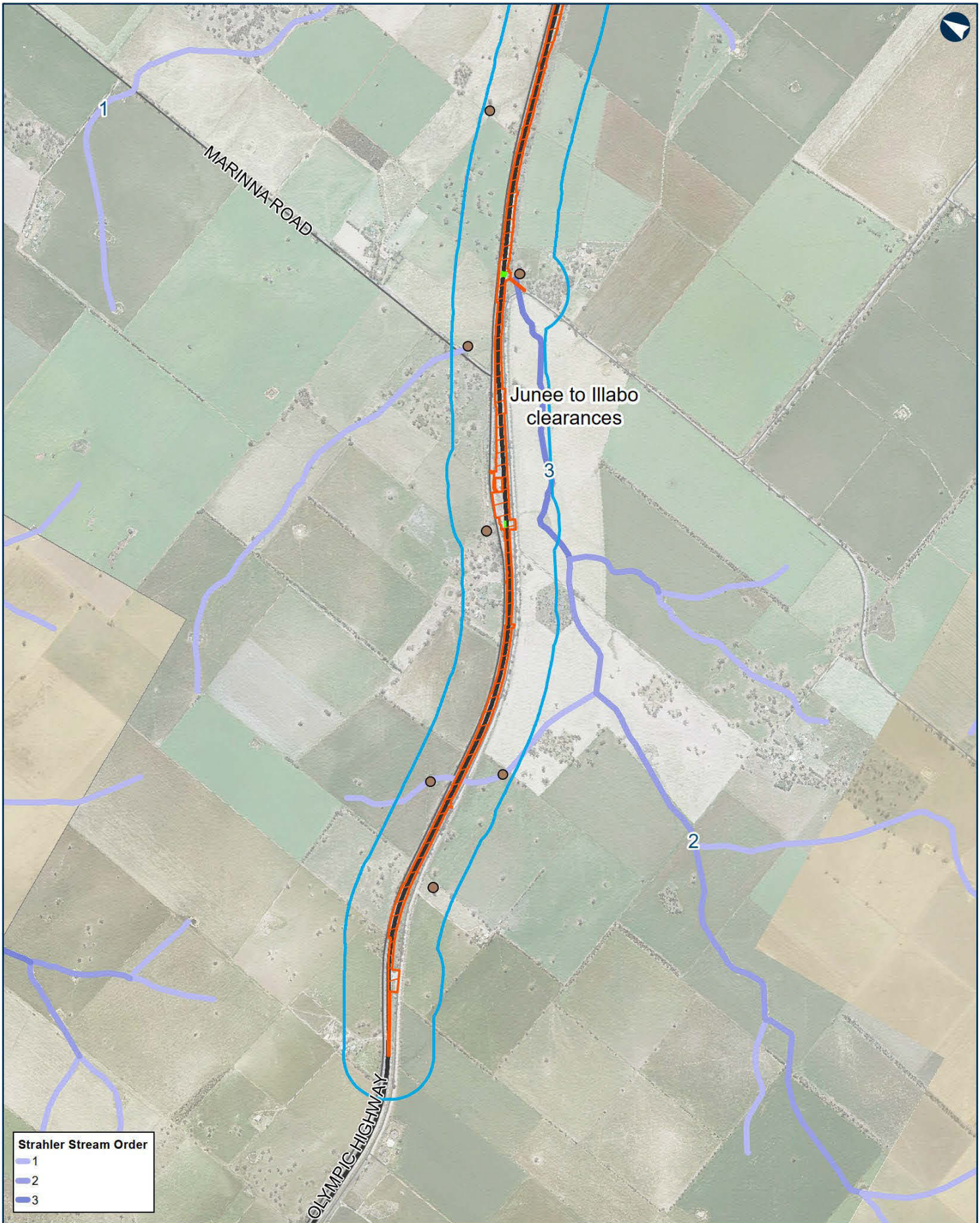
Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Bridge modification / enhancement



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



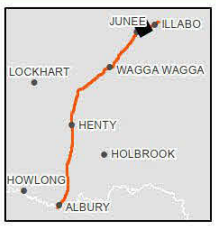
Albury to Illabo Figure 3.13 Junee to Illabo clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:16,000
Data Sources: ARTC, NSWSS

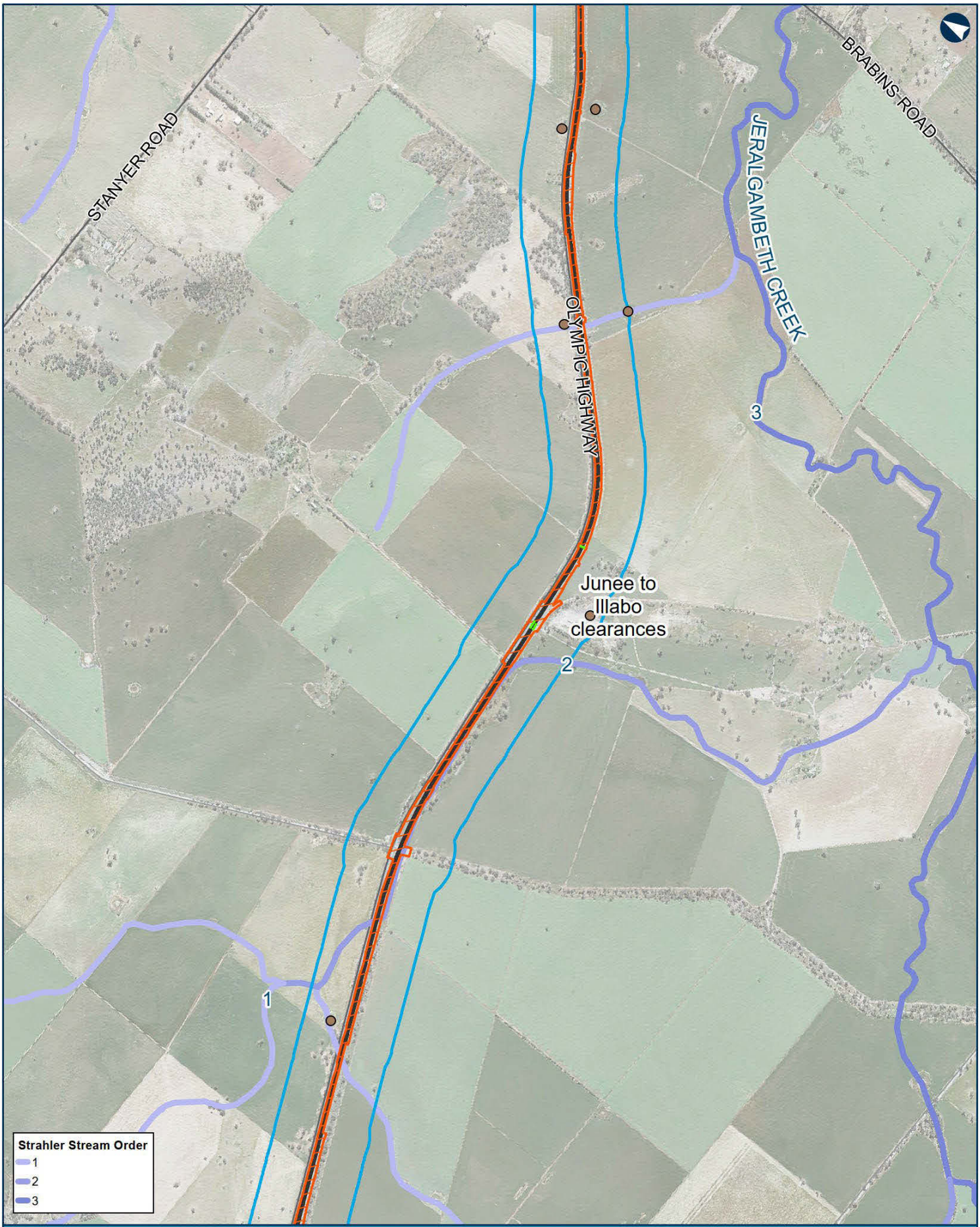
Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Dams and wetlands
Farm dam
Footprint



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



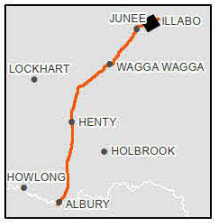
Albury to Illabo Figure 3.14 Junee to Illabo clearances

0 100 m

Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:16,000
Data Sources: ARTC, NSWSS

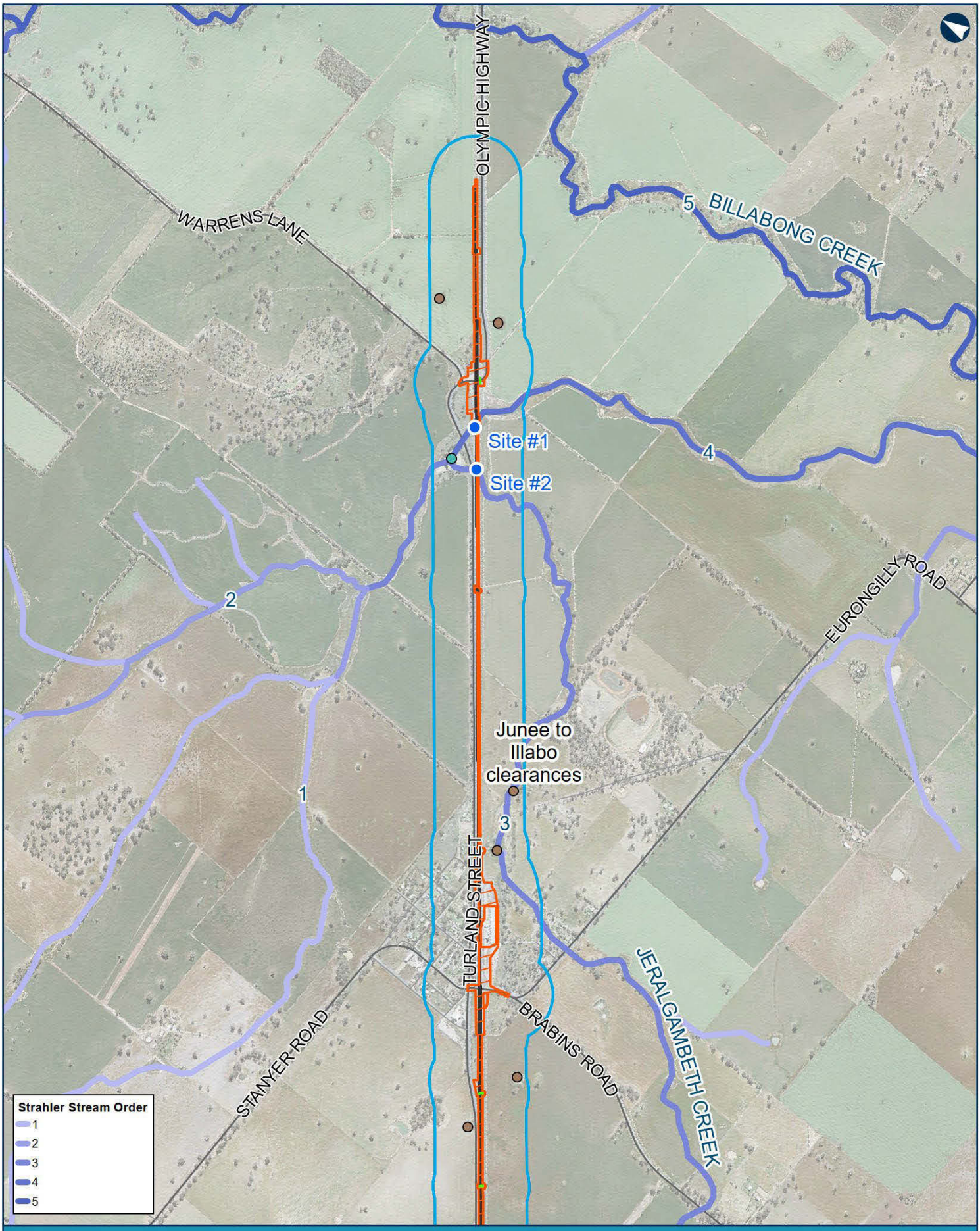
Proposal site
Existing railway
Main road
Local road
Study area
Proposed culvert
Dams and wetlands
Farm dam



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd



Albury to Illabo Figure 3.15 Junee to Illabo clearances

0 100 m

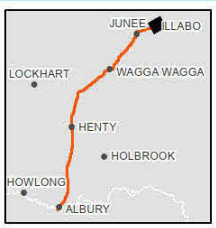
Coordinate System: GDA 1994 MGA Zone 55

Date: 16/02/2022 Paper: A3
Author: WSP Scale: 1:16,000
Data Sources: ARTC, NSWSS

- Proposal site
- Existing railway
- Main road
- Local road
- Study area
- Proposed culvert
- Survey sites

Dams and wetlands

- Farm dam
- Wetland



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_F0301_AquaticAssessmentStudyArea_r1v8.mxd

3.6.2 Targeted threatened species survey requirements

Guidelines are available for sampling threatened aquatic species listed under the EPBC Act, however they are not available for threatened aquatic species listed under the FM Act. Where available, recommended sampling techniques targeting threatened species are summarised in Table 3-4.

Table 3-4. Summary of recommended survey techniques for target threatened species

Target threatened species	FM Act	EPBC Act	Recommended Sampling Techniques (DSEWPC, 2011)
Flathead Galaxias (*Galaxias rostratus*)	CE	CE	No specific survey technique is available for this species. General recommendations for sampling galaxiids include: • Night sampling • Electrofishing • Scoop nets • Plastic traps (bait traps[a]) • Soft mesh fyke nets left overnight (cod ends out of the water or buoyed)
Macquarie Perch (*Macquaria australasica*)	E	E	Survey from March – September in cool clear waters in slow-flowing deep rocky pools of rivers as well as lakes and reservoirs. Adults are solitary near the bottom or midwater. Survey techniques: • Boat-based electrofishing • fyke nets[b] • snorkelling in clear streams for juveniles
Murray Cod (*Maccullochella peelii*)	-	V	Sample from March – August in waters up to 5 metres deep and in sheltered areas with cover from rocks, timber or overhanging banks. Survey techniques: • Larval sampling • Boat-based electrofishing • Daytime snorkelling • Lure fishing and angling along with techniques listed for Trout Cod below
Murray Crayfish (*Euastacus armatus*)	V	-	N/A Sample from May to October
Silver Perch (*Bidyanus bidyanus*)	V	CE	N/A
Southern Purple Spotted Gudgeon (*Mogurnda adspersa*)	E		No specific guidelines are available for this species however other gudgeon species are targeted using bait traps.
Southern Pygmy Perch (*Nannoperca australis*)	E		No specific guidelines are available for this species however other pygmy perch species are targeted using: • Backpack electrofishing combined with fine mesh seines and dip nets • Bait traps • Dip nets

Target threatened species	FM Act	EPBC Act	Recommended Sampling Techniques (DSEWPC, 2011)
Trout Cod (*Maccullochella macquariensis*)	E	E	Sample outside of spawning (October – November in areas of large woody debris in deep water • Boat-based and/or backpack electrofishing (however can result in high mortality rates for this species) • Fyke nets • Drum nets • Set-lines • Light traps • Yabby Traps • Set-lining gillnets • Angling (most successful method if experienced anglers are used). NB. this species may be inaccessible to conventional survey methods in deep water
Olive Perchlet (*Ambassis agassizii*)	Ep		No specific guidelines are available for this species however bait traps are considered suitable.
Murray-Darling Basin population of Eel Tailed Catfish (*Tandanus tandanus*)	Ep		N/A

N/A = Survey guidelines do not contain specific survey techniques for this species nor any general survey techniques for this genus.

Initial surveys by Aquatica Environmental indicated that except for the Murray River, all other watercourses were highly ephemeral, flowing only after rainfall with limited remnant pools. Similarly, during the May 2021 surveys, most watercourses within the study area were dry and fauna sampling opportunities were limited to survey sites containing remnant pools. Within the proposal site, the Murray River along with four ephemeral watercourses containing remnant pools were suitable for sampling (refer Table 3-5).

In the four ephemeral watercourses sampled, the remnant pools were small and shallow (less than 0.5 metre depth) and bait traps were considered the most appropriate sampling technique. There was insufficient space and/or flows at these survey sites for the use of other recommended sampling techniques identified in Table 3-4.

Bait traps were also the only sampling technique used in the Murray River as recommended survey methods for target pelagic species and/or larger bodied fish species (i.e. Murray Cod, Murray Crayfish, Silver Perch, Trout Cod, Macquarie Perch and Eel-tailed catfish) can result in false negative results, low detection rates or risk of harm to these species. It was determined that as the proposal did not involve any direct impacts on the Murray River, that there was sufficient evidence available in publicly accessible databases (ALA, 2021; DPI, 2016) to support species presence in the locality. As such, these larger species not targeted in the Murray River were assumed present in the locality and considered further in a likelihood of occurrence assessment (Appendix D).

Table 3-5. Fauna survey locations and sampling techniques

Survey Site	Enhancement site	Watercourse	Sample Technique[a]
12	Murray River bridge	Murray River	3 bait traps
11	Murray River bridge	Oddies Creek	3 bait traps
10	Billy Hughes bridge (withing 20m of watercourse)	Eight Mile Creek	3 bait traps
9	Henty Yard clearances (withing 50m of watercourse)	Buckaringah Creek	3 bait traps
1	Junee to Illabo clearances	Jeralgambeth Creek	3 bait traps

[a] Bait traps (0.5 metres long x 0.24 metres wide x 0.24 metres high) baited with chicken meal and cat food pellet and left for 2 hours.

3.7 Riparian and aquatic vegetation survey and mapping

Riparian vegetation (percent cover of upper, middle and lower stratum and dominant species) and aquatic vegetation (macrophytes) were recorded using standard recording sheets (NSW AUSRIVAS, 2007). This information is provided in Appendix C for each survey site and summarised in section 4.5.

In addition, the BDAR (Technical paper 8) mapped the terrestrial vegetation within the study area and categorised it into plant community types (PCTs) using plot/transect data. The methodology used is discussed further in the BDAR. The BDAR terrestrial vegetation mapping was used to determine the type and extent of riparian vegetation within the proposal site. The area of riparian vegetation along each hydroline was calculated using the *Guidelines for controlled activities on waterfront land: Riparian corridors* (DPI, 2018) (refer section 2.1.3.5 and Table 2.4 for methodology). The results are presented in section 4.7 and Table 4.3 and a summary of the riparian vegetation impacted by the proposal is provided in section 5.1.2.1.

3.8 Fish community status mapping

The Fish Communities and Threatened Species Distributions of NSW project (FCTSD) combined data collected over twenty years of biological surveys with standard statistical analysis and spatial distribution models, to provide mapping of the status of fish communities and threatened species distributions across NSW. The FCTSD project mapped the status of fish communities across NSW as Very Good, Good, Moderate, Poor, or Very Poor (DPI, 2016).

Fish community status within the locality was mapped by DPI on the following watercourses within the proposal site:

- Murray River (Murray River bridge) - Very Poor
- Buckaringah Creek (outside of but within 200m of Henty Yard clearances) - Very Poor
- Sandy Creek (Uranquinty Yard clearances) - Poor
- Jeralgambeth Creek (Junee to Illabo clearances) - Poor
- Jeralgambeth Creek (Junee to Illabo clearances) – Poor

The fish community status mapping is useful in determining the importance of the habitat within the proposal site to threatened species that occur in the locality.

3.9 Directory of important wetlands

The directory of important wetlands (DAWE, 2021) returned one important wetland within the proposal site: Doodle Comer Swamp. This wetland is located approximately 2.8 kilometres downstream of Buckaringah Creek which crosses the study area at the Henty Yard clearances enhancement site. The wetland is a shallow basin which receives seasonal inflow from winter rains. The Doodle Comer Swamp Nature Reserve was created in January 2011 and covers an area of 1,099 hectares (ha). Draft planning considerations for the wetland note that fish are

present, including European carp (*Cyprinus carpio*) and native species however details on types of native species present were not reported (DPIE, 2020).

Doodle Comer Wetland is a cultural area of high significance by Wiradjuri people. It is a place of both cultural and natural importance. While details of the cultural aspects of this significance were not disclosed, Registered Aboriginal Party's (RAPs) indicated that it was a highly significant place. Furthermore, its association with Buckargingah Creek and its songline reinforces the notion of that significance. Generally, the significance of the natural landscape was expressed by all RAPs during the survey work. This significance revolves around caring for country and ensuring that the proposal does not inadvertently impact the natural environment (Aboriginal cultural heritage assessment report - Technical paper 2).

No important wetlands were found associated with the other enhancement sites.

3.10 Risk of impact criteria

The criteria used to define the risk of impact of the proposal on watercourses at each enhancement site is provided in Table 3-6. The risk of impact of the proposal during construction and operation is considered in section 5 (Table 5-1 and Table 5-3).

Table 3-6. Criteria for defining the risk of impact of the proposal on receiving watercourses

Risk of Impact	Criteria
Moderate	Watercourse occurs within the proposal site, would be directly impacted by instream works or works within the riparian vegetation and or watercourses are defined as type 2 moderately sensitive KFH or above and or class 2 moderate KFH or above.
Low	Watercourse is within the proposal site however construction activities would be minor, would not directly impact the watercourses and indirect impacts can be managed.
Negligible	• Watercourse is within the study area but outside of the proposal site and would not be directly impacted by construction activities. Indirect impacts can be managed. • Watercourse is within the proposal site and directly impacted by construction activities however the watercourse has been defined as either Type 3 minimally sensitive KFH or no KFH, or as a low priority watercourse.

4. Existing environment

4.1 Weather and climatic conditions

The weather during surveys conducted between 2-3 February 2021 was fine and mild with air temperatures ranging between 13.2 - 27.5 degrees Celsius. Rainfall recorded at Wagga Wagga on 2 February 2021 was 13 millimetres (mm) and a total of 77.4 mm of rain was recorded at Wagga Wagga in the previous four weeks with higher rainfall recorded at Albury where a total of 96.8 mm of rainfall was recorded in the previous four weeks (BOM, 2021b).

During the second survey between 24-25 May 2021, temperatures had dropped slightly, ranging between 5.7 - 20.8 degrees Celsius. No rainfall occurred in the 24 hours prior to surveys and total rainfall in the preceding four weeks at Wagga Wagga was 17.8 mm while at Albury, total rainfall in the preceding four weeks was 34.4 mm (BOM, 2021b).

The mean annual rainfall for Wagga Wagga is 486 mm and while annual rainfall has been below this in the past eight years, annual rainfall in 2020 was 668.9 mm which was above the 90th percentile for this area. Rainfall in the first five months of 2021 was also above average (BOM, 2021b). Thus, the area is not considered to be in drought at the time of survey.

4.2 Murray Darling Basin

Information presented here relating to the Murray-Darling Basin was obtained from the Murray Darling Basin Authority (2020) unless cited otherwise.

The Murray-Darling Basin is the catchment for the Murray and Darling Rivers and all their tributaries, covering most of inland NSW and extending from Queensland to South Australia. It is the twentieth largest river catchment in the world, covering more than a million square kilometres, and contains 22 sub-catchments. It is a significant area for food production and aquatic ecosystems (DPIE, undated). Each of the 22 sub-catchments are a different size and have a varied climate, a different landscape, a diverse environment and different communities and industries that occur.

Some sub-catchments receive more rainfall than others. On average, more rain falls in the southern Basin than in the northern Basin. Some sub-catchments are quite flat and water doesn't naturally collect in those areas. Others have more hills or mountain ranges, which create natural valleys and lakes where water can be stored when it flows downhill.

The entire proposal site falls within the Murray Darling Basin however the two relevant sub-catchments are the Murray River catchment and the Murrumbidgee River catchment.

4.2.1 Murray River catchment and landscape

The Murray River is a sub-catchment of the Murray Darling Basin and includes the Albury precinct and a portion of the Greater Hume - Lockhart precinct (at Culcairn).

The Murray River is Australia's longest river, running a course of 2,500 kilometres from near Mount Kosciuszko in the Australian Alps to the Southern Ocean at Goolwa in South Australia. The catchment description of the Murray River is split into three sections — upper, central and lower. The Albury and part of the Greater Hume – Lockhart precincts fall within the central Murray catchment area.

The Murray River is wide and flows steadily in the central catchment, which is predominantly riverine plain on either side of the river. There are extensive floodplains and wetlands in this part of the catchment, including nationally and internationally significant sites.

The catchment is highly developed with many large urban centres established on the banks of the Murray River, and many significant dryland and irrigated agricultural industries located within the region.

The central Murray River catchment is mainly a broad floodplain that contains an intricate network of creeks, floodrunners (floodplain channels that flow during floods) and billabongs.

The central catchment starts in the foothills of the Great Dividing Range, east of Albury then through floodplain areas. River red gum forests dominate the vegetation of the central part of the Murray catchment.

Groundwater in the central Murray catchment is mainly found in the extensive alluvial groundwater systems on the New South Wales side of the Murray. Surface water and groundwater systems in the catchment are highly connected, but whether streams gain or lose water from the groundwater system, varies along the course of the river.

Named watercourses in the Albury precinct that cross the study area include Eight Mile creek, along with three tributaries, which flows south to its confluence with the Murray River and the Murray River itself, which flows west to the Southern Ocean at Goolwa.

Within the Murray River catchment, there are no named watercourses in the Greater Hume – Lockhart precinct that cross the study area, however an unnamed first order drainage line crosses the proposal site at Table Top Yard clearances and Billabong Creek, a seventh order watercourse, occurs outside of the study area near Culcairn enhancement sites.

4.2.2 Murrumbidgee River catchment and landscape

The Murrumbidgee River is a sub-catchment of the Murray Darling Basin and includes the Wagga Wagga, Junee and part of the Greater Hume - Lockhart precincts.

Almost one third of the Murray-Darling Basin's population live in the Murrumbidgee catchment and agriculture is an important land use in the catchment.

The source of the Murrumbidgee River is the Australian Alps, from Kosciuszko National Park and the Monaro High Plains through the Australian Capital Territory. It flows west into the south-west slopes of NSW across the riverine plains to its confluence with the Murray River near Balranald.

Surface water and groundwater systems in the catchment range from being highly connected to permanently disconnected. The interaction between the sources is influenced by extraction of surface and groundwater use, seasonal conditions and frequency and significance and duration of floods. Most upland streams receive flow from fractured rock aquifers.

The only watercourse in the Greater Hume – Lockhart precinct that crosses the study area is Buckaringah Creek near Henty, which is a tributary of Doodle Comer Swamp and is otherwise not connected to other creeks or the Murrumbidgee River.

Watercourses outside but nearby to the study area include Yerong Creek and Sandy Creek, which is a tributary of Yerong Creek which flows north into Bullenbong Creek and Old Man Creek before its confluence with the Murrumbidgee River, and Burkes Creek north of The Rock which is also outside of the study area but flows into the Murrumbidgee via Old Man Creek.

Watercourses in the Wagga Wagga precinct that cross the study area include Sandy Creek at Uranquinty. This creek is different and not connected to the Sandy Creek located at Yerong discussed above. Sandy creek flows north to its confluence with the Murrumbidgee River. The Murrumbidgee River occurs to the north of the Edmondson Street bridge however it is outside of the study area.

The only named watercourses in the Junee precinct that cross the study area is Jeralgambeth Creek, which along with three first and or second order drainage lines, flows east into Billabong Creek which then flows south to its confluence with the Murrumbidgee River.

An unnamed tributary also crosses the proposal site at Olympic Highway underbridge and flows northwest to its confluence with Houlaghans Creek, which flows south into the Murrumbidgee River.

4.3 Water Quality

Visual assessment of water quality was undertaken at each survey site using categories described (section 3.6.1). Watercourses with remnant pools present at the time of survey were categorised as having a moderate or high level of disturbance, attributed to inputs from nearby roads, rail and catchment land use practices (i.e., farming and residential and industrial development). Visual assessments for each survey site are provided in Appendix C.

The hydrology, flooding and water quality assessment (Technical paper 11) summarised the existing water quality in the study area (based on desktop review) as follows:

The existing water quality is varied across the study area. Water quality targets for turbidity and EC were generally achieved, particularly on larger waterways such as the Murrumbidgee and Murray Rivers. There was limited water quality data available for watercourses intersected by the proposal. Given the high proportion of land developed for urban and agricultural purposes within the study area, it is likely that runoff from these areas contributes to degradation of water quality, and some watercourses near the proposal would not achieve the water quality criteria, particularly for nutrients. The sources of the high nutrient levels are likely to be diffuse and related to current and historical agricultural activities within the study area.

4.4 Groundwater Dependent Ecosystems

The Bureau of Meteorology's GDE Atlas (BOM, 2021a) provides the following groundwater dependent ecosystem definitions:

- Aquatic ecosystems that rely on the surface expression of groundwater – this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – this includes all vegetation ecosystems.
- Subterranean ecosystems – this includes cave and aquifer ecosystems.

The GDE Atlas outlined three high or moderate potential aquatic GDEs which are associated with watercourses within the study area. These watercourses are listed in Table 4-1.

Table 4-1. BOM (2021a) aquatic GDE potential mapping summary

Watercourse	Aquatic GDE potential
Murray River	Moderate
Sandy Creek	High
Jeralgambeth Creek	High

The riparian vegetation associated with these GDEs within the proposal site are discussed further in section 4.7. Further details regarding GDEs is available in the Groundwater Assessment (Technical paper 12) and the BDAR (Technical paper 8) further considers terrestrial GDEs.

4.5 Aquatic habitat within the study area

Watercourses were categorised into KFH habitat types based on their sensitivity (DPI, 2013), watercourse classifications (Fairfull and Witheridge, 2003) and identified aquatic features in the field surveys. This is summarised in Table 4-2 and sections 4.5.1 to 4.5.4, with full details in Appendix C.

Table 4-2. Watercourses along the proposal site, type, class and presence of key fish habitat

Survey Site	Enhancement site	Watercourse	Water present[a]?	Strahler stream order	Habitat Type[b]	Class[c]	KFH present
Albury Precinct							
12	Murray River bridge	Murray River	Yes	9	Type 1 highly sensitive KFH (expected threatened species habitat for Flathead Galaxies (*G. rostratus*), Murray Cod (*M. peelii*), Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*) and Trout Cod (*M. macquariensis*) (DPI, 2016), however no instream gravel beds, snags or native aquatic plants other than emergent sp.).	Class 1 Major KFH (permanently flowing river)	Yes
11	Murray River bridge	Oddies Creek	No – however some residual pools present.	1	Type 2 moderately sensitive KFH (contains snags greater than 300 mm in diameter, native aquatic plants but lacks instream gravel beds and is ephemeral).	Class 2 moderate KFH (clearly defined banks, semi permanent water in pools, freshwater aquatic vegetation present)	Yes
10	Billy Hughes bridge (within 20m of watercourse)	Eight Mile Creek	No – however some residual pools present.	4	No KFH mapped (DPI, 2016) Type 3 minimally sensitive KFH (contains native instream but invasive macrophytes, lacks gravel beds, woody debris and is highly ephemeral).	Class 4 unlikely KFH	No
Greater Hume - Lockhart							
9	Henty Yard clearances (within 50m of watercourse)	Buckaringah Creek	No – however some residual pools present.	4	Type 1 highly sensitive KFH (despite being mapped as indicative distribution for Southern Pygmy Perch (*N. australis*) (DPI, 2016) it has no instream gravel beds, snags or native aquatic plants (other than emergent sp.))	Class 2 moderate KFH (intermittent flow and sporadic refuge only after rain events, connected to Doodle Comer Swamp).	Yes
8	Yerong Creek Yard clearances	Sandy Creek	No - lack of defined banks	3	Type 1 highly sensitive KFH (despite being mapped as expected threatened species habitat for Southern pygmy perch (*N. australis*) (i.e. indicative distribution maps (DPI, 2016), this survey site did not have defined banks or native aquatic or wetland vegetation and is considered unlikely to provide fish habitat).	Class 4 unlikely KFH (intermittent flow following rain events only, little or no defined channel, no aquatic flora present).	No

Survey Site	Enhancement site	Watercourse	Water present[a]?	Strahler stream order	Habitat Type[b]	Class[c]	KFH present
Wagga Wagga Precinct							
6	Pearson Street bridge	Unnamed artificial drainage line	No	0	No KFH mapped (DPI, 2016)	Class 4 unlikely KFH	No
7	Uranquinty Yard clearances	Sandy Creek	No	6	Type 1 highly sensitive KFH (despite being mapped as indicative distribution for Flathead Galaxias (*G. rostratus*) (DPI, 2016) it has no instream gravel beds, snags or native aquatic plants (other than emergent sp.))	Class 2 moderate KFH (intermittent flow and sporadic refuge only after rain events).	Yes
Junee Precinct							
5	Harefield Yard clearances	Reedy Creek	No	4	No KFH mapped (DPI, 2016)	Class 4 unlikely KFH	No
4	Harefield Yard clearances	Bucks Creek	No	4	No KFH (DPI, 2016)	Class 4 unlikely KFH	No
3	Kemp Street bridge	Unnamed	No	3	No KFH (DPI, 2016)	Class 4 unlikely KFH	No
2	Junee to Illabo clearances	Jeralgambeth Creek – south arm	No	3	No KFH (DPI, 2016)	Class 4 unlikely KFH	No
1	Junee to Illabo clearances	Jeralgambeth Creek – north arm	No – however some residual pools present.	4	Type 2 moderately sensitive KFH (no instream gravel beds, snags or native aquatic plants (other than emergent sp.)). Remnant pools present and connected during rain events to larger remnant pools.	Class 2 moderate KFH (semi-permanent water in pools outside of rain events present however no freshwater aquatic vegetation is present).	Yes

[a] within a 100 metre reach centred on the survey site; [b] Habitat Sensitivity Type: *Policy and guidelines for fish habitat conservation and management* (DPI, 2013);

[c] Classification of Watercourse for Fish Passage: *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge, 2003); KFH=Key Fish Habitat

4.5.1 Albury Precinct

Three named watercourses and four unnamed tributaries occur within the study area within the Albury precinct:

- Murray River (Murray River bridge)
- Oddies Creek (Murray River bridge)
- Eight Mile Creek and three unnamed tributaries of Eight Mile Creek (Billy Hughes bridge).
- Unnamed unconnected drainage line (Table Top Yard clearances)

Site inspections were undertaken at the Murray River (Figure 3-1; Appendix C (Plate 1 and Plate 2)), which was a high priority site, Oddies Creek (Figure 3-1; Appendix C (Plate 3 and Plate 4)) and Eight Mile Creek (Figure 3-2; Appendix C (Plate 5 and Plate 6)), which were both moderate priority sites. The three unnamed first and second order tributaries of Eight Mile Creek (Figure 3-2) and the unnamed drainage line at Table Top Yard clearances (Figure 3-3) not connected to a network of watercourses were determined to be low priority sites (refer Table 3-2),however the potential impacts of the proposal on these tributaries and their receiving environments are considered in section 5.

4.5.1.1 Murray River bridge

The Murray River is the only perennial watercourse within the study area. At survey site 12, this river was approximately 100m wide and there were moderate flows. Riparian vegetation consisted of River Red Gum (*Eucalyptus camaldulensis)* and Willow (*Salix sp)*, with a sparse middle and lower stratum of mainly exotic species. Instream submerged macrophytes were sparse and included less than one per cent cover of Ribbonweed (*Vallisneria americana*). The land use on both banks consisted of rural properties and rail and road infrastructure however the broader catchment includes industrial, commercial, and residential land use.

Visual assessment indicated that the water quality, instream habitat and riparian zone was highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the turbid coloration of the water, the presence of instream rubbish and exotic species, the past clearing of the riparian vegetation and the intensive land use within the catchment.

The banks of Oddies Creek, a tributary of the Murray River, were approximately eight metres wide at the survey site. No flowing water was present at the time of surveys however two small remnant pools with dimensions of approximately 8 metres x 10 metres and 4 metres x 10 metres, and a depth of 0.4 metres, occurred within the survey site. Riparian vegetation included River Red Gum and Willow, with a sparse middle and lower stratum consisting of mainly exotic species. Emergent macrophytes included Common Reed (*Phragmites australis)*, Rushes (*Juncus sp*.), Umbrella sedge (*Cyperus eragrostis)* and some large patches of Slender knot weed (*Persicaria sp*). Outside of the rail corridor, the land use on the northern bank consisted of urban development while the southern bank consisted mainly of rural properties. The broader land uses within the catchment also includes industrial and commercial operations.

Visual assessment indicated that the water quality, instream habitat and riparian zone was highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the presence of instream rubbish, the presence of instream invasive species (Mosquitofish), the clearing of the riparian vegetation and the intensive land use within the catchment.

4.5.1.2 Billy Hughes bridge

The banks of Eight Mile Creek, which is also a tributary of the Murray River, was observed to be about three metres wide at the survey site. No flowing water was present at the time of surveys however three small remnant pools with dimensions of approximately 3 metres x

4 metres, 2 metres x 2 metres and 1 metre x 10 metres, with depths ranging from of 0.4 metres, 0.5 metres and 0.5 metres respectively, occurred within the survey site. Riparian vegetation included Blakely's Red Gum (*Eucalyptus blakelyi)* with a middle stratum consisting of a dense cover of emergent macrophytes within the watercourse itself such as Common Reed, Rushes and Umbrella sedge. The lower stratum was a dense cover of exotic herbs and grasses. Outside of the rail corridor, the land use on both sides of the bank consisted of rural properties.

Visual assessment indicated that the water quality, instream habitat and riparian zone was moderately disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the clearing of the riparian vegetation and the rural land use within the catchment.

4.5.2 Greater Hume – Lockhart Precinct

One named watercourse occurs within the study area within the Greater Hume – Lockhart precinct:

- Buckaringah Creek (Henty Yard clearances)

Site inspections were undertaken at Buckaringah Creek (Figure 3-5; Appendix C (Plate 7 and Plate 8)), which was a high priority site and Sandy Creek (Figure 3-6; Appendix C (Plate 9 and Plate 10) which was a moderate priority site however following design modifications, this watercourse now occurs outside of the study area. The potential impacts of the proposal on these watercourses are considered in section 5.

4.5.2.1 Henty Yard clearances

The banks of Buckaringah Creek were approximately five metres wide and at the time of survey, no flowing water was present however three small remnant pools with dimensions of approximately 1.5 metres x 4 metres, 1 metre x 1 metre and 2 metres x 10 metres, with depths ranging from 0.4 metres, 0.3 metres and 0.5 metres respectively, occurred within the survey site. Riparian vegetation included River Red Gum and a number of exotic species including Phoenix Palm (*Phoenix canariensis)*, Norfolk Island Hibiscus (*Lagunaria patersonia)* and Pepper Tree (*Schinus mole)*. The middle and lower stratum consisted of emergent macrophytes, Rushes and Umbrella sedge and exotic herbs and grasses. Outside of the rail corridor, the land use on both banks consisted of rural properties.

Visual assessment indicated that the water quality, instream habitat and riparian zone was moderately disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the presence of instream invasive species (Mosquitofish), the clearing of the riparian vegetation and the rural land use within the catchment.

4.5.2.2 Yerong Creek Yard clearances

Following design changes to the proposal, Sandy Creek at Yerong Creek Yard clearances occurs just outside of the study area. At the survey site, Sandy Creek had no defined bank or channels and no riparian vegetation, with exotic grasses, herbs and crop species dominating the landscape.

Visual assessment indicated that the instream habitat and riparian zone was extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of road and rail bridges), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.

4.5.3 Wagga Wagga Precinct

One named watercourse and one unconnected drainage line occur within the study area within the Wagga Wagga precinct:

- Sandy Creek (Uranquinty Yard clearances)
- Unnamed artificial drainage line (Pearson Street bridge)

Site inspections were undertaken at Sandy Creek (Figure 3-7; Appendix C (Plate 11 and Plate 12)), which was a high priority site, and the artificial drainage line at Pearson Street bridge (Figure 3-8; Appendix C (Plate 13 and Plate 14)) which was ranked as a moderate priority site as desktop studies indicated there was a nearby (artificial) wetland (ERM, 2020). The potential impacts of the proposal on these watercourses are considered in section 5.

4.5.3.1 Uranquinty Yard clearances

Sandy Creek, which is a different, unconnected watercourse to the Sandy Creek near Yerong yard clearances, is approximately ten meters wide and at the time of survey, no flowing water was present and no natural remnant pools occurred. Riparian vegetation included a sparse cover of River Red Gum (*E. camaldulensis)*, while the middle stratum was sparse and consisted of some juvenile eucalypts, possible planted and emergent macrophytes such as Rushes and Umbrella sedge, with a dense cover of exotic herbs and grasses in the lower stratum. Outside of the rail corridor, the land use on both banks consisted of rural properties.

Visual assessment indicated that the instream habitat and riparian zone was highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the presence of instream rubbish and exotic species, the clearing of the riparian vegetation and the rural land use within the catchment.

4.5.3.2 Pearson Street bridge

The unnamed drainage line at Pearson Street bridge was a concrete lined, artificial drainage line with urban run-off flows only. Riparian vegetation included a sparse cover of Blakely's Red Gum and Yellow Box (*Eucalyptus melliodora)*. The middle stratum was sparse and consisted of Acacia sp. and exotic emergent macrophytes while the lower stratum was a dense cover of exotic herbs and grasses. Outside of the rail corridor, the land use on both banks consisted of urban and industrial.

Visual assessment indicated that the instream habitat and riparian zone was extremely disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges and concrete lining in the channel), the presence of instream rubbish and exotic species, the clearing of the riparian vegetation and the urban and industrial land use within the catchment.

ERM (2020) identified potential habitat for Sloane's Froglet (*Crinia sloanei)* in an artificial wetland at the Pearson Street bridge enhancement site. The artificial wetland was mapped as Miscellaneous ecosystem - highly disturbed areas in the BDAR (Technical paper 8) and is considered unlikely to provide habitat for threatened fish species as it is not connected to a network of watercourses. However, the artificial wetland may provide habitat for protected aquatic species such as eels, crustaceans and freshwater turtles.

4.5.4 Junee Precinct

Fifteen watercourses occur within the study area within the Junee precinct:

- Reedy Creek (Harefield Yard clearances)
- Bucks Creek (Harefield Yard clearances)
- Unnamed tributary of Reedy Creek (Harefield Yard clearances)
- Unnamed tributary of Houlaghans Creek (Junee Yard clearances)
- Two unnamed tributaries of Houlaghans Creek (Olympic Highway underbridge)
- Unnamed tributary of Houlaghans Creek (Kemp Street bridge)
- Three unnamed unconnected drainage lines (Junee to Illabo clearances)
- Three unnamed tributaries of Jeralgambeth Creek (Junee to Illabo clearances).
- Jeralgambeth Creek south arm (Junee to Illabo clearances)
- Jeralgambeth Creek north arm (Junee to Illabo clearances)

Site inspections were undertaken at Reedy Creek (Figure 3-9; Appendix C, (Plate 15 and Plate 16)), Bucks Creek (Figure 3-9; Appendix C, (Plate 17 and Plate 18)), the unnamed tributary of Houlaghans Creek at Kemp Street bridge (Figure 3-10; Appendix C, (Plate 19 and Plate 20)), and Jeralgambeth Creek south arm (Figure 3-15; Appendix C, (Plate 21 and Plate 22)) and north arm (Figure 3-15; Appendix C, (Plate 23 and Plate 24)) which were all ranked as medium priority sites. The remaining unnamed tributaries were defined as low priority (refer Table 3-2) and were not assessed. The potential impacts of the proposal on all watercourses are considered in section 5.

4.5.4.1 Harefield Yard clearances

Reedy Creek was approximately three meters wide and no flowing water was present at the time of surveys and no remnant pools occurred within the survey site. Riparian vegetation included a sparse cover of River Red Gum. The middle stratum was absent and the lower stratum consisted of a dense cover of exotic herbs and grasses. Outside of the rail corridor, the land use on both banks consisted of rural properties.

Visual assessment indicated that the instream habitat and riparian zone was highly disturbed based on the disruption to the natural hydrology, the presence of instream rubbish and exotic species, the clearing of the riparian vegetation and the rural land use within the catchment.

Bucks Creek had no defined bank or channels and no riparian vegetation, with exotic grasses, herbs and crop species dominating the landscape. Visual assessment indicated that the instream habitat and riparian zones was extremely disturbed based on the disruption to the natural hydrology, the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.

4.5.4.2 Kemp Street bridge

The artificial drainage line at Kemp Street bridge was concrete lined and flows were from urban runoff only. There were no trees within the riparian vegetation and middle and lower stratum consisted of exotic herbs and grasses. Outside of the rail corridor, the land use on both sides of the bank consisted of urban and industrial development.

Visual assessment indicated that the instream habitat and riparian zone was extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of rail bridges), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.

4.5.4.3 Junee to Illabo clearances

Jeralgambeth Creek crosses the proposal site in two locations in addition to numerous crossings by its tributaries. At the southern arm, this watercourse had no defined bank or channels and no riparian vegetation was present, with exotic grasses, herbs and crop species

dominating the landscape. Visual assessment indicated that the area was extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of rail crossings), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.

The northern arm of Jeralgambeth Creek had no flowing water at the time of survey but consisted of three remnant pools with dimensions of approximately 2 metres x 10 metres, 4 metres x 18 metres and 4 metres x 14 metres and a depth of approximately 0.5 metres each. During rainfall events, these pools would link to larger remnant pools along Jeralgambeth Creek (outside of the study area). Trees were absent from the riparian vegetation and middle stratum consisted of sparse cover of emergent macrophytes and a lower stratum consisting of exotic herbs and grasses. Outside of the rail corridor, the land use on both side of the bank consisted of rural landscape.

Visual assessment indicated that the water quality, instream habitat and riparian zone was moderately disturbed based on the disruption to the natural hydrology (through the presence of rail crossings), the turbid coloration of the water, the presence of instream exotic species, the complete clearing of natural riparian vegetation and the rural land use within the catchment.

4.5.5 Other waterbodies

Within the study area, waterbodies other than watercourses include two wetlands, one artificial wetland and 28 farm dams.

One wetland (Junee to Illabo clearance) and 28 farm dams occur outside of the proposal area on privately owned land. They are unlikely to provide habitat for threatened aquatic species listed under the FM Act or EPBC Act however they may provide habitat for protected aquatic species such as eels, turtles, crustaceans and some hardy native fish species.

One wetland (Calcairn yard clearances) and an artificial wetland (Pearson Street bridge) occur within the proposal site. Neither of these waterbodies are likely to provide habitat for threatened aquatic species listed under the FM Act and EPBC Act as they are not linked to other waterbodies, however they may provide habitat for protected aquatic native species such as eels, turtles and crustaceans. The artificial wetland also provides potential habitat for amphibians, including Sloane's Froglet (*C. sloanei)* (ERM, 2020), which is listed as threatened under the BC Act and considered further in the BDAR (Technical paper 8).

4.6 Summary of aquatic habitat within the study area

In summary, except for the Murray River, no flowing water was observed in any of the watercourses that cross the study area at either survey time. Most of the watercourses were dry at the time of survey however the following watercourses contained shallow remnant pools:

- Oddies Creek (at survey site 11) – Murray River bridge
- Eight Mile Creek (at survey site 10) – Billy Hughes bridge
- Buckaringah Creek (at survey site 9) – Henty Yard clearances
- Jeralgambeth Creek (at survey site 1) – Junee to Illabo clearances

The lack of flowing water and only limited refuge areas observed in a year with above average rainfall indicates that, except for the Murray River, the watercourses that cross the proposal site are highly ephemeral, only holding water for a short period following rain events, and draining away quickly, leaving limited refuge areas.

The presence of macrophytes/aquatic vegetation is an important habitat feature in defining the type and sensitivity of KFH as it provides refuge, breeding and foraging habitat. There are three types of aquatic vegetation:

- submerged;
- floating; and
- emergent.

While most of survey sites were identified as containing macrophytes, only two survey sites (Oddies Creek and Murray River) contained instream macrophyte species that provided habitat opportunities. The remaining surveys sites contained sparse cover of emergent macrophytes dominated by the exotic Umbrella sedge. The presence of sparse, emergent macrophytes is not considered to be an important habitat feature for fish.

Another important habitat feature in defining the type and sensitivity of KFH is the presence of in-stream gravel beds, rocks greater than 500 mm, snags greater than 300 mm in diameter or three metres in length. No survey sites contained rocks or gravel beds (unless artificially placed for bridge construction) and only three survey sites (Buckaringah Creek, Oddies Creek and Murray River) contained large snags.

Most of the survey sites contained limited bank overhang and trailing bank vegetation which are also important habitat features as they provide habitat for macroinvertebrates and therefore foraging resources for native fish species.

4.7 Riparian vegetation

Where a watercourse does not exhibit the features of a defined channel with bed and banks, the watercourse is not waterfront land for the purposes of the WM Act (DPI, 2018). Thus, for the purpose of this assessment, vegetation has only been defined as riparian vegetation where it is associated with a hydroline defined as moderate to high priority watercourses. Vegetation associated with hydrolines defined as low priority is not included as riparian vegetation. The impacts of the proposal on non-riparian vegetation are considered in the BDAR (Technical paper 8).

In addition, while non-native riparian vegetation may provide some bank stability, the preservation of non-native riparian vegetation is not an objective in the *Guidelines for controlled activities on waterfront land* nor does its removal trigger the KTP 'Degradation of native riparian vegetation along NSW watercourses'.

Table 4-3 lists the native riparian vegetation type (PCT) and riparian corridor area, calculated at each enhancement site within the proposal site (refer section 2.1.3.5 and section 3.7 for methodology). It does not include vegetation associated with low priority hydrolines within the study area nor does it include non-native vegetation.

Table 4-3. Riparian vegetation type and area within the proposal site

Precinct/Enhancement site/watercourse	PCT Name	Area within the proposal site (m^2)
Albury		
Murray River bridge Murray River	PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland	50.4
Murray River bridge Oddies Creek	PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland	50.9
Wagga Wagga		
Uranquinty Yard clearances Sandy Creek	PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland	64.4

Precinct/Enhancement site/watercourse	PCT Name	Area within the proposal site (m^2)
Junee		
Harefield Yard clearances Reedy Creek	PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland	168.8
Native riparian vegetation		**334.5** **(0.03 ha)**

Section 4.5 discusses the dominant species observed during the aquatic assessment at each of the aquatic survey sites and Appendix C provides further detail on percent vegetation cover of each stratum.

4.8 Target aquatic fauna survey results

Fauna sampling opportunities were limited to the Murray River and the four survey sites containing remnant pools. Results of surveys at these five survey sites are presented in Table 4-4. Fauna trapping resulted in capture of the exotic Mosquitofish and no captures of any native fish species, which is consistent with the poor to very poor fish community status mapping by DPI (2016).

No threatened species were recorded during surveys.

Table 4-4. Fauna survey results

Survey Site	Enhancement Site	Watercourse	Capture Results
12	Murray River bridge	Murray River	No captures
11	Murray River bridge	Oddies Creek	Approximately 1,000 Mosquitofish
10	Billy Hughes bridge	Eight Mile Creek	No captures
9	Henty Yard clearances	Buckaringah Creek	30 Mosquitofish
1	Junee to Illabo clearances	Jeralgambeth Creek	Approximately 200 Mosquitofish

4.9 Threatened species, populations and ecological communities

4.9.1 NSW BioNet

The BioNet search tool for past records of threatened species resulted in 19,005 records of 132 threatened species in the Murray CMA and 28,782 records of 179 threatened species in the Murrumbidgee CMA however no threatened aquatic species were recorded.

Additional searches using the BioNet tool for protected aquatic species previously recorded in the locality resulted in 526 records of platypus and 1,039 records of freshwater turtle.

4.9.2 Atlas of Living Australia

The ALA (2021) contained records of eight threatened aquatic species and two endangered aquatic populations (Table 4-5), along with records of 38 other protected native aquatic species including five species of reptiles, two crustacean species, one mammal species (platypus) and six exotic species previously recorded in the Murrumbidgee and Murray CMAs.

Table 4-5. Threatened aquatic species records within the Murrumbidgee and Murray CMAs: Atlas of Living Australia

Species	FM Act	EPBC Act
Olive Perchlet *(Ambassis agassizii)*	EP	
Silver Perch *(Bidyanus bidyanus)*	V	CE
Flathead Galaxias *(Galaxias rostratus)*	P	CE
Trout Cod *(Maccullochella macquariensis)*	E	E
Murray Cod *(Maccullochella peelii)*	P	V
Macquarie Perch *(Macquaria australasica)*	E	E
Southern Purple-Spotted Gudgeon *(Mogurnda adspersa)*	E	
Southern Pygmy Perch *(Nannoperca australis)*	E	
Australian Grayling *(Prototroctes maraena)*	E	V
Freshwater Catfish *(Tandanus tandanus)*	EP	
Murray Crayfish *(Euastacus armatus)*	V	

CE=Critically Endangered; E=Endangered, V=Vulnerable; Ep=Endangered population; P=Protected

4.9.3 Protected matters search tool

The results of the searches of PMST from the Riverina and Murray Natural Resource Management Regions are provided in full in Appendix B and summarised in Table 4-6. Terrestrial threatened and migratory species and terrestrial EEC's are considered in the BDAR (Technical paper 8). Only MNES relating to the aquatic environment are considered further in this assessment.

Table 4-6. Matters of National Environmental Significance within the locality

MNES	Results of PMST Report	Relevance to the Aquatic Assessment
Listed threatened species	85	Eight of the 85 threatened species are aquatic species: • Flathead Galaxias (*Galaxias rostratus)* (CE) • Macquarie Perch (*Macquaria australasica)* (E) • Silver Perch (*Bidyanus bidyanus)* (CE) • Southern Pygmy Perch (*Nannoperca australis)* (V) • Trout Cod (*Maccullochella macquariensis)* (E) • Murray Cod (*Maccullochella peelii)* (V) • Murray Hardyhead (*Craterocephalus fluviatilis)* (E) • Australian Grayling (*Prototroctes maraena)*.

MNES	Results of PMST Report	Relevance to the Aquatic Assessment
Listed TECs	9	All TECs have been considered in the BDAR (Technical paper 8). One TEC includes aquatic habitat (Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains) however the proposal site is outside of the indicative distribution map for this TEC (DSEWPaC, 2012).
Listed Migratory species	25	All migratory species are birds and have been assessed in the BDAR (Technical paper 8)
Ramsar wetlands of international importance	9	Refer to section 4.9.9
Commonwealth Marine Area	None	N/A
World Heritage properties	None	N/A
National Heritage places	3	N/A
Great Barrier Reef Marine Park	None	N/A

4.9.4 DPI website and Fisheries spatial data portal

Review of DPI threatened species list, species profiles including Primefacts and distribution maps (Appendix A) resulted in seven threatened species, one endangered population and one EEC listed under the FM Act that were previously recorded in database searches:

- Flathead Galaxias (*G. rostratus*)
- Macquarie Perch (*M. australasica*)
- Murray Crayfish (*E. armatus*)
- Silver Perch (*B. bidyanus*)
- Southern Purple Spotted Gudgeon (*M. adspersa*)
- Southern Pygmy Perch (*N. australis*)
- Trout Cod (*M. macquariensis*)
- Murray Darling Basin population of Eel Tailed Catfish (*T. tandanus*)
- Lowland Murray River aquatic ecological community

4.9.5 Summary of database searches

Database searches resulted in eight threatened species and two endangered populations being identified as target species for further assessment (Table 4-7).

Table 4-7. Targeted Species

Target Species	Legal Status	
	FM Act	EPBC Act
Flathead Galaxias *(Galaxias rostratus)*	CE	CE
Macquarie Perch *(Macquaria australasica)*	E	E
Murray Cod *(Maccullochella peelii)*	-	V
Murray Crayfish *(Euastacus armatus)*	V	-
Silver Perch *(Bidyanus bidyanus)*	V	CE
Southern Purple Spotted Gudgeon *(Mogurnda adspersa)*	E	
Southern Pygmy Perch *(Nannoperca australis)*	E	
Trout Cod *(Maccullochella macquariensis)*	E	E
Western population of Olive Perchlet *(Ambassis agassizii)*	Ep	
Murray-Darling Basin population of Eel Tailed Catfish *(Tandanus tandanus)*	Ep	

CE=Critically Endangered; E=Endangered, V=Vulnerable; Ep=Endangered population; P=Protected

Indicative species identified on the PMST that have a known distribution outside of the locality (i.e. Murray Hardyhead and Australian Grayling) were not considered target species for further assessment.

4.9.6 Likelihood of occurrence summary

Following site inspections, habitat assessment and targeted surveys, the Likelihood of Occurrence Assessment for the state and/or Commonwealth listed threatened species, populations and EECs identified during the desktop review are detailed in Appendix D and summarised in Table 4-8 for each precinct. Species with moderate or above likelihood of occurrence are considered in an assessment of significance of impact in accordance with the FM Act and EPBC Act (Appendix E and Appendix F respectively).

The Lowland Murray River aquatic ecological community listed as endangered under the FM Act is known to occur within the study area. The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut rivers, as well as all their tributaries and branches. The community includes 23 native fish species and over 400 recorded native invertebrate species. This EEC is considered in an assessment of significance in accordance with the FM Act (Appendix E).

Consideration of the habitat potential for protected native species such as Platypus and freshwater turtles is also provided in Appendix D. Platypus are considered likely to occur in the Murray River, while freshwater turtles are likely to be present in all watercourses within the proposal site containing water or remnant pools (i.e. Jeralgambeth Creek, Buckaringah Creek, Eight Mile Creek, Oddies Creek, the Murray River, wetland areas and farm dams).

Table 4-8. Likelihood of occurrence of target threatened aquatic species in watercourses within the study area

Precinct watercourse	Flathead Galaxias (*Galaxias rostratus*)	Macquarie Perch (*Macquaria australasica*)	Murray Cod (*Maccullochella peelii*)	Murray Crayfish (*Euastacus armatus*)	Silver Perch (*Bidyanus bidyanus*)	Southern Purple-Spotted Gudgeon (*Mogurnda adspersa*)	Southern Pygmy Perch (*Nannoperca australis*)	Trout Cod (*Maccullochella macquariensis*)	Oliver Perchlet (*Ambassis agassizii*)	Eel-tailed Catfish (*Tandanus tandanus*)
Albury precinct										
Murray River	**possible**	unlikely	**likely**	**likely**	**likely**	unlikely	unlikely	**likely**	unlikely	unlikely
Oddies Creek	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Eight Mile Creek	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Greater Hume – Lockhart Precinct										
Buckaringah Creek	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	**possible**	unlikely	unlikely	unlikely
Wagga Wagga precinct										
Unnamed artificial drainage line (Pearson Street bridge)	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Sandy Creek	**possible**	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Junee precinct										
Reedy Creek	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Bucks Creek	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Unnamed drainage line (Kemp Street bridge)	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Jeralgambeth Creek south arm	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Jeralgambeth Creek north arm	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely

NB. Likelihood of occurrence categories are defined in Appendix D (Table D1)

4.9.7 State listed threatened species and threatened ecological communities

Five aquatic species were identified as likely or possible to occur within the proposal site (Appendix D) and are assessed against an assessment of significance under the FM Act (Appendix E):

1. Flathead Galaxias (*G. rostratus*) CE
2. Murray Crayfish (*E. armatus*) V
3. Silver Perch (*B. bidyanus*) V
4. Southern Pygmy Perch (*N. australis*) E
5. Trout Cod (*M. macquariensis*) E

The Lowland Murray River aquatic ecological community is known to occur in the study area and is assessed against an assessment of significance under the FM Act (Appendix E).

4.9.8 Critical habitat

The study area does not contain any water or land identified as critical habitat under the FM Act.

4.9.9 Matters of national environmental significance

Four aquatic species were identified as likely or possible to occur within the study area (Appendix D) and are assessed against the test of significance under the EPBC Act (Appendix F):

1. Silver Perch (*B. bidyanus)* CE
2. Flathead Galaxias (*G. rostratus)* CE
3. Trout Cod (*M. macquariensis)* E
4. Murray Cod (*M. peelii)* V

Ramsar Listed Wetlands

The PMST identified that the locality occurs within the catchment of nine Ramsar wetlands of international importance (Appendix B).

The proposal site occurs a considerable distance from all of these wetlands and as such, the proposal is considered unlikely to impact these wetlands (Table 4-9).

Table 4-9. Proximity of Ramsar wetlands to the proposal site

Wetlands of International Importance (Ramsar)	Proximity to Proposal Site
Banrock station wetland complex	900 kilometres downstream of Albury
Barmah forest	150 kilometres downstream of Albury
Blue lake	250 kilometres upstream of Albury
Gunbower forest	300 kilometres downstream of Albury
Hattah-Kulkyne lakes	600 kilometres downstream of Albury
Kerang wetlands	400 kilometres downstream of Albury
NSW central Murray state forests	250 kilometres downstream of Albury
Riverland	800 kilometres downstream of Albury
The Coorong, and Lakes Alexandrina and Albert wetland	1,000 kilometres downstream of Albury

5. Impact assessment

This impact assessment has been structured under six sub-sections, and considers the potential impacts of the proposal on:

1. aquatic biodiversity during construction
2. aquatic biodiversity during operation
3. threatened species, populations and EECs protected by the FM Act
4. key threatening processes identified under the FM Act
5. matters of national environmental significance protected by the EPBC Act
6. sensitive areas:
    a. KFH
    b. waterfront land
    c. groundwater dependent ecosystems.

5.1 Construction

Consideration of the potential impacts of the proposal on water quality and aquatic biodiversity at survey sites is provided in sections 5.1.1 and 5.1.2. These potential impacts and the subsequent risk to receiving watercourses at each enhancement site are detailed in Table 5-1. Table 5-2 summarises the overall risk of impact on watercourses within the proposal site.

5.1.1 Potential impacts on water quality

Without the implementation of appropriate erosion and sediment controls and mitigation measures throughout construction, construction activities have the potential to impact water quality in watercourses within the study area, through the mobilisation of sediments and other contaminants via wind or stormwater runoff.

Potential activities which can result in water quality impacts include:

- clearing of riparian vegetation
- instream works associated with temporary crossing or bridge pier works
- transportation of dust, litter and other pollutants associated with construction
- transportation of soils, exposed sediments and contaminants associated with stockpiles, construction compounds and or storage areas
- transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment
- transportation of concrete dust, concrete slurries or washout water associated with concrete works.

The hydrology, flooding and water quality assessment (Technical paper 11) for the proposal concluded that construction of the proposal is unlikely to cause changes to the water quality environment against the identified NSW Water Quality Objectives.

This is due to the minor, short-term works at the enhancement sites during construction, which would be managed through the correct implementation of the mitigation measures described in Technical paper 11.

5.1.2 Potential impacts on aquatic biodiversity

Construction of the various proposal elements across all enhancement sites would involve a range of activities that present potential risk to aquatic biodiversity both directly and indirectly if management measures are not implemented, monitored and maintained throughout the construction phase. Potential impacts on aquatic biodiversity include:

1. removal of riparian corridor vegetation
2. removal of instream vegetation and large woody debris
3. temporary obstruction of fish passage during construction
4. poor water quality.

Consideration of potential impacts on other water bodies such as farm dams and wetlands within the study area is provided in section 5.1.2.5.

5.1.2.1 Removal of riparian corridor vegetation

The riparian corridor forms a transition zone between the land and the watercourse. The protection, restoration or rehabilitation of VRZ's is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of a watercourse (DPI, 2018).

The riparian corridor reduces the risk of erosion by reinforcing and increasing cohesion of the soil, and by providing a protective surface matting. Vegetation also uses water in the banks and increase the drainage of the soils which reduces the risk of bank failure due to heavy saturated soils. The riparian corridor and the associated layer of litter and debris also increases channel roughness, slowing the flow and reducing the capacity of the flowing water to erode and transport sediment.

Most pollutants and nutrients are attached to sediment particles and riparian vegetation plays an important role in trapping this sediment and associated nutrients and pollutants before they reach the channel. The potential impacts of excess nutrients and sediments are discussed further in section 5.1.2.4. The wider the riparian corridor buffer zone, the more effective it is at trapping sediment.

The riparian corridor also plays an important role in ecological function. Healthy, native riparian vegetation reduces the water temperature of aquatic habitats by shading. Without shading, water temperature increases, which can result in unfavourable conditions and can lead to fish kills.

Impacts of the proposal includes clearing of riparian corridor vegetation, which is environmentally sensitive land (i.e. waterfront land as defined under the WM Act (refer section 5.5.2)). The proposal includes removal of a total of 0.03 hectares of native riparian vegetation from the following watercourses:

- 50.4 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from the Murray River, Murray River bridge
- 50.9 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Oddies Creek, Murray River bridge
- 64.4 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Sandy Creek, Uranquinty Yard clearances
- 168.8 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland from Reedy Creek, Harefield Yard clearances

The proposed clearing of native riparian vegetation is relatively minor given the extent of these watercourses (and their associated native riparian vegetation) outside of the proposal site, and as such, is considered unlikely to impact aquatic biodiversity along these watercourses.

Removal of native riparian vegetation (PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland) has also been conservatively assessed for the Murray River at the Murray River bridge however it is noted that impacts to riparian vegetation along the Murray River relate mainly to vegetation trimming, not removal. The proposed trimming would be minimised to that required for access during construction and would be undertaken in accordance with the controls outlined in the EIS.

Consideration of impacts of the proposal on riparian vegetation is primarily concerned with native riparian vegetation, however all riparian vegetation plays an important role in bank stability and removal should be re-instated or improved where possible as part of the rehabilitation strategy.

Degradation of native riparian vegetation along NSW watercourses is listed as a KTP under the FM Act and is discussed further in section 5.3.7.

5.1.2.2 Removal of instream vegetation/large woody debris

Large woody debris and macrophytes within the stream provides shelter, feeding and spawning habitat for many native birds, fish and invertebrates. Instream or aquatic vegetation is also effective at water purification by further removing nutrients.

The Murray River, Oddies Creek and Eight Mile Creek were there only watercourses identified as having native instream aquatic vegetation. As instream works are not required at these watercourses, the native macrophytes would not be impacted by the proposal.

However most watercourses at survey sites within the proposal site contained emergent exotic species such as Umbrella Sedge, sparse occurrences of native sedges in addition to native and exotic grasses and herbs which stabilise the bed and banks of the ephemeral watercourses during flood events. Direct impacts on instream vegetation (including exotic sedges and native and exotic grasses) are likely at the following watercourses:

- Sandy Creek (Uranquinty yard clearances)
- Jeralgambeth Creek (Junee to Illabo clearances)

The Murray River, Oddies Creek and Buckaringah Creek were the only watercourses identified as having large woody debris (snags). As direct impacts such as instream works are not required at these watercourses, the KTP 'removal of large woody debris' under the FM Act is not triggered by the proposal.

5.1.2.3 Temporary obstruction of fish passage

While all of the watercourses crossed by the proposal site (except for the Murray River) have been defined as ephemeral, they have the potential to connect isolated water bodies to defined waterways during times of flow. Fish passage is critical to the survival of Australian native fish, which move within waters at different times to access food and shelter, to avoid predators, and to seek out mates to breed and reproduce. Examples of the various types and reasons for fish movement include:

- Local movement to access food, avoid predators and shelter during daylight
- Daily movement to access habitat, food and shelter, defend territory and avoid predators.
- Seasonal movement to complete part of their breeding cycle in response to rising water levels or temperatures.
- Upstream movement to access new habitats or established spawning areas.
- Downstream movement post-spawning and to avoid predators; and
- Lateral movement to access food, complete their breeding cycle and for juvenile recruitment to habitat areas (Fairfull and Witheridge, 2003).

Potential impacts to fish passage during construction phase include earthworks or placement of structures that physically block the watercourse or installed erosion and sediment control measures, all of which may prevent fish passage during times of flow.

The proposal would require modifications to existing instream structures (i.e. bridges and culverts) at the following watercourses:

- Jeralgambeth Creek
- a tributary of Eight Mile Creek
- a tributary at Kemp Street bridge
- the artificial drainage line at Pearson's Street.

Of these four watercourses, only Jeralgambeth Creek has been defined as KFH. The preferred crossing requirements at Jeralgambeth Creek, a type 2 moderately sensitive KFH

and class 2 watercourse, is a bridge, arch structure, culvert (high flow design) or ford in that order of preference. The proposed modification of an existing culvert at Jeralgambeth Creek achieves the minimum requirements for fish passage (Fairfull and Witheridge, 2003). The remaining three watercourses are not defined as having KFH and as such, fish friendly waterway crossing designs are unwarranted (Fairfull and Witheridge, 2003).

The temporary crossing proposed at Sandy Creek (Uranquinty Yard clearances) would obstruct fish passage in times of flow for a four to six week period while the crossing is in place. This watercourse is mapped by DPI (2016) as being within the indicative distribution of the threatened Flathead Galaxias (*G. rostratus*). At the survey site however, this creek was ephemeral, lacked instream fish habitat features such as remnant pools, aquatic vegetation, woody debris, bank overhangs and trailing bank vegetation. As such, it was considered unlikely to provide habitat for this species nor is it considered important habitat for native fish. During consultation, DPI confirmed that the site is unlikely to provide important habitat for Flathead Galaxias (*G. rostratus*), and that temporary fish passage was therefore not required at this watercourse while the temporary crossing was in place (refer Appendix G). It is also noted that if the temporary crossing and construction occurs during a dry period, then this would avoid impacts to potential fish passage.

5.1.2.4 Poor water quality

Reduced water quality resulting from construction activities can impact aquatic biodiversity in the following ways:

- shading of aquatic vegetation due to high turbidity, smothering aquatic vegetation and resulting in dieback
- mortality of filter feeding aquatic fauna, including invertebrates, by blocking filter apparatus preventing oxygen flow
- fish kills due to clogging fish gills
- fish kills resulting from high turbidity, making it difficult for fish to see and catch prey
- fish kills resulting from increased nutrients and subsequent algal blooms and oxygen depleted water
- low recruitment in fish species where eggs laid on the bottom of rivers are buried by sedimentation.
- potential increase in abundance of pest species able to tolerate poorer water quality which can subsequently outcompete native species for resources
- reduction in native fish species presence through altered habitat resulting from sedimentation in remnant pools
- toxicity and mortality in freshwater organisms, particularly microorganisms, invertebrates and vegetation resulting from pollutants such as lead paint, petroleum, diesel, hydraulic fluids and oils that may be spilled into ephemeral waterways and become mobilised following rainfall events. The effects of toxicity and mortality can move up the food chain and indirectly impact higher order species such as fish, birds and mammals.

Potential indirect and direct impacts to water quality from construction is relevant to all watercourses within the study area. The above impacts on aquatic biodiversity due to impacts to water quality are worst case scenarios. The hydrology, flooding and water quality assessment (Technical paper 11) for the proposal concluded that construction of the proposal is unlikely to cause changes to the water quality environment against the identified NSW Water Quality Objectives. Measures to minimise the impacts on water quality are provided in Chapter 7.

5.1.2.5 Other waterbodies

Within the study area, waterbodies other than watercourses include two wetlands, one artificial wetland and numerous farm dams.

One wetland occurs within the proposal site at Culcairn Yard clearances however it would not be directly impacted by construction works. Another larger wetland occurs along Jeralgambeth Creek to the west of the proposal site in privately owned land. These wetlands are unlikely to provide habitat for aquatic threatened species listed under the FM Act or EPBC Act however they may provide habitat for protected aquatic species such as eels, turtles, crustaceans and native fish species. Indirect impacts from construction include a reduction in water quality to these wetlands. This would be mitigated with appropriate erosion and sediment control.

One artificial wetland occurs near Pearson Street bridge within the proposal site and would potentially be impacted during construction. Construction of a retaining wall would result in changes to groundwater flows which in turn could cause an increase in salinity in the artificial wetland. The artificial wetland does not provide habitat for threatened aquatic species listed under the FM Act and EPBC Act, however it may provide habitat for protected native species such as turtles and eels and as such, salinity monitoring of the wetland is required to ensure that protected aquatic species are not impacted.

The 28 farm dams occur within the study area however all are located outside of the proposal site and would not be directly impacted by construction activities. The farm dams likely provide habitat for protected aquatic species such as eels, turtles and crustaceans. Indirect impacts from construction include a reduction in water quality to farm dams following rainfall. This would be mitigated with appropriate erosion and sediment control.

The impact of the proposal on other threatened species such as amphibians listed under the FM Act and or EPBC Act that may occur in waterbodies within the study area are considered in the BDAR (Technical paper 8). Dewatering of any waterbodies is not required as part of the proposal.

Table 5-1. Potential construction impacts on water quality and aquatic biodiversity at each enhancement site and associated risk to receiving watercourses

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Albury Precinct			
Murray River bridge	Bridge modifications include: • construction associated with site establishment and access • sandblasting, removal of lead paint • rail bridge structure modifications, including minor clearing of riparian vegetation.	The proposal does not require any works to the sub-structure of the existing bridge or instream works in either the Murray River or Oddies Creek. Potential direct impacts from construction activities include: • clearing of riparian vegetation • impacts to water quality from contamination by lead paint and sandblasting. Potential indirect impacts on water quality from construction activities at this site include: • mobilisation of sediments and other contaminants to the Murray River and/or Oddies Creek from construction associated with site establishment • transportation of soils, exposed sediments and contaminants associated with proposed laydown area 30 metres from the top of bank at Oddies Creek • contaminants reaching the watercourses associated with the rail bridge structure modifications • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment	Receiving watercourses include the Murray River and Oddies Creek. <u>Murray River</u> The Murray River is defined as type 1 highly sensitive KFH and as such, has a moderate risk of being impacted by the proposal. Potential direct impacts include minor impacts to 50.4 square metres of riparian vegetation (PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland) as impacts relate mainly to trimming of vegetation. Potential escape of lead paint into the watercourse also constitutes a moderate risk, in addition to indirect impacts on water quality resulting from construction near the Murray River. Any clearing would be re-instated in accordance with the rehabilitation strategy. Lead paint removal would be undertaken in stages, reducing the scale of any potential impacts, in addition to the use of a membrane fixed around the work area to capture hazardous materials. Potential impacts on threatened and protected aquatic flora, fauna and their habitat resulting from poor water quality are detailed in section 5.1.2 however given the proposed works are minor and direct or indirect impacts can be mitigated, the

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
		• increased nutrients reaching the watercourse from demobilisation and landscaping works.	proposal is unlikely to impact any threatened species with potential to occur in the Murray River, or the habitat of these threatened species. <u>Oddies Creek</u> Oddies Creek is defined as type 2 moderately sensitive KFH. 50.9 square metres of PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland has been mapped within the proposal site at Oddies Creek however it has a low risk of being directly impacted as: • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse • impacted riparian vegetation would be re-instated as part of the rehabilitation strategy.
Albury Station pedestrian bridge	Replacement of the pedestrian bridge	N/A	No watercourses were identified within the study area relevant to this site.
Albury Station Yard clearances	Track realignment Signal gantry replacement	N/A	No watercourses were identified within the study area relevant to this site.
Riverina Highway bridge	Track lowering and realignment Construction of retaining structures and drainage associated with track lowering	N/A	No watercourses were identified within the study area relevant to this site.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Billy Hughes bridge	Track lowering and realignment The lowered track slot would be managed using cess drains adjacent batters, spoon drains with subsoil and a longitudinal drainage adjacent the retaining structures. It is proposed that stormwater would discharge via gravity upstream of the existing transverse rail culvert.	Construction has the potential to indirectly impact water quality from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Receiving watercourses include Eight Mile Creek and unnamed tributaries of Eight Mile Creek. <u>Eight Mile Creek</u> Eight Mile Creek is not mapped by DPI as KFH, however following a site inspection, it is defined as type 3 minimally sensitive KFH due to the presence of instream macrophytes. The proposal does not require any works to the existing box culvert or within the bed of Eight Mile Creek. Thus, direct impacts from the proposal on water quality, aquatic flora, fauna and their habitat are unlikely. The aquatic biodiversity in Eight Mile Creek has a low risk of being indirectly impacted from poor water quality as: • the watercourse is defined as having minimal KFH • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse. <u>Unnamed tributaries</u> These tributaries are not mapped by DPI as KFH and are defined as low priority watercourses.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
			One of the three unnamed tributaries of Eight Mile Creek may be directly impacted by culvert replacements however the risk of impact on aquatic biodiversity is considered negligible. The risk of impact to receiving waters such as Eight Mile Creek is also low for reasons discussed above.
Table Top Yard clearances	Removal of the signal gantry	No track work or drainage work are proposed at this location.	Receiving watercourse includes an unnamed drainage line which occurs within the study area but outside of the proposal site. This unnamed drainage line is not mapped by DPI as KFH and is defined as a low priority watercourse. As the proposed works are minor and do not directly impact this watercourse, any aquatic biodiversity associated with the drainage line has a negligible risk of being impacted. In addition, as it is not connected to a network of watercourses, there are unlikely to be indirect impacts on receiving watercourses.
Greater Hume - Lockhart Precinct			
Culcairn Yard clearances	Track realignment Gantry modification	N/A	No watercourses were identified within the study area relevant to this site.
Culcairn pedestrian bridge	Footbridge removal	N/A	No watercourses were identified within the study area relevant to this site.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Henty Yard clearances	Track realignment Level crossing modification Modification of the signal gantry	Construction has the potential to indirectly impact water quality from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	Receiving watercourses include Buckaringah Creek. <u>Buckaringah Creek</u> Buckaringah Creek is defined as type 1 highly sensitive KFH and the threatened Southern Pygmy Perch (*N. australis*) has a possible likelihood of occurrence. This watercourse is within the study area but outside of the proposal site so there would be negligible direct impacts on this watercourse or associated aquatic biodiversity. The aquatic biodiversity in Buckaringah Creek and the receiving Doodle Comer Swamp has a low risk of being indirectly impacted from poor water quality as: • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Yerong Creek Yard clearances	Track realignment Level crossing modification Platform and hut removal	Construction has the potential to indirectly impact water quality in Sandy Creek from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	Sandy Creek is located just outside of the study area (following design changes) and as such would not be directly impacted by works. Sandy Creek is defined as type 1 highly sensitive KFH as it was mapped by DPI (2016) as within the indicative distribution of a threatened species (Southern Pygmy Perch (*N. australis*)), however following a site inspection, it does not provide potential habitat for any threatened species. There is a low risk of indirectly impacting this creek during track realignment and construction activities if appropriate erosion and sediment control measures are installed and maintained.
The Rock Yard clearances	Gantry modification	N/A	No watercourses were identified within the study area relevant to this site.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Wagga Wagga Precinct			
Uranquinty Yard clearances	Track realignment Widening of the Sandy Creek Bridge Adjustment of one level crossing Removal of the redundant station platform Removal of riparian vegetation Installation of a temporary crossing on the southern side of the existing rail bridge.	Potential direct impacts from construction activities include: • clearing of riparian vegetation • installation of a temporary crossing resulting in temporary obstruction to fish passage • alteration of riverbanks and instream habitat • removal of instream vegetation and woody debris. Indirect impacts on water quality can also occur from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of direct and indirect impacts may be: • instream works for the temporary crossing • removal of vegetation along riverbanks and in the riparian zone • alterations of creek flow velocity due to temporary instream barriers which could potentially cause scour, as well as streambed and bank destabilisation • transportation of sediments and pollutants due to construction activities within or near watercourses • transportation of soils, exposed sediments and contaminants associated with earthworks and vegetation clearing	Receiving watercourses include Sandy Creek. <u>Sandy Creek</u> Sandy Creek is defined as type 1 highly sensitive KFH and the threatened Flathead Galaxias (*G. rostratus*) has a possible likelihood of occurrence. This watercourse and associated aquatic biodiversity have a moderate risk of impact as the proposal will result in a direct impact through the construction of a temporary crossing at this watercourse. Direct impacts include the clearing of approximately 64 square metres of riparian vegetation (PCT 5 River Red Gum herbaceous - grassy very tall open forest wetland) and the deposition of suitable rock and aggregate embankment formed as a bridging structure across the watercourse. The riparian vegetation would be removed from the eastern bank of Sandy Creek, between the existing rail line and Olympic Highway. This patch of vegetation has been mapped as PCT 5 River Red Gum herbaceous grassy very tall open forest wetland. The western bank is mapped as Miscellaneous ecosystem – highly disturbed areas. As such, no native riparian vegetation would be impacted on the eastern side. While the establishment of a temporary culvert crossing would minimise the risk of direct contamination of stream flow by construction traffic, it may also

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
		• transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	temporarily impact fish passage during times of flow. Further discussion on potential impacts of instream works and obstruction to fish passage are provided in section 5.1.2. During consultation, DPI advised that the temporary crossing can proceed without the provision of temporary fish passage due to the lack of important habitat features in Sandy Creek and its highly ephemeral nature (refer Appendix G). The aquatic biodiversity in Sandy Creek is unlikely to be indirectly impacted from poor water quality as: • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • impacted riparian vegetation would be re-instated as part of the rehabilitation strategy.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Pearson Street bridge	Track lowering A 450 mm drainage system has been provided to drain stormwater from the lowered track sag located east of the Pearson St Bridge. Stormwater would be transferred to Glenfield Drain.	Construction has the potential to directly impact the artificial channel through instream works and indirectly impact the channel from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of direct and indirect impacts may be: • transportation of sediments and pollutants due to construction activities within or near watercourses • transportation of soils, exposed sediments and contaminants associated with earthworks and vegetation clearing • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	The receiving watercourse is an unnamed artificial concrete drainage line which is not a mapped hydroline, is not mapped KFH (DPI, 2016), does not connect to other natural watercourses and does not provide potential habitat for threatened species. As such, there is a negligible risk of impact to this drainage line, receiving watercourses and any aquatic biodiversity associated with the drainage line. The nearby artificial wetland does not provide important fish habitat and is unlikely to support any threatened aquatic species however it does provide habitat for protected aquatic species such as turtles, eels and crustaceans. The artificial wetland has a low risk of impact if appropriate erosion and sediment control measures are installed and maintained during construction.
Cassidy Parade pedestrian bridge	Replacement of the pedestrian bridge	N/A	No watercourses were identified within the study area relevant to this site.
Edmondson Street bridge	Replacement of the road bridge Track realignment	N/A	No watercourses were identified within the study area relevant to this site.
Wagga Wagga Station pedestrian bridge	Replacement of the pedestrian bridge	N/A	No watercourses were identified within the study area relevant to this site.
Wagga Wagga Yard clearances	Track realignment	N/A	No watercourses were identified within the study area relevant to this site.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Bomen Yard clearances.	Track realignment	N/A	No watercourses were identified within the study area relevant to this site.
Junee Precinct			
Harefield Yard clearances	Track realignment Cutting back Harefield station platform (closed) overhang Widening of the rail underbridge at Reedy Creek	Direct impacts from the proposal may occur from accessing the underbridge at Reedy Creek however there would be minimal ground disturbance from actual bridge works. Indirect impacts are mainly associated with track realignment which may indirectly impact water quality from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of sediments and pollutants due to instream construction activities • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	Receiving watercourses include Reedy Creek, Bucks Creek and unnamed tributaries of these watercourses. <u>Unnamed tributary of Reedy Creek</u> This unnamed tributary occurs within the study area but outside of the proposal site. This tributary is not mapped by DPI as KFH and is defined as a low priority watercourse. As the proposed works are minor and do not directly impact this watercourse, any aquatic biodiversity associated with the drainage line has a negligible risk of being impacted. <u>Bucks Creek</u> Bucks Creek occurs within the proposal site and may be directly impacted by works however there is a low risk of direct or indirect impacts on water quality or aquatic biodiversity as: • the watercourse is defined as having no KFH • threatened aquatic species are considered unlikely to occur • the watercourse is ephemeral and does not hold water for most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
			<u>Reedy Creek</u> Reedy Creek occurs within the proposal site and may be directly and indirectly impacted by widening of the rail underbridge. Direct impacts to native riparian vegetation include the removal of 168.8 square metres of PCT 5 River Red Gum herbaceous – grassy very tall open forest wetland. There is a low risk of direct or indirect impacts on aquatic biodiversity as: • the watercourse is defined as having no KFH • threatened aquatic species are considered unlikely to occur • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • where possible, instream works would be conducted in dry conditions • impacted riparian vegetation would be re-instated as part of the rehabilitation strategy.
Kemp Street bridge	Replacement of the existing road bridge (online option)	Construction requires demolition of the existing bridge and construction of a new three-span bridge, crossing the rail yard, main line, Edgar Street and open drainage channel. Works include construction of new piers and abutments. The bridge abutments and approach embankments occupy a similar position to the existing bridge and no impacts to local or regional overland flows are expected.	Receiving watercourses include an unnamed tributary of Houlaghans Creek. The unnamed tributary would be directly impacted by the proposal through bridge replacement. The unnamed tributary is a concrete, artificial drainage line. There is a negligible risk of direct or indirect impacts on aquatic biodiversity associated with the drainage line and downstream watercourses as:

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
		There are no modification to rail drainage however the existing bridge drainage and intersection drainage would be demolished, and new bridge/road drainage constructed. Connections to the existing Council drainage network would be made at the limit of works. The existing drainage line is concrete lined however construction works have the potential to impact water quality indirectly from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of sediments and pollutants due to instream construction activities • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	• the watercourse is defined as having no KFH • threatened aquatic species are considered unlikely to occur • any indirect impacts on Houlaghans Creek can be mitigated through appropriate erosion and sediment control measures • where possible, instream works would be conducted in dry conditions.
Junee Station pedestrian bridge	Demolition of a redundant pedestrian bridge	N/A	No watercourses were identified within the study area relevant to this site.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Junee Yard clearances	Removal of a redundant signal gantry Track realignment of about 150m on Up Platform Loop north of Kemp Street bridge –up to 322mm horizontally and 96mm vertical	During track realignment, the existing ballast would be removed and replaced with new ballast. Construction works have the potential to impact water quality in receiving waters indirectly from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Receiving watercourse includes an unnamed tributary of Houlaghans Creek which is defined as a low priority watercourse. The unnamed tributary is within the study area but outside of the proposal site so would not be directly impact by the proposal There is a negligible risk of direct or indirect impacts on aquatic biodiversity associated with this tributary and downstream watercourses as any indirect impacts on Houlaghans Creek can be mitigated through appropriate erosion and sediment control measures.
Olympic Highway underbridge	Track realignment Removal of redundant main track	During track realignment, construction has the potential to impact water quality in receiving waters indirectly from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes may be: • transportation of dust, litter and other pollutants associated with construction • transportation of soils, exposed sediments and contaminants associated with stormwater flows • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Receiving watercourses include two unnamed first and second order tributaries of Houlaghans Creek. The tributaries occur in the study area however only one is within the proposal site. There is a negligible risk of direct or indirect impacts on aquatic biodiversity associated with these tributaries as: • they are defined as a low priority watercourses • any indirect impacts can be mitigated through appropriate erosion and sediment control measures.

Enhancement Site	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Junee to Illabo clearances	Track realignment Adjustments to level crossings Adjustments to rail bridges (bridges confirmed as suitable for reuse would be retained, thus exact number and location is not known) Extension or replacement of 8 culverts: • service relocation and protection and establishment of site and laydown • construct crane pads and access roads. • undertake off line extensions. • implement protection • remove track and disconnect structure from existing abutments and piers • remove ballast • install extensions to structures. • replace bottom ballast • reinstall track.	Construction has the potential to directly impact aquatic species, riverbanks and channels. Indirect impacts on water quality can also occur from the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of direct and indirect impacts may be: • instream works for a temporary crossing • removal of vegetation along riverbanks and in the riparian zone • alterations of creek flow velocity due to temporary instream barriers which could potentially cause scour, as well as streambed and bank destabilisation • transportation of sediments and pollutants due to construction activities within or near watercourses • transportation of soils, exposed sediments and contaminants associated with earthworks and vegetation clearing • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment • transportation of concrete dust, concrete slurries or washout water associated with concrete works.	Receiving watercourses include two arms of Jeralgambeth Creek, 3 unnamed tributaries of Jeralgambeth creek and 3 unnamed drainage lines not connected to a network of watercourses . <u>Jeralgambeth Creek (north arm)</u> Jeralgambeth Creek is defined as type 2 moderately sensitive KFH. There is a moderate risk of direct impact on the north arm of Jeralgambeth Creek as instream works are required for the modification of an existing culvert. Further discussion on potential impacts of instream works and obstruction to fish passage are provided in section 5.1.2. The risk of impact on water quality and aquatic biodiversity in Jeralgambeth Creek would be reduced by: • appropriate erosion and sediment control measures • where possible, instream works would be conducted in dry conditions. <u>Jeralgambeth Creek (south arm) and unnamed tributaries</u> There is negligible risk of impact on the south arm of Jeralgambeth Creek and the unnamed tributaries of Jeralgambeth Creek and any associated aquatic biodiversity as these watercourses are ranked as low priority, they lacked defined banks, contained no aquatic habitat features and in some cases were not connected to a network of watercourses.

Summary of risk of impacts on watercourses for each enhancement site

A summary of impacts from construction to watercourses within the study area is provided in Table 5-2.

Table 5-2. Summary of impact on watercourses within the study area

Risk of Impact	Watercourse / Enhancement Site
Moderate	• Murray River (Murray River bridge) • Sandy Creek (Uranquinty Yard clearances) • Jeralgambeth Creek north arm (Junee to Illabo clearances)
Low	• Oddies Creek (Murray River bridge) • Eight Mile Creek (Billy Hughes bridge) • Bucks Creek (Harefield Yard clearances)
Negligible	• Unnamed, unconnected drainage line (Table Top Yard clearances) • Buckaringah Creek (Henty Yard clearances) • Sandy Creek (Yerong Creek Yard clearances) • Unnamed tributary of Reedy Creek (Harefield Yard clearances) • Unnamed tributary of Houlaghans Creed (Junee Yard clearances) • Unnamed tributary of Houlaghans Creek (Olympic Highway underbridge) • Three unnamed tributaries of Eight Mile Creek (Billy Hughes bridge) • Unnamed artificial drainage line (Pearson Street bridge) • Reedy Creek (Harefield Yard clearances) • Unnamed tributary of Houlaghans Creek (Olympic Highway underbridge) • Unnamed drainage line (Kemp Street bridge) • Jeralgambeth Creek south arm (Junee to Illabo clearances) • Three unnamed tributaries of Jeralgambeth Creek and three unnamed, unconnected drainage lines (Junee to Illabo clearances)

5.2 Operation

During the operational phase of the proposal, the upgrades to the existing railway line would be complete and cleared areas would be landscaped and stabilised as required. Areas with high risk of soil erodibility would be stabilised and therefore there would be little or no risk of soil erosion and subsequent transport of sediment into nearby watercourses.

Proposed alterations to the existing bridges and culverts do not change the type of structure currently present and as such, risks to aquatic ecosystems during the operation would be mainly associated with maintenance activities and accidental spills or leaks that could potentially mobilise contaminants.

5.2.1 Potential impacts on water quality

For the operational phase, the risks are related to potential impacts to water quality through the mobilisation of sediments and other contaminants via wind or stormwater runoff from:

- transportation of dust, litter, exotic vegetation seed, and other pollutants associated with train operations.
- transportation of pollution and sediments from less permeable surfaces. The runoff may contain sediments and gross pollutants from the rail formation, cuttings and from trackside drainage systems.
- transportation of pollutants from accidental spills or leaks from loaded trains.
- transportation of pollutants from major incidents such as a train derailment.
- transportation of pollutants during maintenance activities such as routine vegetation clearing and weed control.

The hydrology, flooding and water quality assessment (Technical paper 11) for the proposal concluded that operation of the proposal is unlikely to cause changes to the water quality environment against the identified NSW Water Quality Objectives.

Given the proposal site is located along an existing rail line, these are existing risks which are managed in line with ARTC's standard operating procedures. There would not be anticipated to be any additional impacts from operation of rolling stock along the rail line and as such there would be no change to the existing water quality condition in the study area as a result of the proposal (Technical paper 11).

5.2.2 Impacts to aquatic biodiversity

For the operational phase, the risks to aquatic biodiversity are related to:

- Barriers to fish-passage due to blocked and or unmaintained water crossing structures. This applies to Jeralgambeth Creek, which is the only location where the proposal requires modification to instream structures in a watercourse identified as KFH. The proposed modification of the culvert on Jeralgambeth Creek would meet the minimum requirements for fish passage (Fairfull and Witheridge, 2003).
- Changes in water quality resulting in:
    - shading of aquatic vegetation due to high turbidity, smothering aquatic vegetation and causing dieback
    - mortality of filter feeding aquatic fauna, including invertebrates, by blocking filter apparatus preventing oxygen flow
    - fish kills due to clogging fish gills
    - fish kills resulting from high turbidity, making it difficult for fish to see and catch prey
    - fish kills caused from increased nutrients and subsequent algal blooms and oxygen depleted water
    - low recruitment in fish species where eggs laid on the bottom of rivers are buried by sedimentation.
    - potential increase in abundance of pest species able to tolerate poorer water quality which can subsequently outcompete native species for resources
    - reduction in native fish species presence through altered habitat caused by sedimentation in remnant pools
    - toxicity and mortality in freshwater organisms, particularly microorganisms, invertebrates and vegetation caused from pollutants such as petroleum, diesel, hydraulic fluids and oils that may be spilled into ephemeral waterways and become mobilised following rainfall events. The effects of toxicity and mortality can move up the food chain and indirectly impact higher order species such as fish, birds and mammals.

Given that there are unlikely to be additional impacts from operation on water quality, the additional risk of impact on aquatic biodiversity from the operation of the proposal is negligible.

In summary, potential operational impacts on the aquatic biodiversity are considered negligible for the following reasons:

- The proposed modification to the culvert on Jeralgambeth Creek has been designed to be fish-friendly in accordance with recommended crossing types outlined in relevant guidelines (Fairfull and Witheridge, 2003).
- The overall increase in impervious area would be minor, therefore overall impact to the volume of runoff would be minimal.
- The rail track and trains would be maintained in accordance with ARTC standards and protocols, therefore risk of spills would be unlikely.

During operation, it is expected that potential impacts would be substantially reduced through implementation of the following:

- Adopting drainage and scour protection at modified/replaced watercourse crossing structures.
- Re-establishment of riparian vegetation and aquatic habitat features within and on the banks of watercourses.
- On-going monitoring and maintenance to ensure that watercourse crossing structures are cleared of debris, particularly following heavy rainfall events.

Potential operational impacts on watercourses where relevant for each enhancement site and the level of impact to the respective watercourse is provided in Table 5-3.

Table 5-3. Potential operation impacts on water quality and aquatic biodiversity at each enhancement site and associated risk to receiving watercourses

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Albury Precinct			
Murray River bridge	Train operations Maintenance activities Track drainage	The existing bridge piers over the Murray River and Oddies Creek would not be altered by the proposal and the operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts are discussed in section 5.2.1.	Receiving watercourses include the Murray River and Oddies Creek. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on the Murray River and Oddies Creek are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. No additional risk to the receiving watercourses and aquatic biodiversity have been identified from the operation of the proposal.
Albury Station pedestrian bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Albury Station Yard clearances	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Riverina Highway bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Billy Hughes bridge	Train operations Maintenance activities Track drainage	A culvert replacement would be required on a tributary of Eight Mile Creek, however this tributary is low priority and is not defined as having any KFH. The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourses include Eight Mile Creek and unnamed tributaries of Eight Mile Creek. Potential direct impacts on a tributary of Eight Mile Creek and its aquatic biodiversity resulting from the replacement of a culvert would be low as it is not defined as KFH. As such, there are no fish passage design requirements. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on Eight Mile Creek are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.
Table Top Yard clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes an unnamed drainage line. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on the unnamed drainage line are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Greater Hume - Lockhart Precinct			
Culcairn Yard clearances	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Culcairn pedestrian bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Henty Yard clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes Buckaringah Creek. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on Buckaringah Creek are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.
Yerong Creek Yard clearances	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
The Rock Yard clearances	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Wagga Wagga Precinct			
Uranquinty Yard clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes Sandy Creek. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on Sandy Creek are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. The temporary crossing would be removed and the riparian vegetation and instream habitat would be remediated. As such, no additional risk of operation to this watercourse has been identified.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Pearson Street bridge	Train operations Maintenance activities Track drainage	Modifications to Pearson Street bridge would not impact water quality or aquatic biodiversity in the artificial drainage line during the operation of the proposal as the operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. As the artificial drainage line is not defined as KFH, there are no fish passage requirements for this watercourse. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse is an unnamed artificial drainage line. Potential direct impacts on the artificial drainage line and its aquatic biodiversity resulting from bridge modifications would be negligible as the drainage line is not defined as KFH and as such, there are no fish passage design requirements. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on the artificial drainage line are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.
Cassidy Parade pedestrian bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Edmondson Street bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Wagga Wagga Station pedestrian bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Wagga Wagga Yard clearances	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Bomen Yard clearances.	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Junee Precinct			
Harefield Yard clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes Reedy Creek, Bucks Creek and unnamed tributaries of these creeks. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on these watercourses are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to these watercourses have been identified.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Kemp Street bridge	Train operations Maintenance activities Track drainage	Modifications to Kemp Street bridge would not impact water quality or aquatic biodiversity during the operation of the proposal as the operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. As the artificial drainage line is not defined as KFH, there are no fish passage requirements for this watercourse. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes an unnamed tributary of Houlaghans Creek. Potential direct impacts on the unnamed tributary and its aquatic biodiversity resulting from alterations to the bridge would be negligible as the tributary is not defined as KFH and as such, there are no fish passage design requirements. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on this tributary are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.
Junee Station pedestrian bridge	Train operations Maintenance activities Track drainage	N/A	No watercourses were identified within the study area relevant to this site.
Junee Yard clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes an unnamed tributary of Houlaghans Creek. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on this tributary are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to this watercourse has been identified.

Proposal site	Key operational activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Olympic Highway underbridge	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes two unnamed tributary of Houlaghans Creek. Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on these tributaries are considered negligible as the rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. No additional risk of operation to watercourses have been identified.
Junee to Illabo clearances	Train operations Maintenance activities Track drainage	The operation of the rail line would be consistent with the existing train operations including maintenance activities and track drainage. The operation of the rail line infrastructure has the potential to impact water quality due to the mobilisation of sediments and other contaminants via wind or stormwater runoff. Potential causes of impacts at discussed in section 5.2.1.	Receiving watercourse includes Jeralgambeth Creek and associated unnamed tributaries. Potential direct impacts on aquatic biodiversity resulting from the modification of an existing culvert on Jeralgambeth Creek is low as the proposal would meet the minimum design requirements for fish passage for a class 2 watercourse (i.e. a high flow design culvert (Fairfull and Witheridge, 2003). Potential indirect impacts on aquatic biodiversity resulting from poor water quality from train operation are discussed in detail in section 5.2.2. The risk of these impacts on this creek and its tributaries are considered negligible as the rail track, trains and culverts would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. No additional risk of operation to watercourses have been identified.

5.3 Threatened species, populations and aquatic ecological communities assessed under the FM Act

Relevant database searches identified eight threatened species, two endangered populations and one aquatic ecological community listed under the FM Act that have been previously recorded in the study area. Of these, five aquatic threatened species were identified as likely or possible to occur within the study area and were assessed against an assessment of significance in Appendix E:

1. Flathead Galaxias (*G. rostratus*) CE
2. Murray Crayfish (*E. armatus*) V
3. Silver Perch (*B. bidyanus*) V
4. Southern Pygmy Perch (*N. australis*) E
5. Trout Cod (*M. macquariensis*) E

In addition, *Lowland Murray River aquatic ecological community* is known to occur within the proposal site and was also assessed against an assessment of significance.

5.3.1 Impact on life cycle of a threatened species

Within the proposal site, Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*) and Trout Cod (*M. macquariensis*) were considered likely to occur in the Murray River and while there are records of these species from the Murray River near Albury (ALA, 2021), the bridge location has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). As such, the proposal site at the Murray River bridge is considered unlikely to provide important habitat for these species. In addition, the proposal does not require any works to the sub-structure of the existing bridge or within the bed of the Murray River. Thus, the level of impact to the aquatic environment is minor and the habitat being impacted is not considered to be important habitat for refuge and breeding.

Flathead Galaxias (*G. rostratus*) was considered to have moderate likelihood of occurrence in the Murray River and in Sandy Creek at Uranquinty as these watercourses are within the indicative distribution mapped for this species (DPI, 2016). However, the Murray River lacked important habitat features required by the species such as aquatic vegetation and coarse sand and as discussed above, the bridge location has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). The impact of the proposal at the Murray River bridge is relatively minor, with no works proposed within the creek bed.

Similarly, the quality of the habitat for Flathead Galaxias (*G. rostratus*) at Sandy Creek is defined as low as the creek is highly ephemeral, flowing only after rain events, and there were no refuge pools observed at the survey site during site inspections. While there were some sparse emergent, mainly exotic macrophytes, there were no submerged or floating macrophytes. In addition, the habitat at the survey site has been highly modified and the status of fish communities in Sandy Creek is defined as poor (DPI, 2016). The proposal does not require any works to the sub-structure of the existing bridge however a temporary crossing is proposed for approximately four weeks on Sandy Creek which would impact 64 square metres riparian vegetation. These works have the potential to impact fish passage during flow events however as Sandy Creek is highly ephemeral and does not provide important habitat features for this species, the temporary crossing and loss of riparian vegetation is considered unlikely to adversely affect the life cycle of this species.

Southern Pygmy Perch (*N. australis*) was considered possible to occur at Buckaringah Creek near Henty Yard clearances as it is within the indicative distribution mapped for this species (DPI, 2016). The watercourse at this survey site was dry at the time of survey however there were some remnant pools, some instream habitat features such as branches and trailing bank vegetation but there was only sparse emergent, mainly exotic

macrophytes, with no submerged or floating macrophytes. Buckaringah Creek at the survey site is not considered to provide good quality habitat as it does not contain well vegetated, slow flowing waters, which are preferred habitat features of this species. The habitat at the survey site has been highly modified and the status of fish communities in Buckaringah Creek is defined as poor (DPI, 2016). In addition, the proposal would not result in any direct impacts on the creek. As such, the proposal site is considered unlikely to provide important habitat for this species.

Potential indirect impacts on water quality at all watercourses within the proposal site are associated with the mobilization of sediments during rain events. Both direct and indirect impacts can be managed during the operation and construction phase and the level of impact to the aquatic environment is therefore considered minor. Thus, the assessment of significance under the FM Act concluded that the proposal is considered unlikely to have an adverse effect on the life cycle of any of these potentially occurring threatened species, such that a viable local population of the species is likely to be placed at risk of extinction.

5.3.2 Impact on the life cycle of an endangered population

No endangered populations were considered likely to occur in the study area.

5.3.3 Impacts on the extent and composition of an EEC

The study area occurs within the Lowland Murray River aquatic ecological community. The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut rivers, as well as all their tributaries and branches. Within the study area, this includes Jeralgambeth Creek, Reedy Creek, Sandy Creek, Buckaringah Creek, Eight Mile Creek, Oddies Creek and the Murray River. Except for Sandy Creek, the proposal would not result in any direct impacts on the aquatic environment and direct impacts at Sandy Creek are minor and can be mitigated following the removal of the temporary crossing. Thus, the proposal would not result in permanent removal of this EEC and as such, the proposal is unlikely 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 composition of this EEC includes 23 species of fish and over 400 recorded native invertebrate species. Risks to the EEC include regulation of the river system, introduced fishes, clearing of riparian vegetation, some types of agriculture and overfishing. The EEC provides a range of habitats for fish and invertebrates, including pools, runs or riffles, backwaters and billabongs, large woody habitats and aquatic plants (DPI, 2007b). The watercourses within the study area lack riffle sections, backwaters and billabongs. Remnant pools were observed only at Oddies Creek, Eight Mile Creek, Buckaringah Creek and Jeralgambeth Creek, large woody habitats were recorded only at the Murray River, Oddies Creek and Buckaringah Creek and native aquatic vegetation was recorded only at the Murray River, Oddies Creek and Eight Mile Creek. The proposal is unlikely to alter the composition of this EEC as it will not permanently impact watercourses identified as containing large woody debris and proposed works at Eight Mile Creek and Jeralgambeth Creek include modifications to existing culverts only, which is unlikely to permanently alter existing pools or aquatic vegetation at these locations.

In addition, the watercourses within the proposal site have been modified through past disturbance through the construction and operation of road and rail infrastructure, and land use practices within the catchment. The instream habitat has limited aquatic vegetation, with the exotic Umbrella sedge (*C. erogrostis*) being the dominant species and the exotic Mosquitofish (*G. holbrooki)* recorded at sites during surveys. The proposal is unlikely to further contribute to the presence of exotic aquatic species through the implementation of appropriate mitigation and management during construction and

operation. As such, the proposal is unlikely 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.

5.3.4 Impacts on the habitat of a threatened species or EEC

Similarly, potential impacts to the habitat of these threatened species and the aquatic ecological community are unlikely to be significant. The proposal requires minimal direct impacts and potential indirect impacts can be mitigated through appropriate erosion and sediment control. As such, the proposal is unlikely to impact the extent of the habitat available for threatened species and the aquatic ecological community nor would the proposal result in their habitat to become fragmented or isolated from other areas of habitat. While three watercourses were identified as potential habitat for threatened species (Murray River, Buckaringah Creek and Sandy Creek), the habitat at these watercourses is considered as low importance for the long-term survival of Trout Cod (*M. macquariensis*), Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*), Southern Pygmy Perch (*N. australis*) and/or Flathead Galaxias (*G. rostratus*) populations in the locality, mainly due to the absence of important habitat features within these watercourses. For example, habitat requirements for these threatened species include large woody debris, well oxygenated flowing water, rapids and races and or aquatic vegetation, all of which are absent from these watercourses or would not be directly impacted by the proposal.

5.3.5 Impacts on critical habitat

The study area does not contain any water or land identified as critical habitat under the FM Act.

5.3.6 Consistency with a recovery plan or threat abatement plan

Priority action statements for the five threatened species and the Lowland Murray River aquatic ecological community are generally not directly relevant to the proposal and relate to actions required by DPI to ensure the protection of these species and the aquatic ecological community. Habitat rehabilitation is however of relevance and would be undertaken as part of a rehabilitation strategy for the area of impact (outside of the operational area) following completion of works.

5.3.7 Key threatening processes

Eight KTPs are listed under the FM Act however only three are of relevance to the proposal:

- Degradation of native riparian vegetation along New South Wales water courses
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Removal of large woody debris from New South Wales rivers and streams

The proposal is modifying or replacing exiting bridges and culverts however it does not change the style of instream structures from what currently exists. As such, the proposal does not contribute further to the ‘installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams’.

Similarly, as the proposal does not require instream works at sites identified as having large snags (Murray River, Oddies Creek and Buckaringah Creek), it is unlikely to contribute to ‘removal of large woody debris from NSW rivers and streams’.

Thus, the ‘degradation of native riparian vegetation along New South Wales water courses’ is the only KTP that would be impacted by the proposal.

Native riparian vegetation degradation along NSW watercourses has been listed as a KTP because of its negative impacts on many threatened species, populations and ecological communities.

Compounds and stockpile sites would be located a minimum distance of 40m from top of bank where native riparian vegetation is present (in accordance with *Guidelines for controlled activities on waterfront land* (DPI, 2018)) to avoid direct impacts on riparian vegetation and indirect impacts on aquatic habitat. Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable. The proposal requires the removal of 0.03 hectares of riparian vegetation. Following completion of works, disturbed areas outside of the operation area would be restored in accordance with a rehabilitation strategy. As such, the proposal is unlikely to significantly contribute to this KTP.

5.4 Matters of National Significance assessed under the Commonwealth EPBC Act

The assessment of significance for MNES under the EPBC Act is provided in Appendix F. The assessment varies according to the species status. As such, summaries of each of the four threatened aquatic species identified as likely or possible to occur within the study area are considered below according to the species legal status.

Critically endangered/endangered species

Three critically endangered/endangered species listed under the EPBC Act were considered to likely or possibly occur within the proposal site (at the Murray River bridge). Silver Perch (*B. bidyanus*), Flathead Galaxias (*G. rostratus*) and Trout Cod (*M. macquariensis*) have previously been recorded within the Murray River (ALA, 2021) near to the Murray River bridge, however the records are from greater than 10 years ago. Indicative distribution mapping by DPI (2016) does not map the Murray River at the bridge location as potential occurrence of any of these three species. Thus, while they may occur in the Murray River, the proposal site within the Murray River is not considered important habitat for these species. In addition, the proposal does not require any instream works or removal of riparian vegetation at the Murray River bridge enhancement site.

Sandy Creek at Uranquinty was also identified as being within the indicative distribution for Flathead Galaxias (*G. rostratus*). The proposal at this location may require temporary obstruction to fish passage over a four-week period for a temporary crossing, and minor removal of riparian vegetation (64 square metres). However, given Sandy Creek is highly ephemeral and the riparian vegetation has already been highly modified, these actions are considered unlikely to significantly impact this species.

Thus, it is concluded that the proposal is unlikely to have a significant impact on these three endangered or critically endangered species (refer Appendix F for the full assessment).

Vulnerable species

One vulnerable species (Murray Cod) listed under the EPBC Act was considered likely to occur within the proposal site (at the Murray River bridge).

Under the meaning of the Act, an “important” population is one that is necessary for a species’ long-term survival and recovery and may include key source populations for breeding and dispersal, populations necessary for maintaining genetic diversity and populations near the limit of the species range.

While there are past records of Murray Cod in the Murray River, and there is suitable habitat available for the Murray Cod within the proposal site at the Murray River bridge, there have been no records (ALA, 2021) of this species within the past ten years (within a five kilometre radius of the Murray River bridge). In addition, the Murray River bridge is not within the indicative distribution of this species. Thus, it is considered unlikely that the proposal site at the Murray River bridge provides important habitat for this species or that the site supports an “important” population of this species. In addition, the proposal does not

require instream works at the Murray River. As such, the proposal is considered unlikely to have a significant impact on the Murray Cod (refer Appendix F for the full assessment).

No other MNES were identified as possible or likely to be impacted by the proposal (refer Table 4-6 and Appendix D).

5.5 Sensitive areas

5.5.1 Key fish habitat

KFH within the study area was defined based on existing KFH mapping by DPI (2007), watercourses sensitivity type (DPI, 2013) and watercourse class (Fairfull and Witheridge, 2003) which were defined following site inspection. Only instream habitat (top of bank to top of bank) I defined as KFH. This excludes riparian vegetation.

Within the Albury Precinct, the Murray River is defined as type 1 highly sensitive KFH as it is a perennial watercourse, with aquatic vegetation, woody debris, bank overhang and riparian vegetation. Oddies Creek is defined as type 2 moderately sensitive KFH as, while it is highly ephemeral, it does have remnant pools, aquatic vegetation and woody debris. Within the Greater Hume to Lockhart precinct, Buckaringah Creek is defined as type 1 highly sensitive KFH as it was mapped by DPI (2016) within the indicative distribution of a threatened species (Southern Pygmy Perch (*N. australis*)). In the Wagga Wagga precinct, Sandy Creek is defined as type 1 highly sensitive KFH as, despite having no habitat features, it was mapped by DPI (2016) within the indicative distribution of a threatened species (Flathead Galaxias (*G. rostratus*)). In the Junee to Illabo precinct, Jeralgambeth Creek north arm, is defined as type 2 moderately sensitive KFH due to the presence of remnant pools and aquatic vegetation. All other watercourses within the proposal site are defined as type 3 minimal KFH and class 3 minimal or class 4 unlikely KFH due to the absence of fish habitat features.

Potential impacts to KFH in watercourses include:

- Jeralgambeth Creek where a culvert would be modified. This instream structure is not in addition to what currently exists, and it would be in accordance with relevant design guidelines for water crossing structures and therefore not expected to impact fish-passage or disrupt habitat functionality in anyway.
- Temporary instream disturbance and obstruction of fish passage at Sandy Creek (Uranquinty Yard clearances) for the temporary crossing.

KFH would not be permanently lost or disrupted provided the proposal implements the proposed design and alignment, construction methodology, mitigation measures, rehabilitation strategy and operational monitoring and management. As such, no aquatic biodiversity offset is required, which has been confirmed by DPI during consultation (Appendix G).

However, DPI did recommend some habitat improvement opportunities such as the placement of removed riparian vegetation within the bed of the watercourse for re-snagging (i.e., large woody debris), log revetment works or other enhancement works along with any opportunities to improve water quality by stabilising the bank of watercourses using revegetation.

The aquatic biodiversity impact assessment concludes that the impacts of the proposal would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area. Most of the potential construction impacts are associated with indirect impacts on water quality and would therefore be temporary and managed through the adoption of appropriate erosion and sediment control measures. Rail track and trains would be maintained in accordance with ARTC standards and protocols which is consistent with existing conditions. As such, no additional risk of operation to these watercourses have been identified.

5.5.2 Waterfront land

The construction and operation of the proposal would involve works on waterfront land which includes the bed and bank of watercourses and all land within 40 metres of the highest bank. Activities that are expected to impact waterfront land include:

- native riparian vegetation clearing
- instream works
- earthworks, including cuttings and embankments and movement/use of vehicles across exposed soil
- construction compounds and associated activities.

Where possible, the construction footprint would be minimised to reduce clearing in the riparian corridor and practises would be implemented to minimise disturbance of the banks. Bank stabilisation processes would also be undertaken after removal of the temporary crossing at Sandy Creek, Uranquinty.

5.5.3 Groundwater dependent ecosystems

The Groundwater Assessment (Technical paper 12) identified two enhancement sites: Riverina Highway Bridge at Albury and Kemp Street Bridge at Junee, as having a high risk of intersecting the regional water table as part of construction activities. In addition, construction and operation works at Pearson Street Bridge at Wagga Wagga present an increased risk to the groundwater table dependant on future climatic conditions or potential changes in operational procedures of current dewatering activities undertaken by Wagga Wagga City Council for urban salinity management. No KFH occurs within the study area at these enhancement sites.

The assessment of the proposals impacts on aquifers and GDEs in regard to the minimal impact considerations of the NSW Aquifer Interference Policy, indicates the proposal complies with Level 1 criteria, which considers the potential impacts as acceptable (Groundwater Assessment (Technical paper 12)). As such, the proposal is considered unlikely to impact any GDE during construction or operation.

6. Cumulative impact assessment

For an EIS, cumulative impacts can be defined as the successive, incremental, and combined effect of multiple impacts, which may in themselves be minor but could become significant when considered together. The methodology for the cumulative impact assessment is provided in detail in the EIS (Chapter 26).

The study area for the cumulative aquatic biodiversity impact assessment is watercourses crossed by the proposal and a 200 metre buffer around these watercourses. Six major projects were identified within this buffer and as having a potential cumulative impact. Major projects outside of this buffer (detailed in Chapter 26 of the EIS) were considered unlikely to contribute to cumulative impacts on watercourses within the study area and were therefore not considered further. In addition, projects that were within the buffer but did not require any construction works or soil disturbance within the buffer (i.e. the Tottenhan to Albury (Victoria) section of Inland Rail) were also excluded from the cumulative impact assessment.

The following projects have been considered (refer Table 6-1):

1. Thurgoona Link Road
2. Nexus Industrial Precinct
3. Junee Station Upgrade
4. Junee to Griffith Line Upgrade
5. Inland Rail, Illabo to Stockinbingal section.

The locations of these projects are shown in Figure 6-1.

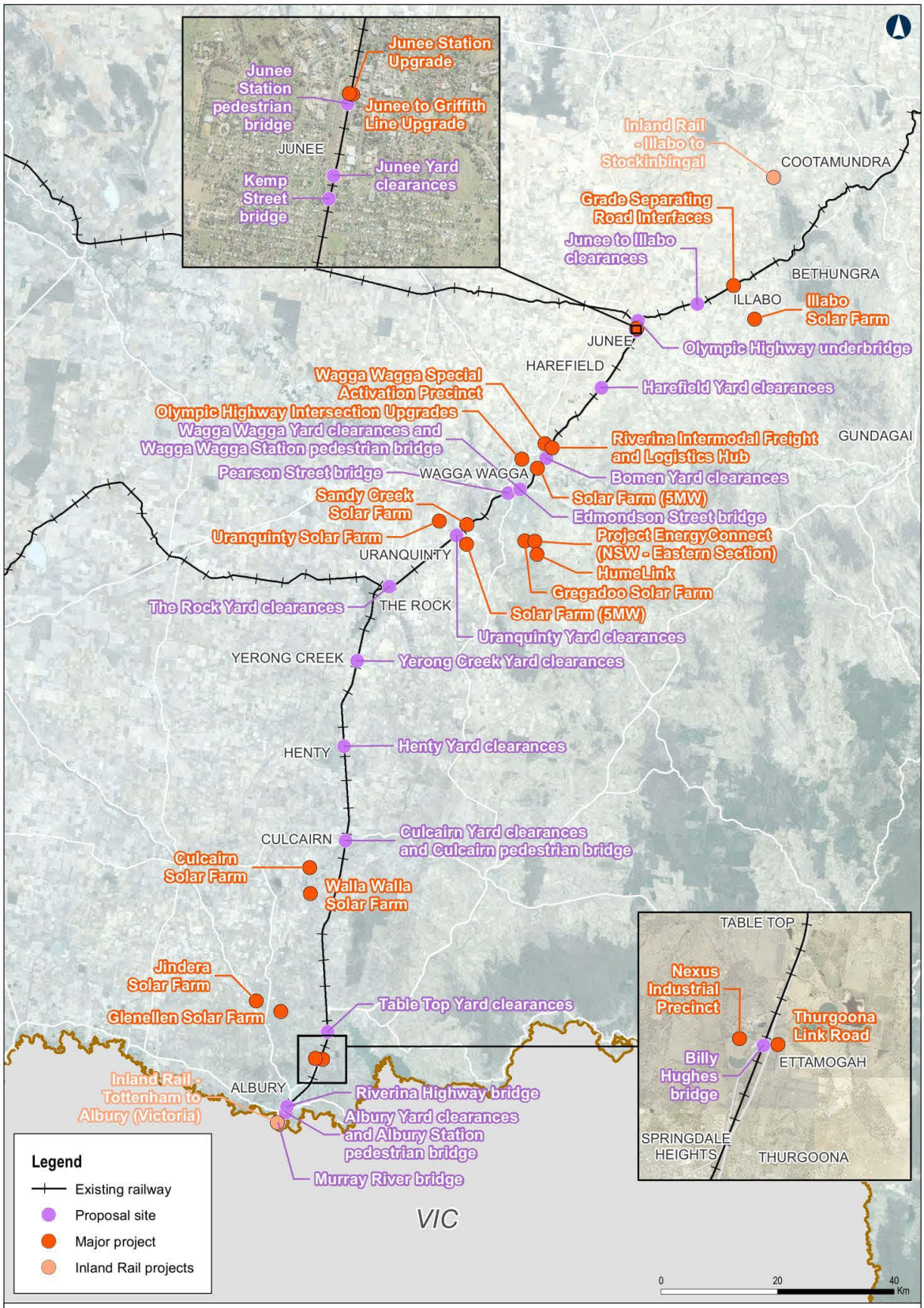


Figure 6-1 Major projects in the vicinity of the proposal

Data Sources: ARTC, NSWSS

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:850,000
Paper size: A3
Date: 24/05/2022

210_EAP_FXX_MajorProjects_r1v2.mxd

Table 6-1. Summary of potential cumulative impacts

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Thurgoona Link Road					
Billy Hughes bridge Eight Mile Creek and tributaries	Stage 2 of this project occurs within the study area and involves the extension of Elizabeth Mitchell Drive to Davey Road which is 2 kilometre of road. Construction is proposed in 2023. Of relevance to this aquatic biodiversity impact assessment is the following: • Vegetation removal and clearing and grubbing of the alignment and corridor. • Removal of existing road infrastructure and assets. • Installation of kerbing, roundabouts and concrete/asphalt pathways. • Construction of a bridge over Eight Mile Creek. • Installation of new drainage and landscaping.	Potential construction mitigation measures relevant to aquatic biodiversity that were identified in the Thurgoona Link Road project fact sheet include: • Avoiding certain times of the year for vegetation clearing and construction in wet areas to consider animal migrations, movements and breeding. • Rehabilitation activities, including the use of locally indigenous trees and shrubs in all revegetation and plantings. • Protecting those areas of vegetation and fauna habitat not required for construction.	Reduced water quality through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff associated with road operation and maintenance. This could subsequently impact aquatic biodiversity through increased turbidity nutrients and toxicants in the water, resulting in fish kills, algal blooms and aquatic vegetation dieback.	Potential operation mitigation measures relevant to aquatic biodiversity that were identified in the Thurgoona Link Road project fact sheet include: • Environmental monitoring after construction.	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project on Eight Mile Creek and its tributaries, which are ephemeral and dry most of the time, would be negligible.

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	Construction works have the potential to reduce water quality in Eight Mile Creek through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff which could subsequently impact aquatic biodiversity. Increased turbidity results in shading and potential dieback of aquatic vegetation, fish kills through clogging gills or making prey hard to find and/or reduced recruitment by smothering fish eggs. Excess nutrients attached to sediments can result in algal blooms and oxygen depletion, leading to fish kills. Transport of contaminants resulting from spill such as petroleum, diesel, hydraulic fluids and oils that may become mobilised following rainfall and cause toxicity and mortality in freshwater organisms, which can move up the food chain.,	• Environmental monitoring during and after construction. • Maintaining connectivity along watercourses for aquatic animals. • Use of erosion and sediment controls.	Flood impacts due to redirection of overland flows which may subsequently impact aquatic species due to changes in flow regimes.		

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Nexus Industrial Precinct					
Billy Hughes bridge Eight Mile Creek	The project consists of: • The construction of the Davey Road interchange (discussed above). • Gas reticulation and mains extension works. • Sewer augmentation and subdivision (this has been completed). The gas reticulation works have the potential to reduce water quality through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff which could subsequently impact aquatic biodiversity. Increased turbidity results in shading and potential dieback of aquatic vegetation, fish kills through clogging gills or making prey hard to find and/or reduced recruitment by smothering fish eggs. Excess nutrients attached to sediments can result in algal blooms and oxygen depletion, leading to fish kills. Transport of contaminants resulting from spill such as petroleum, diesel, hydraulic fluids and oils that may become	Details on potential construction mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Erosion and sediment control measures in accordance with the Blue Book. • Stockpile management. • Compounds and stockpile sites located outside of riparian habitat and waterfront land.	Reduced water quality through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff associated with various industry. This could subsequently impact aquatic biodiversity through increased turbidity nutrients and toxicants in the water, resulting in fish kills, algal blooms and aquatic vegetation dieback.	Details on potential operation mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Refueling outside of waterfront land. • Environmental monitoring after construction. • Operation of various industry in accordance with relevant environmental guidelines.	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project on Eight Mile Creek and its tributaries, which are ephemeral and dry most of the time, would be negligible.

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	mobilised following rainfall and cause toxicity and mortality in freshwater organisms, which can move up the food chain.				
Junee Station Upgrade					
Junee to Illabo clearances First order tributary of Houlaghans Creek	The project is expected to be completed in 2022 and consists of: • New accessible ramps to verandah. • Upgrades to family accessible, female and male toilets. • New boarding assistance zone. • Modifications to the waiting room and ticket counter. • Resurfacing of entrance walkway. • Upgraded platform seating. • Improvements to wayfinding and lighting. The proposed works require negligible soil disturbance and as such, are unlikely to result in a reduction in water quality through the mobilization of sediments.	Details on potential construction mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Erosion and sediment control measures in accordance with the Blue Book	The operation of the proposal is unlikely to increase the potential impacts of the current operation of the station.	No operation mitigation measures relate to aquatic biodiversity.	The cumulative impacts of the project on the unnamed tributary of Houlaghans Creek, would be negligible. The tributary is a low priority watercourse and is ephemeral. As such, is unlikely to be impacted.

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	As works are greater than 200 metres from the first order tributary of Houlaghans Creek, there are unlikely to be any direct or indirect impacts on aquatic flora, fauna and or habitat.				
Junee to Griffith Line Upgrade					
Junee to Illabo clearances First order tributary of Houlaghans Creek	The proposed works require negligible soil disturbance in the vicinity of the tributary of Houlaghans Creek, and as such, are unlikely to result in a reduction in water quality through the mobilization of sediments. As works are greater than 200 metres from the first order tributary of Houlaghans Creek, there are unlikely to be any direct or indirect impacts on aquatic flora, fauna and or habitat.	Details on potential construction mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Erosion and sediment control measures in accordance with the Blue Book.	The operation of the proposal is unlikely to increase the potential impacts of the current operation of the station.	No operation mitigation measures relate to aquatic biodiversity.	The cumulative impacts of the project on the unnamed tributary of Houlaghans Creek, would be negligible. The tributary is a low priority watercourse and is ephemeral. As such, is unlikely to be impacted.

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Inland Rail – Illabo to Stockinbingal					
Junee to Illabo clearances Jeralgambeth Creek and Billabong Creek	The scoping report for this project indicates that it would require the installation of approximately 43 new culverts and five bridges. The proposed bridge at Billabong Creek is the closest to the proposal site. The construction sequence is: • Establish construction work sites and environmental controls. • Undertake enabling works, including the excavation, installation and relocation of services. • Remove existing structures and vegetation clearing. • Construct new structures, including: ○ Placement of suitable formation material. ○ Installation of new culverts and associated structures.	The construction has the potential to reduce water quality through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff which could subsequently impact aquatic biodiversity. Increased turbidity results in shading and potential dieback of aquatic vegetation, fish kills through clogging gills or making prey hard to find and/or reduced recruitment by smothering fish eggs. Excess nutrients attached to sediments can result in algal blooms and oxygen depletion, leading to fish kills. Transport of contaminants resulting from spill such as petroleum, diesel, hydraulic fluids and oils that may become mobilised following rainfall and cause toxicity and mortality in freshwater organisms, which can move up the food chain.	Reduced water quality through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff associated with train operation and maintenance. This could subsequently impact aquatic biodiversity through increased turbidity, nutrients and toxicants in the water, resulting in fish kills, algal blooms and aquatic vegetation dieback.	Potential operation mitigation measures relevant to aquatic biodiversity that were identified in the scoping report include: • Weed management protocols for the operational rail corridor and other ARTC facilities would be in accordance with the requirements of the Biosecurity Act 2015. • Culverts that provide for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project on the Jeralgambeth Creek and subsequently Billabong Creek, would be negligible. Both creeks are ephemeral and dry most of the time and as such, are unlikely to be impacted.

Enhancement site and common downstream watercourses[1]	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact

	• Track works including as required:
	  ○ Construction of cuts and fills.
	  ○ Installation of new track, track components and ballast.
	• Installation of signalling infrastructure and other services.
	• Commissioning works.
	• Site rehabilitation.
				contribute to the blockage of fish passage.	

[1] Watercourses that occur both within the proposal study area and within 200 metres of a major project [2] concurrent construction is assumed

7. Mitigation and management measures

The proposal has been designed to avoid and minimise potential impacts to watercourses and aquatic biodiversity as far as practicable. The strategies that have been, and would continue to be implemented include the following:

- Design has avoided and minimised impact to aquatic biodiversity as at most existing bridge locations, no instream works are proposed in watercourses identified as KFH.
- Where bridges will be modified or replaced, bridge piers would be located outside of watercourse channels where practicable to preserve fish passage.
- Works in ephemeral watercourses would be undertaken as far as practicable in dry weather conditions when watercourses are dry.
- Flow discharge points (culverts) would include scour protection measures such as rock protection, to minimise the risk of erosion as surface water enters and exists the structure.

Environmental management for the proposal would be carried out in accordance with the environmental management approach as detailed in Chapter 27 of the EIS (Synthesis of the EIS).

Impacts to aquatic biodiversity would be managed in accordance with the biodiversity management sub-plan, which would be prepared prior to construction and implemented as part of the CEMP. The plan would include measures to manage and minimise the potential for impacts on the aquatic environment during construction. The plan would be prepared in accordance with relevant legislation, guidelines and standards. The plan will include, but not be limited to:

- Locations and requirements for pre-clearing surveys.
- Management measures to minimise impacts to aquatic biodiversity, including monitoring of changes in salinity in affected waterbodies resulting from altered groundwater flows.
- Measures to manage weeds, pests and invasive species.
- Removal and displacement of habitat features (riparian vegetation, instream vegetation and or large rocks and woody debris within the bed) would be avoided as far as practicable.
- Salvage of fauna from watercourses and remnant pools prior to construction on watercourses directly impacted (i.e. Sandy Creek and Jeralgambeth Creek).
- Culverts and bridges on ephemeral watercourses would be installed when the watercourse is dry where practicable.
- Appropriate erosion and sediment control measures will be installed around instream work areas and construction compounds.
- Measures to manage the risk of accidental spills. This should include spill kits always kept on site for works within 100 metres of a watercourse.
- Where possible, access to watercourses by construction plant would be minimised.

For rehabilitation of disturbed areas, a rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas following the completion of construction. The strategy will include:

- clear objectives and timeframes for rehabilitation works (including the biodiversity outcomes to be achieved and clear objectives for the rehabilitation of riparian vegetation in temporary disturbance areas)
- details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas
- identification of flora species and sources
- procedures for monitoring the success of rehabilitation

- corrective actions should the outcomes of rehabilitation not conform to the objectives.

Opportunities for improvement of aquatic habitat such as the reinstatement of removed riparian vegetation within the bed of the watercourse for re-snagging (i.e., large woody debris) along with any opportunities to improve water quality by stabilising the bank of watercourses using revegetation, should be included in the rehabilitation strategy. Specifically, rehabilitation of watercourses where instream works are proposed (i.e. Sandy Creek and Jeralgambeth Creek) or where riparian vegetation will be removed are to be addressed in the rehabilitation strategy.

7.1 Summary of mitigation and management measures

The mitigation measures to minimise impacts to aquatic biodiversity from the proposal during detailed design / pre-construction, construction and operation are outlined in Table 7-1.

Table 7-1. Summary of mitigation and management measures

Impact type	Mitigation management measure	Project phase
Fauna	Detailed design and construction planning will seek to identify refinements that further avoid or minimise the need to further impact or disturb native vegetation, fauna habitat and riparian habitat.	Detailed design/ pre-construction
Fish passage	Fish passage will be maintained at Jeralgambeth Creek (Junee to Illabo clearances).	Detailed design/ pre-construction / construction
Fauna	Pre-clearance surveys will be carried out prior to construction by a suitability qualified ecologist in accordance with the biodiversity management sub-plan. This would include: • native aquatic fauna salvage in watercourses of residual pools directly impacted by construction. All salvaged aquatic fauna would be relocated to similar habitat nearby.	Pre-construction/ Construction
Riparian vegetation	Exclusion areas would be established and maintained around native vegetation and riparian vegetation to be retained, particularly areas of biodiversity value adjoining the proposal site that are located in close proximity to work areas.	Construction
Riparian vegetation	Activities within vegetated riparian zones will be managed to minimise impacts to aquatic environments as far as practicable. Riparian areas subject to disturbance will be progressively stabilised and rehabilitated.	Construction
Instream impacts	Instream works at Sandy Creek (Uranquinty Yard clearances) and Jeralgambeth Creek (Junee to Illabo clearances) would be undertaken in dry conditions as far as practicable. Appropriate erosion and sediment control would be installed and maintained. Aquatic habitat would be returned to pre-works condition (or better) in accordance with the rehabilitation strategy.	Construction
Instream impacts	Any instream habitat features (woody debris, large rocks and boulders) at the temporary creek crossing location at Sandy Creek (Uranquinty Yard clearances) is to be removed and placed up or downstream of the construction area in consultation with a suitably qualified aquatic ecologist. Any such aquatic features would be re-instated within the watercourse at the completion of construction.	Construction

Impact type	Mitigation management measure	Project phase
Unexpected finds	A species unexpected finds protocol will be implemented if threatened ecological communities, flora and fauna species, not assessed in the biodiversity assessment, are identified in the proposal site. This would include stop work orders in the immediate area and notifying DPE.	Construction
Instream impacts	Refuelling would be conducted outside of waterfront land, where practicable, with appropriate measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. This includes spill kits always kept with maintenance vehicles and or machinery within 100 metres of a watercourse.	Construction and Operation
Fish passage impacts	Instream structures (bridges and culverts) that provide for the flow of watercourses would be inspected and maintained during routine track inspections to address any issues that may contribute to the blockage of fish passage.	Operation

7.2 Predicted effectiveness of the mitigation and management measures proposed

As discussed above, the proposal has been designed to avoid and minimise potential impacts to watercourses and aquatic biodiversity as far as practicable.

The proposal includes removal of 0.03 hectares of native riparian vegetation. A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas, which would include re-establishment of riparian vegetation and the stabilisation of disturbed instream substrate in this area. The ecological value of this area would be expected to recover over time. With the implementation of mitigation measures, trimming of riparian vegetation along the Murray River would not result in a loss of ecological value.

Other potential impacts from the proposal are minor and avoidable, provided controls are implemented, maintained and monitored, and the mitigation and management measures proposed are considered to be effective.

8. Conclusion

The aquatic ecological assessment for the construction and operation of the ARTC Inland Rail infrastructure between Albury to Illabo (the proposal) has been prepared based on a review of available aerial photography, topography, databases, literature, policies and guidelines, as well as results of field investigation. The key findings of report are as follows:

Existing aquatic environment

- The study area includes 26 watercourses and three waterbodies, of which 12 were ranked as medium to high priority watercourses and were subject to field survey and habitat assessment. Ranking of watercourses was based on KFH mapping (DPI, 2007a), threatened species distribution mapping (DPI, 2016) and Strahler stream order (Strahler, 1952).
- Aquatic habitat assessment in the field found that except for the Murray River, all other watercourses were highly ephemeral with only four sites containing small, shallow remnant pools:
    - Oddies Creek
    - Eight Mile Creek
    - Buckaringah Creek
    - Jeralgambeth Creek
- The remaining watercourses were completely dry within the proposal site at the time of survey. The Murray River (which is perennial and contained moderate flows) and Oddies Creek both contained habitat features such as woody debris, instream macrophytes, riparian vegetation and bank overhang. Eight Mile Creek contained instream macrophytes and Buckaringah Creek contained large woody debris. The remaining watercourses lacked important fish habitat features. First and second order drainage lines and tributaries that were visited usually lacked riparian or aquatic vegetation and were dry. All watercourses and riparian zones were significantly modified by agricultural land practices.
- Targeted threatened fauna surveys were undertaken using bait traps in medium to high priority watercourses where water and/or remnant pools were present. Pelagic species and/or larger bodied fish species were not targeted in the Murray River and were assumed present and considered further in a likelihood of occurrence assessment. Targeted surveys did not result in the capture of any threatened species and only the exotic Mosquitofish were captured.

Impact assessment – Construction

Direct impacts from the proposal on aquatic biodiversity would include removal of riparian vegetation, temporary barriers to fish-passage and potential mortality to aquatic flora and fauna from poor water quality. Indirect impacts to aquatic biodiversity relate to the mobilisation of poor-quality stormwater runoff from construction activities including vegetation removal, earthworks, establishment and use of construction compounds as well as riverbank and streambed disturbance that would result in sedimentation and pollution downstream and potential mortality to aquatic flora and fauna.

The potential impacts during construction are considered to be a moderate risk at three watercourses:

- Murray River (Murray River bridge) – this watercourse is defined as type 1 highly sensitive KFH and a class 1 perennial watercourse. Potential impacts on this watercourse relate mainly to indirect impacts to water quality during bridge modification.
- Sandy Creek (Uranquinty Yard clearances) – this watercourse is defined as type 1 highly sensitive KFH as it is within the mapped distribution of a threatened species (Flathead Galaxias (*G. rostratus*)) and a class 2 ephemeral watercourse. Potential

impacts on this watercourse relate to instream works required for the construction of a temporary crossing on this watercourse.
- Jeralgambeth Creek north arm (Junee to Illabo clearances) – this watercourse is defined as type 2 moderately sensitive KFH through the presence of some habitat features such as remnant pools and aquatic vegetation and a class 2 ephemeral watercourse. Potential impacts on this watercourse relate to instream works required for the replacement of an existing culvert.

All other watercourses within the study area were considered to have a low or negligible risk of impact from the proposal during construction due to the lack or KFH features and or the minor nature of works proposed at these watercourses.

Risks can be managed in ephemeral watercourses by undertaking construction when watercourses are dry and aquatic fauna species would not be present in addition to implementing appropriate erosion and sediment control measures. Risks to the perennial watercourse (Murray River) can also be managed through the implementation of appropriate erosion and sediment control measures, the use of a membrane fixed around the work area to capture hazardous materials (i.e. lead paint) along with undertaking the work in stages to reduce the scale of any potential impacts.

Impact assessment – operation

For the operational phase, the risks are related to permanent barriers to fish-passage due to modification of water crossing structures (i.e. within Jeralgambeth Creek north arm), potential downstream pollution due to mobilisation of stormwater runoff from new impervious surfaces, as well as from possible leaks or spills from maintenance vehicles on the permanent access tracks or from cargo in train carriages. These potential risks were determined to be unlikely as the proposal consists mainly of modifications to the existing rail line and would not result in additional impacts to fish passage and only minor increases in impervious surface areas which could contribute to runoff.

Threatened species, populations and EECs

Desktop studies identified 8 target threatened species, two endangered populations and one threatened ecological community listed under the FM Act and/or EPBC Act that have previously been recorded in the locality.

The study area was considered to provide possible or likely habitat for the following six threatened species listed under the FM Act and/or EPBC Act:

- Murray Cod (*M. peelii*) likely to occur in the Murray River
- Trout Cod (*M. macquariensis*) likely to occur in the Murray River
- Murray Crayfish (*E. armatus*) likely to occur in the Murray River
- Silver Perch (*B. bidyanus*) likely to occur in the Murray River
- Flathead Galaxias (*G. rostratus*) possible to occur in the Murray River and Sandy Creek (during flow events)
- Southern Pygmy Perch (*N. australis*) possible to occur in Buckaringah Creek (during flow events).

In addition, the Lowland Murray River aquatic ecological community applies to all native fish and aquatic invertebrates within all natural creeks, rivers and associated waterbodies within the study area.

Assessment under the FM Act concluded that the proposal was unlikely to have an adverse effect on the life cycle of Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*), Trout Cod (*M. macquariensis*), Flathead Galaxias (*G. rostratus*) or Southern Pygmy Perch (*N. australis*) such that a viable local population of these species is likely to be placed at risk of extinction. This was based on the lack of important habitat features for these threatened species within watercourses in the study area and the relatively minor nature

of works, with instream works only proposed at one location where a threatened species was considered possible to occur (Sandy Creek). Potential indirect impacts on water quality associated with the mobilization of sediments is relevant to all watercourses within the study area however this can be managed using standard practices during the operation and construction phase of the proposal and the level of impact to the aquatic environment is therefore considered minor.

The proposal was considered unlikely to have an adverse effect on the extent of the Lowland Murray River aquatic ecological community such that its local occurrence is likely to be placed at risk of extinction nor was it considered likely to modify the composition of the EEC such that its local occurrence is at risk of extinction. The risk of impact from the proposal on watercourses within the study area was determined to be medium at three locations: Murray River, Sandy Creek and Jeralgambeth Creek. The latter two of these watercourses are highly ephemeral, lacked important aquatic habitat features and impacts could be mitigated. These two ephemeral watercourses contained a high percentage cover of exotic flora species in the riparian zone and the instream environment and only exotic Mosquitofish are known to occur in the study area. The Murray River is defined as highly sensitive KFH however the proposal at this watercourse requires only minor works that would not directly impact the watercourse. The proposal is considered unlikely to further modify the composition of the EEC.

Similarly, in relation to the habitat of threatened species and EEC, the proposal was considered unlikely to significantly impact its extent or composition or further fragment the habitat due to the relatively minor nature of works. Three watercourses were identified as potential habitat for threatened species (Murray River, Buckaringah Creek and Sandy Creek), The habitat at Buckaringah Creek and Sandy Creek is considered as low importance for the long-term survival of Southern Pygmy Perch (*N. australis*) and Flathead Galaxias (*G. rostratus*) populations (respectively) in the locality, mainly due to the absence of important habitat features (i.e., flowing oxygenated waters and macrophytes) while the habitat in the Murray River within the proposal site was considered as low importance for the long-term survival of Trout Cod (*M. macquariensis*), Murray Crayfish (*E. armatus*), Silver Perch (*B. bidyanus*) and Flathead Galaxias (*G. rostratus*) due to the lack of recent records, the disturbed nature of the habitat and the low abundance of habitat features (i.e. large woody debris and or aquatic macrophytes). The proposal would not result in further fragmentation of habitat nor would it reduce the habitat available for threatened species or the EEC, due to the minor nature of instream works proposed. As such, the proposal was considered unlikely to significantly impact the extent or composition or further fragment the habitat of threatened species or the EEC.

Three KTP's are of relevance to the proposal:

- Degradation of native riparian vegetation along New South Wales water courses
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Removal of large woody debris from New South Wales rivers and streams

The proposal is modifying or replacing exiting bridges and culverts however it does not change the style of instream structure from what currently exists. As such, the proposal does not contribute further to the 'installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams'. All bridges and culverts would be designed in accordance DPI fish passage guidelines (Fairfull and Witheride, 2003).

Similarly, as the proposal does not require instream works at sites identified as having large snags (Murray River, Oddies Creek and Buckaringah Creek), it is unlikely to contribute to 'removal of large woody debris from NSW rivers and streams'.

The KTP 'degradation of native riparian vegetation along New South Wales watercourses' is the only KTP that would be impacted by the proposal. The removal of 0.03 hectares of native riparian vegetation is considered a relatively minor impact and the loss would be addressed in the rehabilitation strategy.

Impacts to key fish habitat

KFH within the study area was determined based on existing KFH mapping by DPI (2007), watercourses sensitivity type (DPI, 2013) and watercourse class (Fairfull and Witheridge, 2003) which were defined following site inspection.

The following watercourses are defined as having moderately sensitive or highly sensitive KFH within the study area:

- Albury precinct
    - Murray River (type 1 highly sensitive)
    - Oddies Creek (type 2 moderately sensitive)
- Greater Hume to Lockhart precinct
    - Buckaringah Creek (type 1 highly sensitive)
- Wagga Wagga precinct
    - Sandy Creek (type 1 highly sensitive)
- Junee precinct
    - Jeralgambeth Creek north arm (type 2 moderately sensitive)

All other watercourses within the study area are defined as type 3 minimal KFH due to the absence of fish habitat features.

Potential impacts to KFH in watercourses include:

- A culvert modification at Jeralgambeth Creek. This instream structure is not in addition to what currently exists and is accordance with relevant design guidelines for water crossing structures and therefore not expected to impact fish-passage or disrupt habitat functionality in any way.
- Temporary instream disturbance and obstruction of fish passage at Sandy Creek (Uranquinty Yard clearances) for the temporary crossing.

KFH would not be permanently lost or disrupted provided the proposal implements the proposed design and alignment, construction methodology, mitigation measures, rehabilitation strategy and operational monitoring and management. As such, no aquatic biodiversity offset is required, which was confirmed by DPI (Appendix G). During consultation, DPI did however, recommend habitat improvement opportunities such as the reinstatement of removed riparian vegetation within the bed of the watercourse for re-snagging, log revetment works or other enhancement works where possible.

Mitigation and management measures

The proposal has been designed to avoid and minimise potential impacts to watercourses and aquatic biodiversity as far as practicable. Any impacts to aquatic biodiversity would be managed in accordance with the biodiversity management sub-plan, implemented as part of the CEMP. The plan should include, but not be limited to:

- locations and requirements for pre-clearing surveys
- management measures to manage impacts to aquatic biodiversity, including monitoring of changes in salinity in affected waterbodies resulting from altered groundwater flows
- measures to manage weeds, pests and invasive species
- Removal and displacement of habitat features (riparian vegetation, instream vegetation and or large rocks and woody debris within the bed) would be avoided as far as practicable

- As far as practicable, concrete usage would be minimal in locations within 100 metres of watercourses that have been identified as type 2 or above watercourses
- Culverts and bridges on ephemeral watercourses would be installed/modified when the watercourse is dry and construction activities would cease prior to any rainfall (as far as practicable). A silt curtain would be available on site in the event of rainfall and installed around the work area on the same side of the bank to avoid obstruction of fish passage (DPI, 2013)
- Where possible, access to watercourses by construction plant would be minimised.

A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas following the completion of construction. Opportunities for improvement of aquatic habitat such as the reinstatement of removed riparian vegetation within the bed of the watercourse for re-snagging (i.e., large woody debris) along with any opportunities to improve water quality by stabilising the bank of watercourses using revegetation, should be included in the rehabilitation strategy.

Conclusion

The aquatic biodiversity impact assessment concludes that the impacts of the proposal would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area. Most of the potential construction impacts are associated with indirect impacts on water quality and would therefore be temporary and managed through the adoption of appropriate erosion and sediment control measures. Potential operational impacts would not significantly increase from existing operation impacts and would be managed in accordance with ARTC standards and protocols.

9. References

Atlas of Living Australia (ALA) (2021). The Atlas of Living Australia. Available at http://www.ala.org.au. Accessed May 2021.

AUSRIVAS, (2007). AUSRIVAS, Australian River Assessment System http://ausrivas.ewater.com.au/

Australian Rail Track Corporation (ARTC) (2021). Landscape and rehabilitation strategy- Inland Rail, Revision D.

Bureau of Meteorology (BOM) (2021a), Groundwater Dependent Ecosystems Atlas. Available at: http://www.bom.gov.au/water/groundwater/gde/ Accessed July 2021

Bureau of Meteorology (BoM) (2021b). Climate Data Online: Wagga Wagga and Albury. http://www.bom.gov.au/climate/data/index.shtml

Department of Agriculture, Water and the Environment (DAWE) (undated). Species Profile and Threats Database, *Maccullochella peelii* — Murray Cod SPRAT Profile. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66633

Department of Agriculture, Water and the Environment (DAWE) (2021). Directory of Important wetlands, Protected Matters Search Tool https://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf

Department of Environment and Climate Change (DECC) (2008) Managing Urban Stormwater – Soils and Construction, Volume 2A, 2C, 2D and 2E (the Blue Book).

Department of Planning, Industry and the Environment (DPIE) (2020). Doodle Comer Swamp Nature Reserve Draft Planning Considerations. Department of Planning, Industry and Environment, 26 June.

Department of Planning, Industry and the Environment (DPIE) (undated) Water in New South Wales – Murray-Darling Basin. https://www.industry.nsw.gov.au/water/basins-catchments/murray-darling

Department of Primary Industries (DPI) (2007a). Key Fish Habitat Maps. Available at https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal. Accessed May 2021.

Department of Primary Industries (DPI) (2007b). Lower Murray River aquatic ecological community, Primefact 172 2nd ed. September 2007.

Department of Primary Industries (DPI) (2013). *Policy and Guidelines for Fish Habitat Conservation and Management* – Update

Department of Primary Industries (DPI) (2016). Fish Communities and Threatened Species Distributions of NSW https://www.dpi.nsw.gov.au/fishing/habitat/your-catchment/condition-of-fish-communities-in-nsw

Department of Primary Industries: Office of Water (DPI) (2018). Guidelines for Controlled Activities on Waterfront Land: Riparian Corridors, Natural Resources Access Regulator.

Department of Primary Industries (DPI) (undated a). Department of Primary Industries, Threatened species lists. https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current

Department of Primary Industries (DPI) (undated b). Department of Primary Industries, distribution maps, accessed 3rd May 2021 https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal

Department of Primary Industries (DPI) (undated c). Department of Primary Industries, Primefacts for individual species. https://www.dpi.nsw.gov.au/fishing/species-protection/what-current

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). Survey Guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the Environment Protection and Biodiversity Conservation Act, 1999.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). Indicative Map of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains. http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=97&status=Critically+Endangered

Department of the Environment (DoE) (2013). Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.

Department of the Environment (DoE) (2021) Protected Matters Search Tool http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf

Divljan A (2019). Australian Museum, Platypus. https://australianmuseum.net.au/learn/animals/mammals/platypus/

Environment, Energy and Science (EES) (2020). Biodiversity Assessment Method, October 2020.

Environment, Energy and Science (EES) (2020). Biodiversity Assessment Method 2020 Operational Manual – Stage 1.

ERM (2020). A2I Inland Rail Targeted Fauna Survey, Spring 2020, letter report dated 30 October 2020, Reference: 0520125. ARTC Doc No: 2-0001-640-ESV-00-RP-0003_A.

Fairfull, S. and Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla

Lincoln Smith, M. (2003) Aquatic Ecology in Environmental Impact Assessment EIA Guideline

Murray-Darling Basin Authority (MDBA) (2020). Catchments in the Murray–Darling Basin. https://www.mdba.gov.au/water-management/catchments

Office of Environment and Heritage (OEH) (2018). Threatened Species Test of Significance Guidelines. Published by Office of Environment and Heritage, ISBN 978 1 76039 957 3, July 2018.

Office of Environment and Heritage (OEH) (2019). Biodiversity Assessment Method Operational Manual – Stage 2.

Office of Environment and Heritage (OEH) (2021). BioNet Atlas of NSW Wildlife database and mapping tool. http://www.bionet.nsw.gov.au/

Water New South Wales (undated). Glossary of water terms https://www.waternsw.com.au/

Strahler, A.N. (1952) Dynamic Basis of Geomorphology. Geological Society of America Bulletin, 63, 923-938.

Transport for NSW (TfNSW) (2017). NSW Sustainable Design Guidelines, version 4.0. https://www.transport.nsw.gov.au/sites/default/files/media/documents/2017/sustainable-design-guidelines-v4.pdf

Witheridge, G. (2002) Fish Passage Requirements for Waterway Crossings - Engineering Guidelines. Institute of Public Works Engineering, Brisbane.

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix A Results of desktop studies

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix A. Results of desktop studies

Table A1. Indicative threatened species distribution maps, atlas of living Australia results and determination of target species

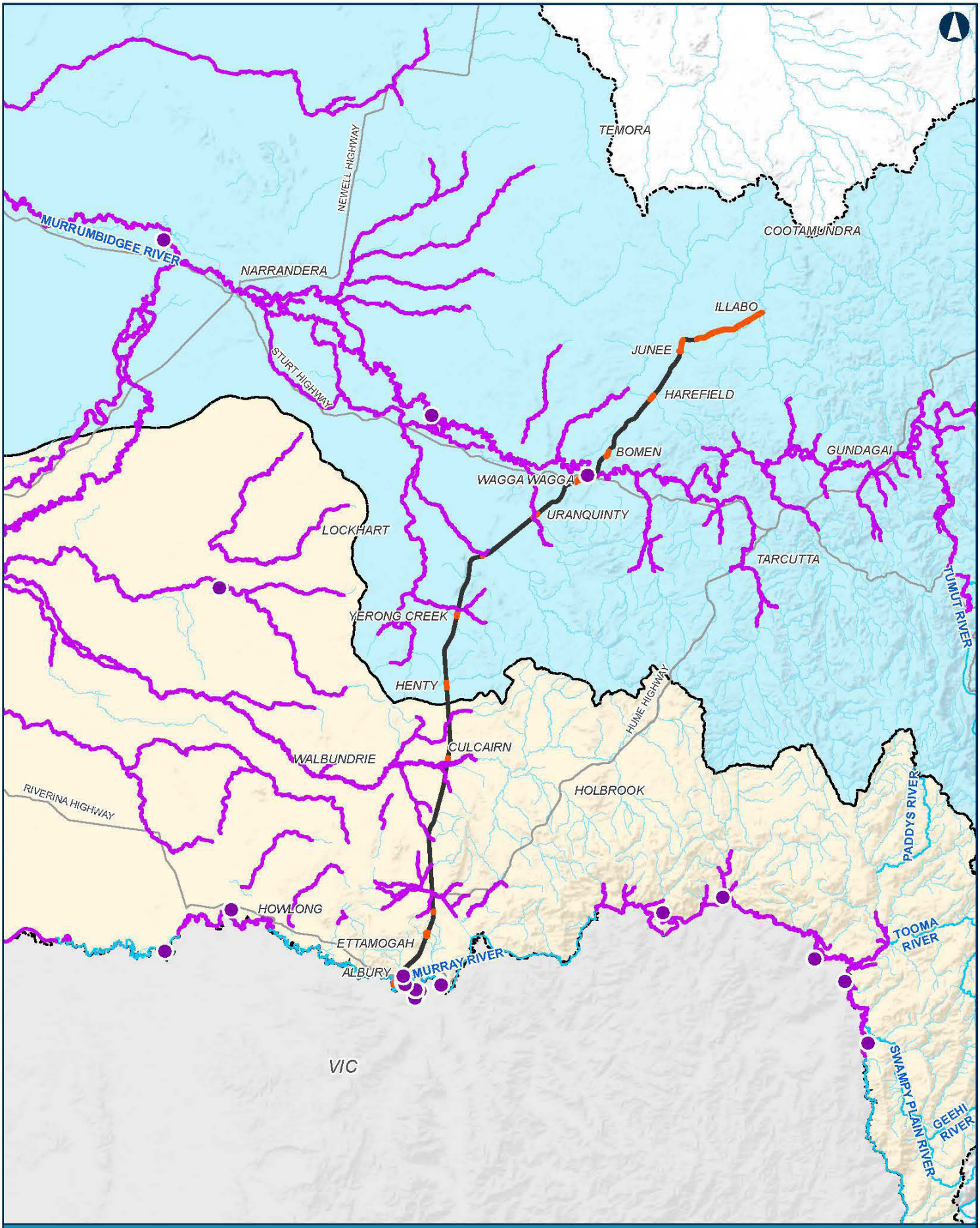
Threatened Species Name	Indicative distribution map	Target Species?
Australian Grayling *(Prototroctes maraena)* E (FM Act) V (EPBC Act)	Distribution maps are available for this species however the distribution is outside of the locality.	No Distribution around south coast of NSW.
Flathead Galaxias *(Galaxias rostratus)* CE (FM Act) CE (EPBC Act)	Refer Figure A1	Yes. Previous records within the locality and within watercourses that cross the proposal site.
Hanley's River Snail *(Notopala hanleyi)* CE (FM Act)	Distribution maps are available for this species however the distribution is outside of the locality.	No. Hanley's River Snail is reduced to a handful of locations, They are now virtually extinct throughout their natural range and living specimens have only been found from within three locations in NSW. The indicative distribution occurs upstream from the proposal site along the Murray River near Mildura and in the Lachlan River. The proposal site is outside the indicative distribution mapped for this species.
Macquarie Perch *(Macquaria australasica)* E (FM Act) E (EPBC Act)	Refer Figure A2	Yes. There are previous records of this species within the locality however the closest record is approximately 150 kilometres upstream of the proposal site. The proposal site is outside the indicative distribution mapped for this species.
Murray Cod *(Maccullochella peelii)* V (EPBC Act)	N/A – indicative distribution maps not available for this species	Yes. The distribution of the Murray Cod occurs in the following bioregions: Murray-Darling Depression, Riverina, NSW South Western Slopes, South Eastern Highlands, Cobar Peneplain, Darling Riverine Plains, Brigalow Belt South and Nandewar (DAWE, undated).
Murray Crayfish *(Euastacus armatus)* V (FM Act)	Refer Figure A3	Yes. Previous records within the locality and within watercourses that cross the proposal site.

Threatened Species Name	Indicative distribution map	Target Species?
Murray Hardyhead *(Craterocephalus fluviatilis)* CE (FM Act) E (EPBC Act)	N/A – indicative distribution maps not available for this species	No. Murray Hardyhead were once widespread and abundant in the Murray and Murrumbidgee river systems in southern NSW and northern Victoria; however, they have suffered a serious population decline, and now seem to be limited to a few sites, mainly in northern Victoria. There are very few recent records in NSW. It may occur upstream from the proposal site along the Murray River near Mildura however the proposal site is outside the distribution for this species.
Silver Perch *(Bidyanus bidyanus)* V (FM Act) CE (EPBC Act)	Refer Figure A4	Yes. Distribution maps (DPI, 2016) indicate this species occurs in Locality although not in watercourses that cross the proposal site.
Southern Purple Spotted Gudgeon *(Mogurnda adspersa)* E (FM Act)	Refer Figure A5	Yes. The indicative distribution mapped for this species is mostly within the Lachlan River catchment to the north. There is one area mapped within the Murrumbidgee River catchment however it is disconnected from the Murrumbidgee River system. The proposal site is outside the indicative distribution mapped for this species.
Southern Pygmy Perch *(Nannoperca australis)* E (FM Act) V (EPBC Act)	Refer Figure A6	Yes. Previous records within the locality and within watercourses that cross the proposal site.
Trout Cod *(Maccullochella macquariensis)* E (FM Act) E (EPBC Act)	Refer Figure A7	Yes. Previous records within the locality and within watercourses that cross the proposal site.
Murray-Darling Basin population of Eel Tailed Catfish *(Tandanus tandanus)* Ep (FM Act)	Refer Figure A8	Yes. Recorded in Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle however the proposal site is outside the indicative distribution mapped for this species. Eel Tailed Catfish numbers in the Murray-Darling Basin have declined due to a range of impacts including invasive species, habitat degradation, cold water pollution and fishing pressures and are now virtually absent from the Murray, Murrumbidgee and Lachlan catchments.

Threatened Species Name	Indicative distribution map	Target Species?
Snowy River population of River Blackfish *(Gadopsis marmoratus)* Ep (FM Act)	Distribution maps are available for this species however the distribution is outside of the locality.	No. River Blackfish occur in the Snowy River catchment of the eastern (coastal) flowing drainages and the Murray-Darling basin in NSW, but these populations are genetically distinct and may in fact be separate species. This population has suffered a serious decline and is now found only along about 50 kilometres of waterways of the Delegate River and some of its tributaries.
Western population of Olive Perchlet *(Ambassis agassizii)* Ep (FM Act)	Distribution maps are available for this species however the distribution is outside of the locality.	Yes. The Olive Perchlet occurs in both eastern (coastal) and western (Murray-Darling) drainages, but these populations may be genetically distinct. The indicative distribution mapped for this species is in the Lachlan River catchment to the north hence the locality is outside the indicative distribution mapped for this species. However, the ALA (2021) has 4 historic records of this species in the locality.
Lowland Murray River aquatic ecological community EEC (FM Act)	N/A	Yes. The lower Murray River endangered ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River (also known as the Murray River) downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria. Excluded from this recommendation are the Lachlan River and the Darling River and their tributaries, and artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs.

CE=Critically Endangered; E=Endangered, V=Vulnerable; Ep=Endangered population; EEC=Endangered Ecological Community

N/A – Indicative distribution maps are unavailable for this species



Albury to Illabo

Figure A1. Flathead Galaxias: Threatened species distributions and ALA results within the Murray Darling Basin

0 10 20 km

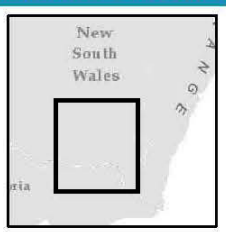
Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

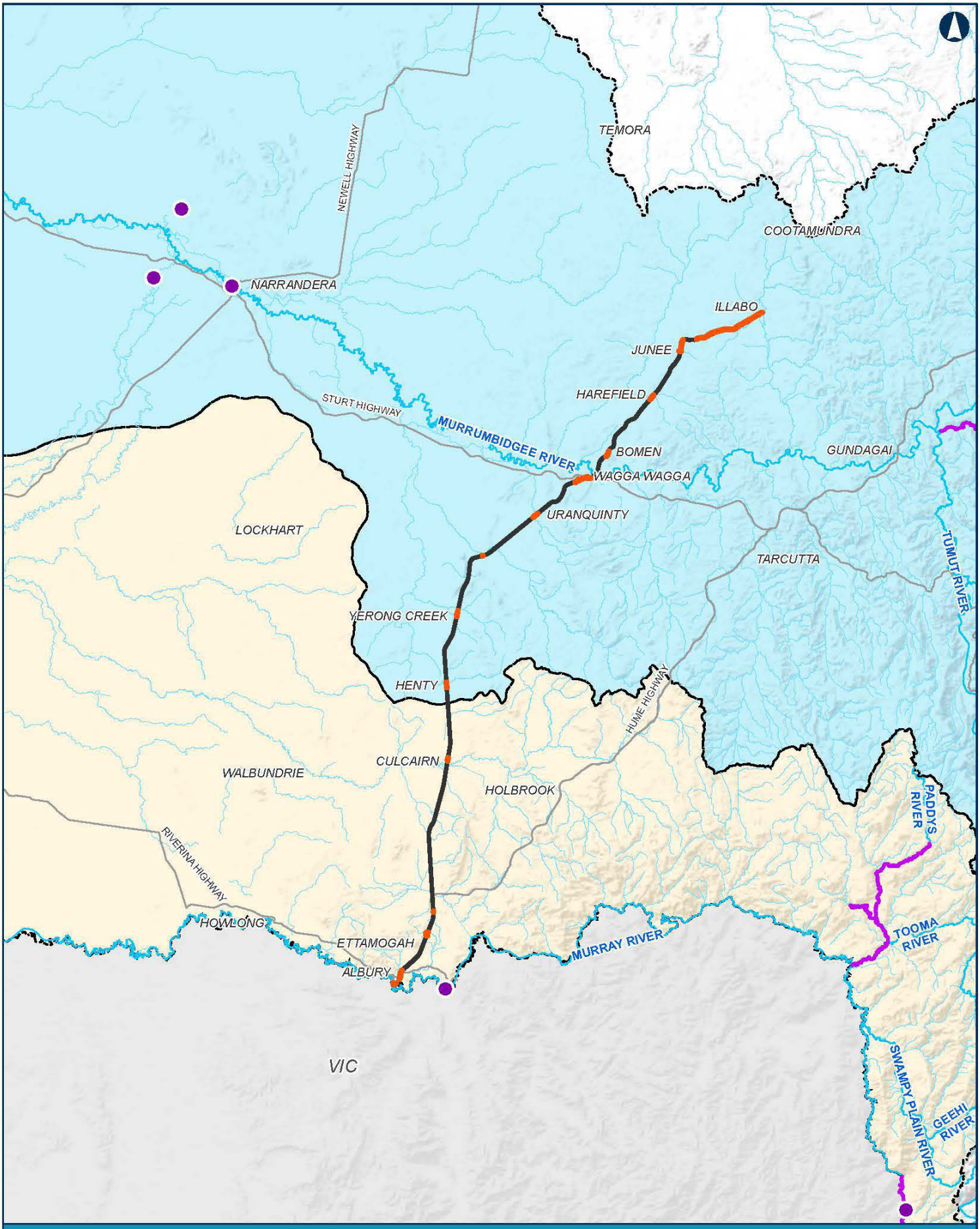
Threatened species distributions (DPI, 2016)
- Flathead Galaxias

Atlas of Living Australia (ALA, 2021) database results
- Flathead Galaxias



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.



Albury to Illabo

Figure A2. Macquarie Perch: Threatened species distributions and ALA results within the Murray Darling Basin

0 10 20 km

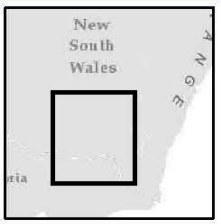
Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

Threatened species distributions (DPI, 2016)
- Macquarie Perch

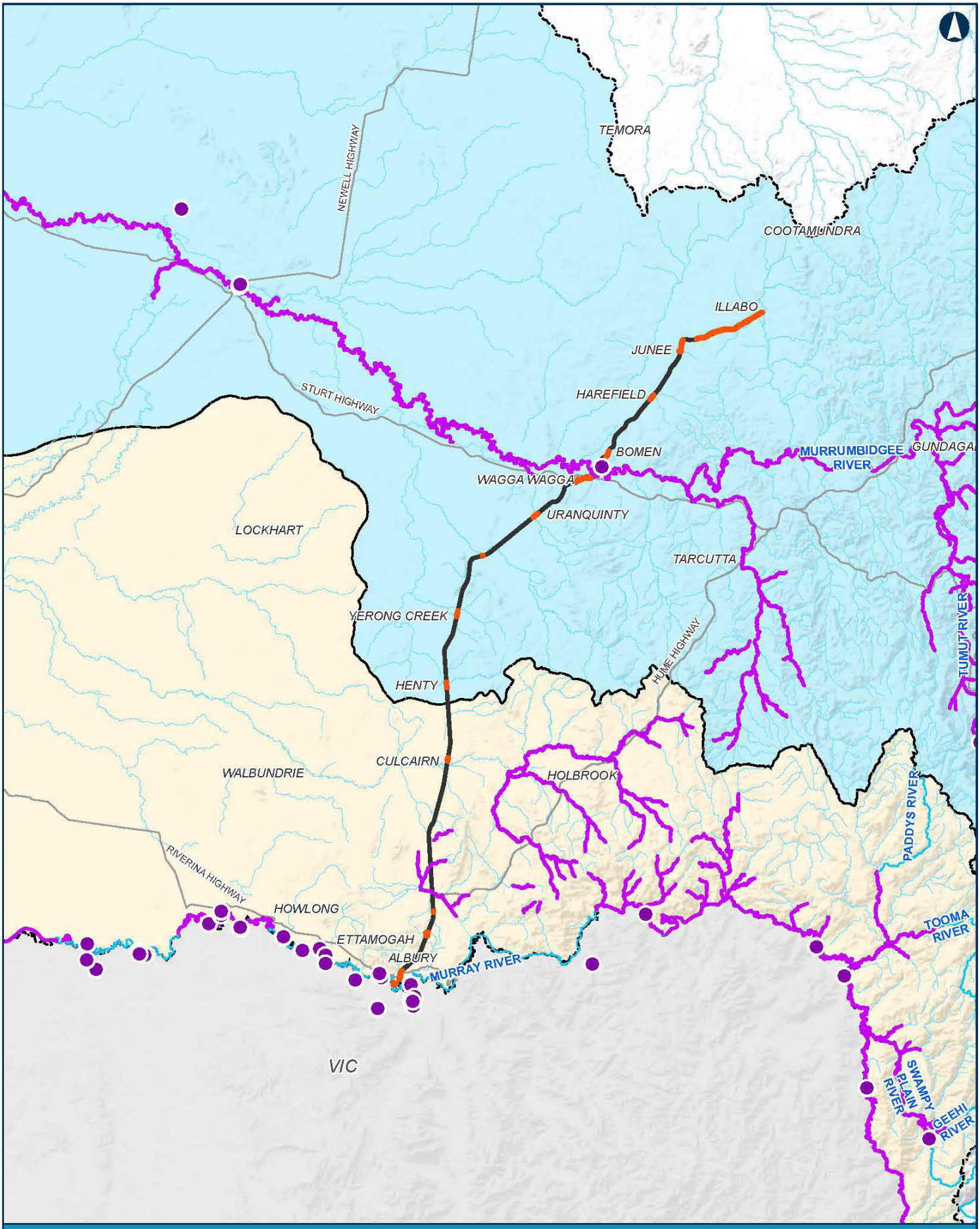
Atlas of Living Australia (ALA, 2021) database results
- Macquarie Perch



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_FA1_FishSpeciesExtents_r1v1.mxd



Albury to Illabo

Figure A3. Murray Crayfish: Threatened species distributions and ALA results within the Murray Darling Basin

0 10 20 km

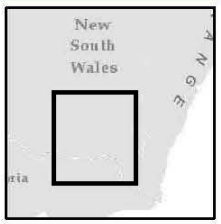
Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

Threatened species distributions (DPI, 2016)
- Murray Crayfish

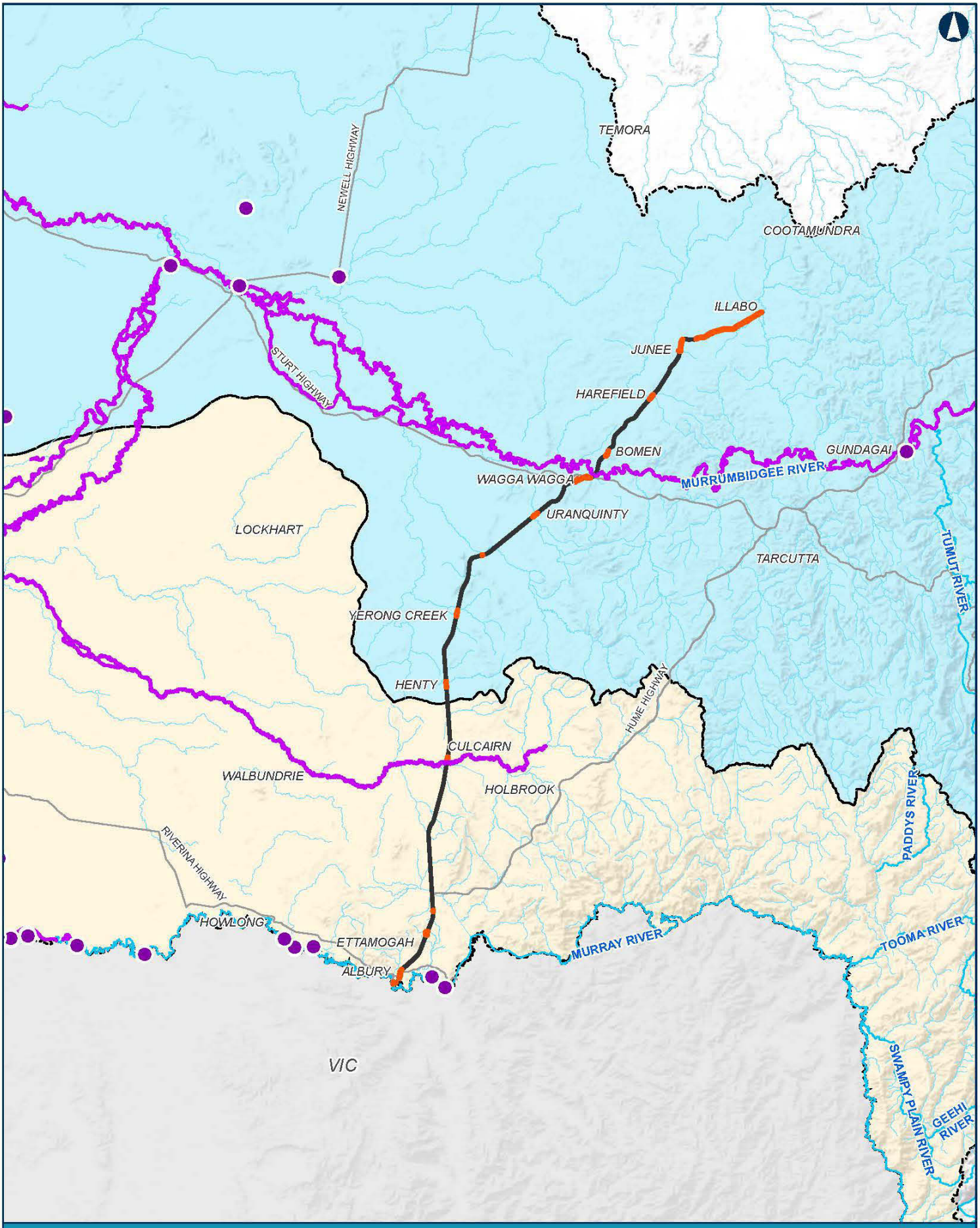
Atlas of Living Australia (ALA, 2021) database results
- Murray Crayfish



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_FA1_FishSpeciesExtents_r1v1.mxd



Albury to Illabo

Figure A4. Silver Perch: Threatened species distributions and ALA results within the Murray Darling Basin

0 10 20 km

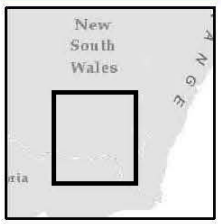
Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

Threatened species distributions (DPI, 2016)
- Silver Perch

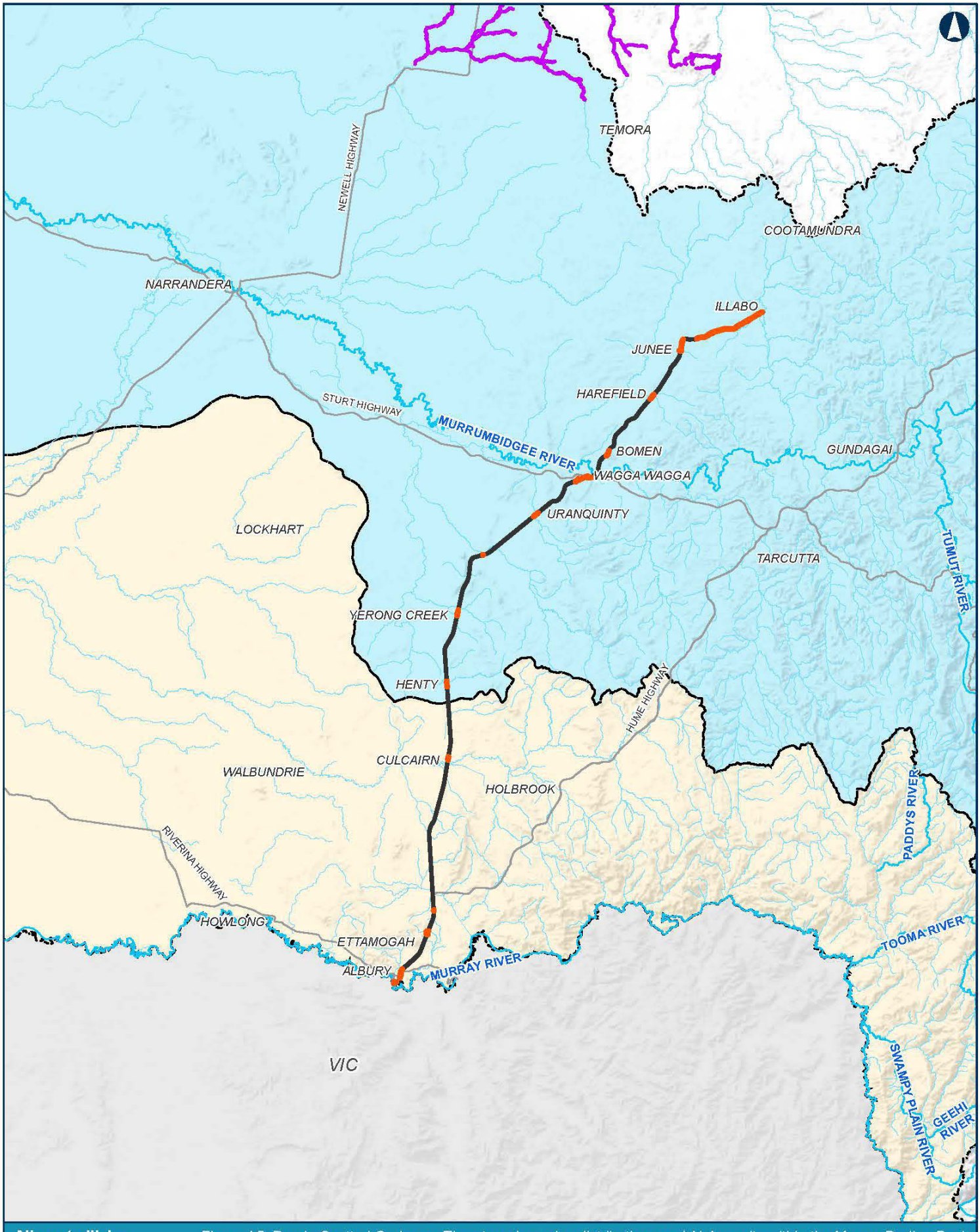
Atlas of Living Australia (ALA, 2021) database results
- Silver Perch



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_FA1_FishSpeciesExtents_r1v1.mxd



Albury to Illabo

Figure A5. Purple Spotted Gudgeon: Threatened species distributions and ALA results within the Murray Darling Basin

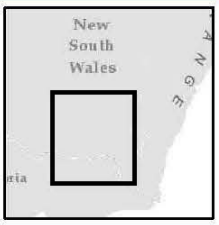
0 10 20 km

Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

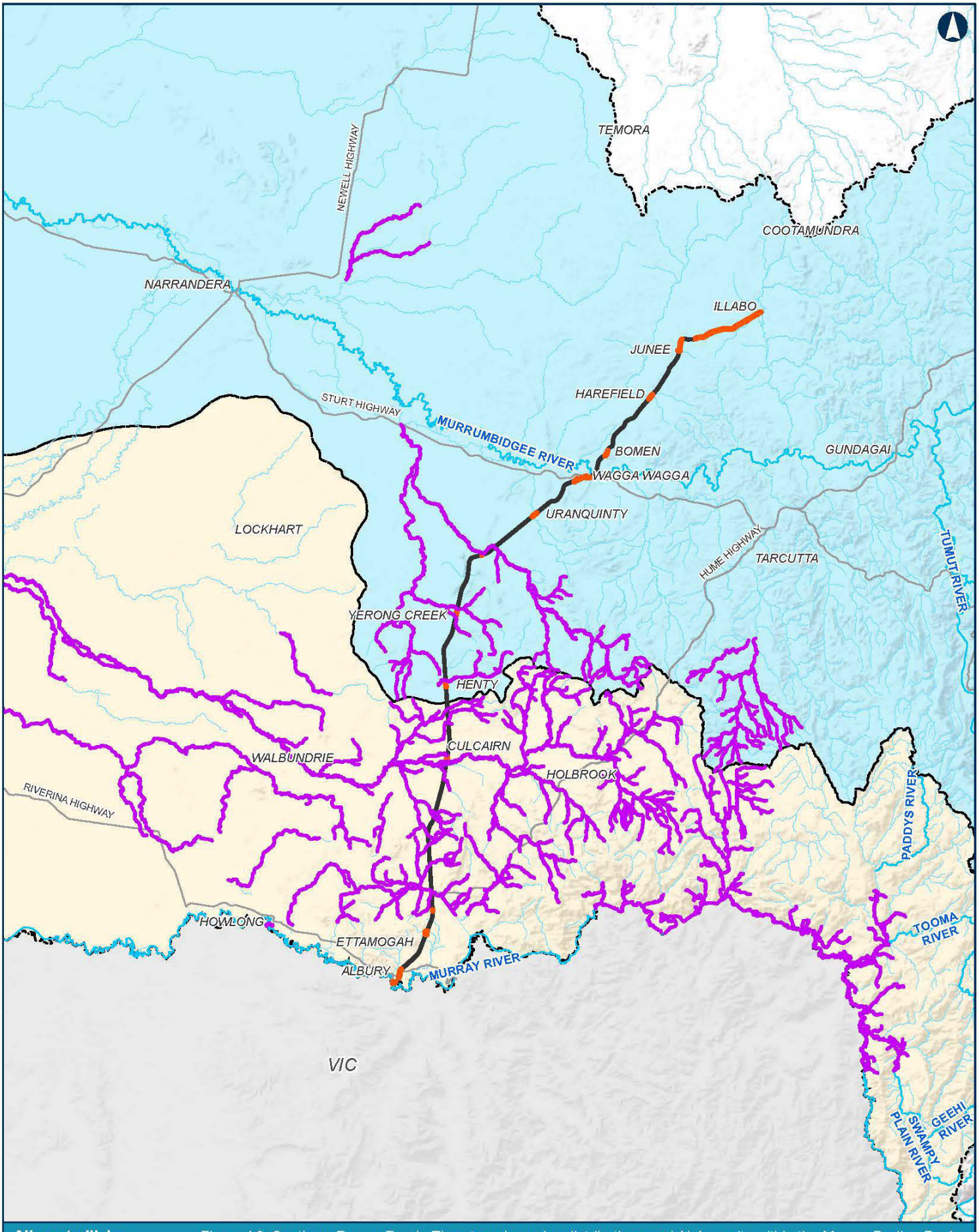
- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

Threatened species distributions (DPI, 2016)
- Purple Spotted Gudgeon



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.



Albury to Illabo

Figure A6. Southern Pygmy Perch: Threatened species distributions and ALA results within the Murray Darling Basin

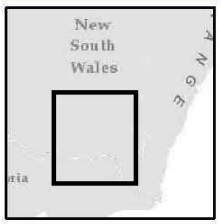
0 10 20 km

Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

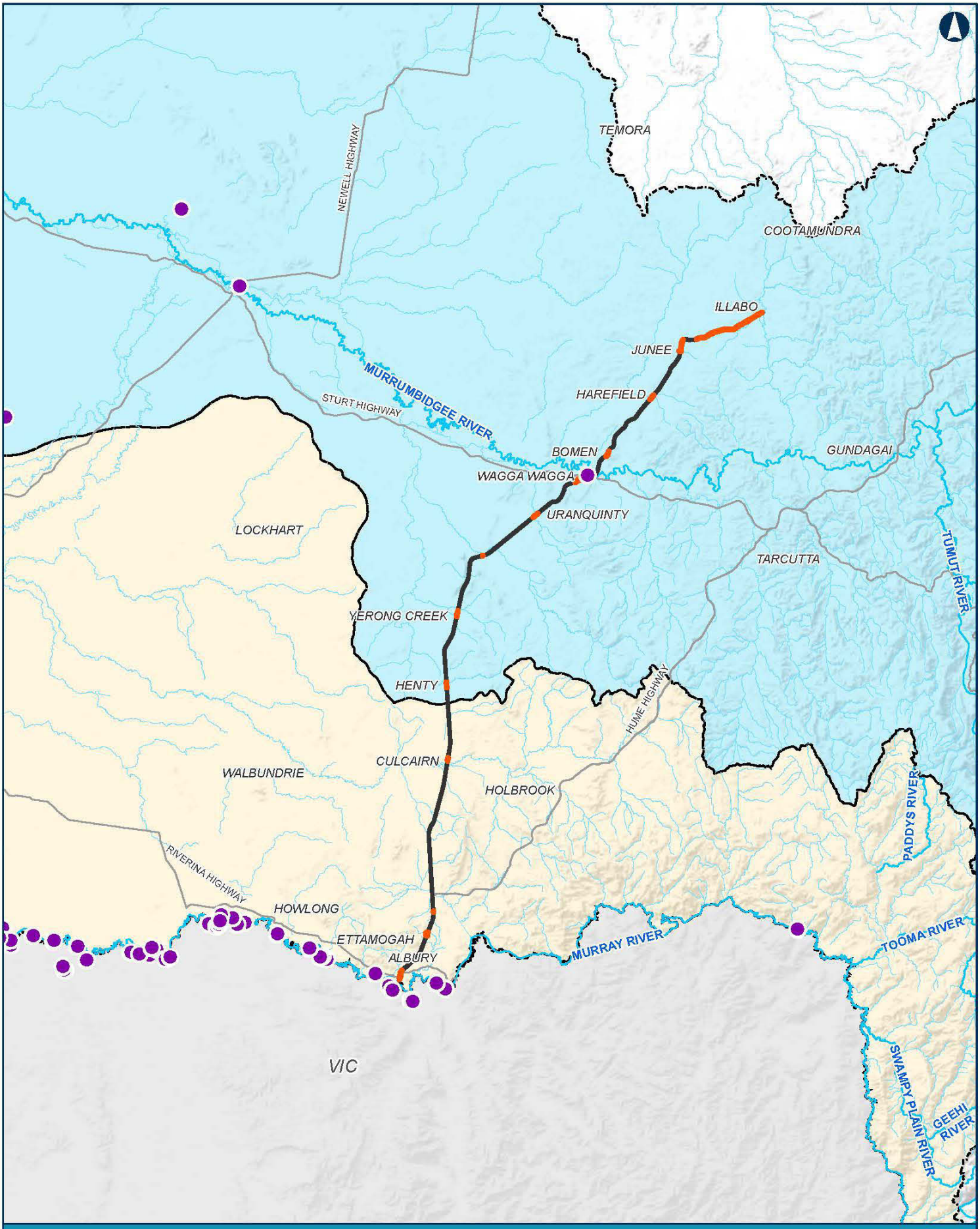
Threatened species distributions (DPI, 2016)
- Southern Pygmy Perch



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

D:\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS122419_Albury_to_Illabo\Tasks\210_0010_EAP_EISReportFigures\Documents\Aquatic\210_EAP_FA1_FishSpeciesExtents_r1v1.mxd



Albury to Illabo

Figure A7. Trout Cod: Threatened species distributions and ALA results within the Murray Darling Basin

0 10 20 km

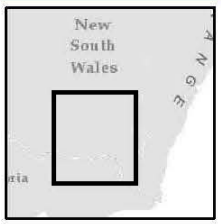
Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

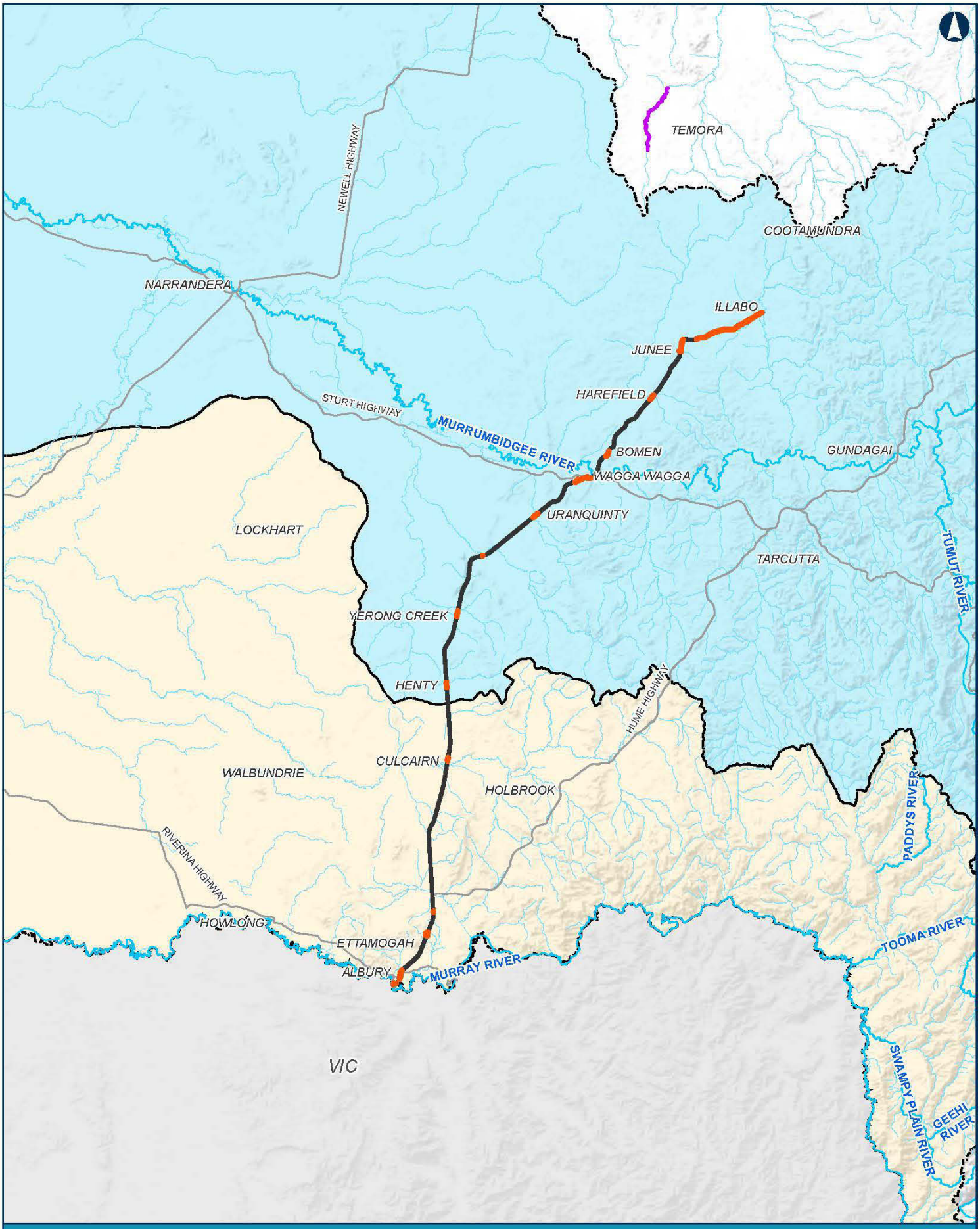
Atlas of Living Australia (ALA, 2021) database results

- Trout Cod



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.



Albury to Illabo

Figure A8. Eel Tailed Catfish: Threatened species distributions and ALA results within the Murray Darling Basin

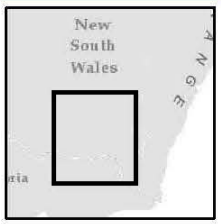
0 10 20 km

Coordinate System: GDA 1994 MGA Zone 55

Date: 27/10/2021 Paper: A3
Author: WSP Scale: 1:750,000
Data Sources: ARTC, NSWSS, DPI, ALA

- Proposal site
- Existing railway
- Roads
- River
- Creek
- Murray River Catchment
- Murrumbidgee River Catchment

Threatened species distributions (DPI, 2016)
- Eel Tailed Catfish



INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix B Protected matters search tool report

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix B. Protected matters search tool report

Murray Natural Resource Management Region

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

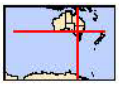
NRM MURRAY, NSW

Report created: 18/05/21 10:43:06

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://environment.gov.au/protection/environment-assessments

World Heritage Properties:	None
National Heritage Places:	3
Wetlands of International Significance:	9
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	8
Threatened Species:	85
Migratory Species:	17

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits-and-application-forms

Commonwealth Lands:	16
Commonwealth Heritage Places:	2
Listed Marine Species:	27
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	52
Regional Forest Agreements:	3
Invasive Species:	54
Nationally Important Wetlands:	18

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Australian Alps National Parks and Reserves	NSW	Listed place
Australian Alps National Parks and Reserves	VIC	Listed place
Historic		
Snowy Mountains Scheme	NSW	Listed place

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	200 - 300km upstream
Barmah forest	Within Ramsar site
Blue lake	Within Ramsar site
Gunbower forest	Within Ramsar site
Hattah-kulkyne lakes	50 - 100km upstream
Kerang wetlands	Within 10km of Ramsar
Nsw central murray state forests	Within Ramsar site
Riverland	200 - 300km upstream
The coorong, and lakes alexandrina and albert wetland	300 - 400km upstream

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community known to occur within area
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community known to occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Natural Grasslands of the Murray Valley Plains	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Breeding known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Polytelis anthopeplus monarchoides Regent Parrot (eastern) [59612]	Vulnerable	Breeding likely to occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
FISH		
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Critically Endangered	Species or species habitat known to occur within area
Craterocephalus fluviatilis Murray Hardyhead [56791]	Endangered	Species or species habitat likely to occur within area
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat known to occur within area
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat known to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Translocated population known to occur within area
Nannoperca australis Murray-Darling Basin lineage Southern Pygmy Perch (Murray-Darling Basin lineage) [91711]	Vulnerable	Species or species habitat known to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
FROGS		
Crinia sloanei Sloane's Froglet [59151]	Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Litoria booroolongensis		
Booroolong Frog [1844]	Endangered	Species or species habitat known to occur within area
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Litoria spenceri		
Spotted Tree Frog [25959]	Endangered	Species or species habitat known to occur within area
Litoria verreauxii alpina		
Alpine Tree Frog, Verreaux's Alpine Tree Frog [66669]	Vulnerable	Species or species habitat known to occur within area
Pseudophryne corroboree		
Southern Corroboree Frog [1915]	Critically Endangered	Species or species habitat likely to occur within area
INSECTS		
Synemon plana		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
MAMMALS		
Burramys parvus		
Mountain Pygmy-possum [267]	Endangered	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus		
Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus		
Smoky Mouse, Konoom [88]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
PLANTS		
Acacia phasmoides		
Phantom Wattle [2784]	Vulnerable	Species or species habitat known to occur within area
Ammobium craspedioides		
Yass Daisy [20758]	Vulnerable	Species or species habitat likely to occur within area
Amphibromus fluitans		
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat known to occur within area
Argyrotegium nitidulum		
Shining Cudweed [82043]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat known to occur within area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat known to occur within area
Brachyscome muelleroides Mueller Daisy [15572]	Vulnerable	Species or species habitat known to occur within area
Brachyscome papillosa Mossgiel Daisy [6625]	Vulnerable	Species or species habitat known to occur within area
Caladenia arenaria Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat known to occur within area
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat may occur within area
Caladenia xanthochila Yellow-lip Spider-orchid [55509]	Endangered	Species or species habitat may occur within area
Calotis glandulosa Mauve Burr-daisy [7842]	Vulnerable	Species or species habitat likely to occur within area
Colobanthus curtisiae Curtis' Colobanth [23961]	Vulnerable	Species or species habitat likely to occur within area
Diuris ochroma Pale Golden Moths [64565]	Vulnerable	Species or species habitat known to occur within area
Genoplesium vernale East Lynne Midge-orchid [68379]	Vulnerable	Species or species habitat likely to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat known to occur within area
Leucochrysum albicans subsp. tricolor Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat known to occur within area
Maireana cheelii Chariot Wheels [8008]	Vulnerable	Species or species habitat likely to occur within area
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat may occur within area
Prasophyllum bagoense Bago Leek-orchid [84276]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum innubum Brandy Marys Leek-orchid [83603]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum keltonii Kelton's Leek-orchid [83604]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum morganii Mignonette Leek-orchid, Cobungra Leek-orchid, Dense Leek-orchid [13804]	Vulnerable	Species or species habitat may occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Prasophyllum validum Sturdy Leek-orchid, Mount Remarkable Leek-orchid [10268]	Vulnerable	Species or species habitat may occur within area
Pterostylis despectans Lowly Greenhood [6272]	Endangered	Species or species habitat may occur within area
Pterostylis oreophila Blue-tongued Orchid, Kiandra Greenhood [22903]	Critically Endangered	Species or species habitat known to occur within area
Ranunculus anemoneus Anemone Buttercup [14889]	Vulnerable	Species or species habitat likely to occur within area
Rutidosis leiolepis Monaro Golden Daisy [21490]	Vulnerable	Species or species habitat known to occur within area
Rytidosperma pumilum Feldmark Grass [66716]	Vulnerable	Species or species habitat likely to occur within area
Sclerolaena napiformis Turnip Copperburr [11742]	Endangered	Species or species habitat known to occur within area
Senecio behrianus Stiff Groundsel, Behr's Groundsel [14030]	Endangered	Species or species habitat likely to occur within area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area
Solanum karsense Menindee Nightshade [7776]	Vulnerable	Species or species habitat known to occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
Swainsona plagiotropis Red Darling-pea, Red Swainson-pea [10804]	Vulnerable	Species or species habitat likely to occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small	Endangered	Species or species

Name	Status	Type of Presence
Purple Pea [7580]		habitat known to occur within area
Thesium australe		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
Zieria citriodora		
Lemon-scented Zieria [56731]	Vulnerable	Species or species habitat known to occur within area
REPTILES		
Aprasia parapulchella		
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area
Cyclodomorphus praealtus		
Alpine She-oak Skink [64721]	Endangered	Species or species habitat known to occur within area
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Liopholis guthega		
Guthega Skink [83079]	Endangered	Species or species habitat known to occur within area

Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Breeding known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Airservices Australia
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - ARMY RECRUITING OFFICE - ALBURY
Defence - MULWALA EXPLOSIVES FACTORY
Defence - WIRLINGA ORDNANCE DEPOT

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Albury Post Office	NSW	Listed place
Mulwala Homestead Precinct	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Alpine	VIC
Bago	NSW
Baillieu Lagoon W.R.	VIC
Barmah	VIC
Benambra	NSW
Bogandyera	NSW
Buckingbong	NSW
Carabost	NSW
Clarke Lagoon W.R	VIC
Clarkes Hill	NSW
Cobberas	VIC
Courabyra	NSW
Crooks Racecourse	NSW
Davies Plain	VIC
Doodle Comer Swamp	NSW
Downfall	NSW
Eurabbie	NSW
Forestry Management Areas in Tumut (FMZ2)	NSW
Goulburn River	VIC
Gunbower	VIC
Helms	NSW
Indi	VIC
Jeremal W.R	VIC
Jerilderie	NSW
Jingellic	NSW
Kosciuszko	NSW
Lake Urana	NSW
Laurel Hill	NSW

Name	State
Lower Goulburn	VIC
Lower Ovens W.R.	VIC
Mullengandra	NSW
Mullengandra	NSW
Mundaroo	NSW
Murray Valley	NSW
Murray Valley	NSW
Nest Hill	NSW
Nyah-Vinifera Park	VIC
Ovens River	VIC
Paddys River	NSW
Pollack	NSW
River Murray Reserve	VIC
River Murray Reserve (non-PV)	VIC
South West Woodland	NSW
Tabletop	NSW
Tintaldra W.R	VIC
Tumut Subregion of Southern Region	NSW
Wiesners Swamp	NSW
Woomargama	NSW
Woomargama	NSW
Yanga	NSW
Yanga	NSW
Yanga	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Gippsland RFA	Victoria
North East Victoria RFA	Victoria
Southern RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Barmah-Millewa Forest	VIC
Beveridge Island	VIC
Black Swamp and Coopers Swamp	NSW
Doodle Corner Swamp	NSW
Gunbower Island	VIC
Koondrook and Perricoota Forests	NSW
Kosciusko Alpine Fens, Bogs and Lakes	NSW
Lake Hume	VIC
Lowbidgee Floodplain	NSW
Lower Goulburn River Floodplain	VIC
Major Mitchell Lagoon	VIC
Millewa Forest	NSW
Ovens River	VIC
Tomneys Plain	NSW
Tomneys Plain	NSW
Wakool-Tullakool Evaporation Basins	NSW
Walla Walla Swamp (Gum Swamp)	NSW
Werai Forest	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining oigations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environment and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-Forestry Corporation, NSW
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Riverina Natural Resource Management Region

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

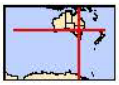
NRM RIVERINA, NSW

Report created: 18/05/21 10:42:52

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://environment.gov.au/protection/environment-assessments

World Heritage Properties:	None
National Heritage Places:	3
Wetlands of International Significance:	9
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	9
Threatened Species:	81
Migratory Species:	25

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits-and-application-forms

Commonwealth Lands:	23
Commonwealth Heritage Places:	4
Listed Marine Species:	35
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	57
Regional Forest Agreements:	1
Invasive Species:	48
Nationally Important Wetlands:	14

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Australian Alps National Parks and Reserves	ACT	Listed place
Australian Alps National Parks and Reserves	NSW	Listed place
Historic		
Snowy Mountains Scheme	NSW	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	300 - 400km upstream
Barmah forest	200 - 300km upstream
Fivebough and tuckerbil swamps	Within Ramsar site
Ginini flats wetland complex	Within Ramsar site
Gunbower forest	300 - 400km upstream
Hattah-kulkyne lakes	100 - 150km upstream
Nsw central murray state forests	200 - 300km upstream
Riverland	200 - 300km upstream
The coorong, and lakes alexandrina and albert wetland	400 - 500km upstream

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community known to occur within area
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Natural Grasslands of the Murray Valley Plains	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
FISH		
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat known to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Translocated population known to occur within area
Nannoperca australis Murray-Darling Basin lineage Southern Pygmy Perch (Murray-Darling Basin lineage) [91711]	Vulnerable	Species or species habitat known to occur within area
FROGS		
Crinia sloanei Sloane's Froglet [59151]	Endangered	Species or species habitat may occur within area
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Litoria castanea		
Yellow-spotted Tree Frog, Yellow-spotted Bell Frog [1848]	Critically Endangered	Species or species habitat may occur within area
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Litoria spenceri		
Spotted Tree Frog [25959]	Endangered	Species or species habitat likely to occur within area
Litoria verreauxii alpina		
Alpine Tree Frog, Verreaux's Alpine Tree Frog [66669]	Vulnerable	Species or species habitat known to occur within area
Pseudophryne corroboree		
Southern Corroboree Frog [1915]	Critically Endangered	Species or species habitat may occur within area
Pseudophryne pengilleyi		
Northern Corroboree Frog [66670]	Critically Endangered	Species or species habitat known to occur within area
INSECTS		
Synemon plana		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat known to occur within area
MAMMALS		
Burramys parvus		
Mountain Pygmy-possum [267]	Endangered	Species or species habitat known to occur within area
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus		
Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus		
Smoky Mouse, Konoom [88]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur

Name	Status	Type of Presence within area
PLANTS		
Acacia curranii Curly-bark Wattle [3908]	Vulnerable	Species or species habitat known to occur within area
Ammobium craspedioides Yass Daisy [20758]	Vulnerable	Species or species habitat known to occur within area
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat known to occur within area
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat known to occur within area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat known to occur within area
Brachyscome muelleroides Mueller Daisy [15572]	Vulnerable	Species or species habitat known to occur within area
Brachyscome papillosa Mossgiel Daisy [6625]	Vulnerable	Species or species habitat known to occur within area
Caladenia arenaria Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat known to occur within area
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat likely to occur within area
Caladenia xanthochila Yellow-lip Spider-orchid [55509]	Endangered	Species or species habitat may occur within area
Calotis glandulosa Mauve Burr-daisy [7842]	Vulnerable	Species or species habitat known to occur within area
Colobanthus curtisiae Curtis' Colobanth [23961]	Vulnerable	Species or species habitat likely to occur within area
Diuris ochroma Pale Golden Moths [64565]	Vulnerable	Species or species habitat may occur within area
Eleocharis obicis a spike rush [15320]	Vulnerable	Species or species habitat known to occur within area
Genoplesium vernale East Lynne Midge-orchid [68379]	Vulnerable	Species or species habitat likely to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area
Grevillea wilkinsonii Tumut Grevillea [56396]	Endangered	Species or species habitat known to occur within area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat known to occur within area
Leucochrysum albicans subsp. tricolor Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat known to occur within area
Maireana cheelii Chariot Wheels [8008]	Vulnerable	Species or species habitat likely to occur within area
Pomaderris cocoparrana [21898]	Endangered	Species or species habitat known to occur within area
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat known to occur within area
Prasophyllum bagoense Bago Leek-orchid [84276]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum innubum Brandy Marys Leek-orchid [83603]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum keltonii Kelton's Leek-orchid [83604]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Prasophyllum validum Sturdy Leek-orchid, Mount Remarkable Leek-orchid [10268]	Vulnerable	Species or species habitat may occur within area
Pterostylis oreophila Blue-tongued Orchid, Kiandra Greenhood [22903]	Critically Endangered	Species or species habitat known to occur within area
Rutidosis leiolepis Monaro Golden Daisy [21490]	Vulnerable	Species or species habitat known to occur within area
Sclerolaena napiformis Turnip Copperburr [11742]	Endangered	Species or species habitat likely to occur within area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area
Solanum karsense Menindee Nightshade [7776]	Vulnerable	Species or species habitat likely to occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Tylophora linearis [55231]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
REPTILES		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area
Cyclodomorphus praealtus Alpine She-oak Skink [64721]	Endangered	Species or species habitat may occur within area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat known to occur within area

Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Airservices Australia
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Broadcasting Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority

Name
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - BLAMEY BARRACKS - KAPOOKA
Defence - DEFCOMARS - URANA
Defence - DEFCOMARS - WAGGA
Defence - LEETON ARES DEPOT ; 4/3 RNSWR ANNEX & POL STORE
Defence - RAAF BASE WAGGA
Defence - WAGGA ARES DEPOT ; BLAMEY BKS -WAGGA WAGGA TRG DEP
Defence - WAGGA - WATER BORE SITE AP1
Defence - WAGGA - WATER BORE SITE AP2
Defence - WAGGA - WATER BORE SITE AP3

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Historic		
Hay Post Office	NSW	Listed place
Junee Post Office	NSW	Listed place
Temora Post Office	NSW	Listed place
Tumut Post Office	NSW	Listed place

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Stiltia isabella		
Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa glareola		
Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bendick Murrell	NSW
Big Bush	NSW
Bimberi	ACT
Bimberi	NSW
Black Andrew	NSW
Boginderra Hills	NSW
Brindabella	NSW
Buckingbong	NSW
Buddigower	NSW
Cocopara	NSW
Cocoparra	NSW
Combaning	NSW
Dananbilla	NSW
Downfall	NSW
Ellerslie	NSW
Flagstaff Memorial	NSW
Forestry Management Areas in Tumut (FMZ2)	NSW
Gubbata	NSW
Gungewalla	NSW
Helms	NSW
Illunie	NSW
Ingalba	NSW
Jimberoo	NSW
Jindalee	NSW
Kalyarr	NSW
Koorawatha	NSW
Kosciuszko	NSW
Lachlan Valley	NSW
Lachlan Valley	NSW
Lachlan Valley	NSW
Langtree	NSW
Livingstone	NSW
Livingstone	NSW
Loughnan	NSW
Micalong Swamp	NSW
Minjary	NSW
Mudjarn	NSW
Murraguldrie	NSW

Name	State
Murrumbidgee Valley	NSW
Murrumbidgee Valley	NSW
Murrumbidgee Valley	NSW
Namadgi	ACT
Nest Hill	NSW
Old Jeremiah	NSW
Oolambeyan	NSW
Pucawan	NSW
Pulletop	NSW
South West Woodland	NSW
Tarcutta Hills	NSW
The Charcoal Tank	NSW
The Rock	NSW
Toogimbie	NSW
Tumblong	NSW
Tumut Subregion of Southern Region	NSW
Ulandra	NSW
Wereboldera	NSW
Young	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Southern RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Austrocylindropuntia spp. Prickly Pears [85132]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple,		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Silverleaf-nettle, Trompillo [12323] Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018] Ulex europaeus		Species or species habitat likely to occur within area
Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Bethungra Dam Reserve	NSW
Doodle Corner Swamp	NSW
Fivebough Swamp	NSW
Great Cumbungi Swamp	NSW
Lachlan Swamp (Part of mid Lachlan Wetlands)	NSW
Lake Brewster	NSW
Lake Cowal/Wilbertroy Wetlands	NSW
Lowbidgee Floodplain	NSW
Lower Mirrool Creek Floodplain	NSW
Micalong Swamp	NSW
Mid Murrumbidgee Wetlands	NSW
Snowy Flats	ACT
Tuckerbil Swamp	NSW
Yarran Swamp	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining oigations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environment and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-Forestry Corporation, NSW
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix C Description of existing environment at survey sites

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix C. Description of existing environment at survey sites

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
Albury Precinct			
12 Murray River bridge Murray River	At the survey site, the Murray River was approximately 100 metres wide and occurs in a broad valley and at the time of survey, there were moderate flows (Plates 1 and 2). Riparian vegetation was present, with the dominant species including River Red Gum (*Eucalyptus camaldulensis)* and Willow (*Salix sp)*, which provided up to five per cent shading of the river. The middle stratum was sparse and consisted mainly of exotic species such as Blackberry (*Rubus fruticosus)* and juvenile Willow trees while the lower stratum was also sparse and consisted of exotic herbs such as Purpletop (*Verbena bonariensis)* along with less than one per cent cover of emergent macrophytes such as Rushes (*Juncus sp.*), Umbrella sedge (*Cyperus eragrostis)* and Slender knot weed (*Persicaria sp.*) Instream submerged macrophytes were sparse and included less than one per cent cover of Ribbonweed (*Vallisneria americana)*. The Plant Community Type (PCT) within the proposal site at this survey site has been defined as River Red Gum herbaceous - grassy very tall open forest wetland (Technical paper 8). The Mitchell Landscape for this survey site is Murray Channels and Floodplains. Outside of the rail corridor, the land use on both banks consisted of rural properties and rail and road infrastructure however the broader catchment includes industrial, commercial, and residential land use.	The habitat sensitivity is defined as Type 1 highly sensitive KFH as the Murray River provides expected threatened species habitat for Flathead galaxies, Murray Cod, Murray Crayfish, Silver Perch and Trout Cod, however no instream gravel beds or snags were present and native aquatic plants only occurred in low density. As it is a major perennial river, it is defined as Class 1 (major river).	 **Plate 1. Murray River – looking southeast upstream**  **Plate 2. Murray river looking northwest downstream**

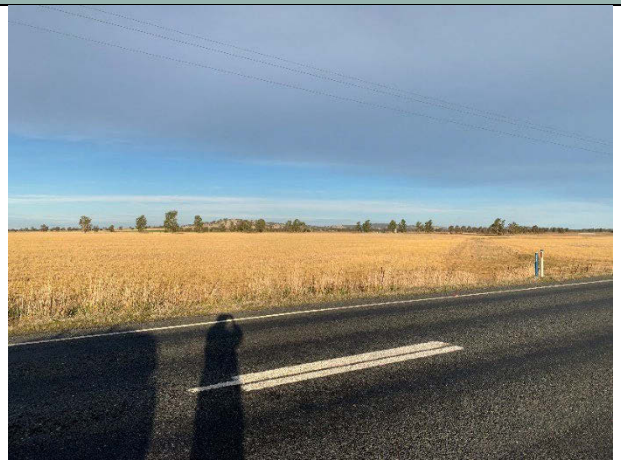
Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	The substrate within the watercourse consisted mainly of silts and clays, with no riffle sections. Edge habitat and trailing bank vegetation were both limited to less than 10 per cent of the total survey site. There were snags greater than 300 millimetres in diameter or three metres in length. The water quality, instream habitat and riparian zone is defined as highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the turbid coloration of the water, the presence of instream rubbish and exotic species, the clearing of the VRZ width to approximately 10 metres and the intensive land use within the catchment.		
11 Murray River bridge Oddies Creek	At the survey site, this watercourse ranges between six to 10 meters wide and occurs in a broad valley. No flowing water was present at the time of surveys (Plate 3 and 4) however two small remnant pools occurred within the survey site. Riparian vegetation included trees greater than 10 metres, with the dominant species including River Red Gum (*E. camaldulensis)* and Willow (*Salix sp)*, providing up to 80 per cent shading of the watercourse. The middle stratum consisted of a medium coverage of mainly exotic species such as Small-leaved Privet *(Ligustrum sinense)* and Blackberry (*Rubus fruticosus)* while the lower stratum was mostly sparse and consisted of exotic herbs along with approximately 20 per cent cover of emergent macrophytes such as Common Reed (*P. australis)*, Rushes (*Juncus sp*.), Umbrella sedge (*C. eragrostis)* and some large patches of Slender knot weed (*Persicaria sp*.) The PCT within the proposal site at this survey site has been defined as River Red Gum herbaceous - grassy very tall open forest wetland (Technical paper 8).	Within the proposal site, the habitat sensitivity at Oddies Creek is defined as Type 2 moderately sensitive as it contains snags greater than 300 millimetres in diameter and a high percentage of native aquatic plants but lacks gravel beds and is highly ephemeral. As there are defined banks, semi-permanent water in pools and freshwater aquatic vegetation present, it is Class 2 Moderate KFH.	 Plate 3. Oddies Creek – looking southeast upstream

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	The Mitchell Landscape for this survey site is Murray Channels and Floodplains. Outside of the rail corridor, the land use on the northern bank consisted of urban development while the southern bank consisted mainly of rural properties. The broader land uses within the catchment also includes industrial and commercial. The substrate within the watercourse consisted mainly of silts and clays, with no riffle sections. Edge habitat and trailing bank vegetation were both limited to less than five per cent of the total survey site. There were snags greater than 300 millimetres in diameter or three metres in length. The depth of the remnant pools was approximately 0.4 metres, with no flows and choked with *Persicaria sp*. The water quality, instream habitat and riparian zone is defined as highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the presence of instream rubbish, the presence of instream invasive species (Mosquitofish *G. holbrooki*), the clearing of the VRZ width to approximately 10 metres and the intensive land use within the catchment.		 **Plate 4. Oddies Creek - looking northwest downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
10 Billy Hughes bridge Eight Mile Creek	At the survey site, this watercourse ranges between 1.5 – 4 metres wide and occurs in a broad valley. No flowing water was present at the time of surveys however some small remnant pools occurred within the survey site. Riparian vegetation included trees greater than 10 metres, with the dominant species including Blakely's Red Gum (*Eucalyptus blakelyi)* providing up to 20 per cent shading of the watercourse. The middle stratum consisted of a dense (80 per cent) cover of emergent macrophytes within the watercourse itself such as Common Reed (*Phragmites australis)*, Rushes (*Juncus sp.*) and Umbrella sedge (*Cyperus eragrostis)*. The lower stratum was a dense cover of exotic herbs and grasses such as Slender Pigeon Grass (*Setaria parviflora)*, White clover (*Trifolium repens)* and Scotch Thistle (*Cirsium vulgare)*. The PCT within the proposal site at this survey site has been defined as Blakely's Red Gum - Yellow Box grassy tall woodland (Technical paper 8). The Mitchell Landscape for this survey site is Burrumbuttock Hills and Footslopes. Outside of the rail corridor, the land use on both sides of the bank consisted of rural properties. The substrate within the watercourse consisted mainly of silts and clays, with no riffle sections. Edge habitat and trailing bank vegetation were both limited to less than five percent of the total survey site. There were no snags greater than 300 millimetres in diameter or three metres in length. The depth of the remnant pools was approximately 0.4 metres, with no flows and with dense Common Reed *P. australis* (Plate 5).	This watercourse has not been mapped by DPI (2016) as KFH, however at the survey site, Eight Mile Creek contained remnant pools and defined banks with dense instream cover of Common Reed (*Phragmites australis)*, which is a highly invasive but native species. This site was defined as Type 3 minimally sensitive KFH and Class 4 unlikely.	 **Plate 5. Eight Mile Creek looking southwest upstream**  **Plate 6. Eight Mile Creek looking northeast downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	The water quality, instream habitat and riparian zone is defined as moderately disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the presence of instream invasive species (Mosquitofish *G. holbrooki*), the clearing of the VRZ and the rural land use within the catchment.		
Greater Hume – Lockhart Precinct			
9 Henty Yard clearances Buckaringah Creek	This watercourse is within the study area but outside the area of impact. At the survey site, this watercourse ranges between three to eight metres wide and occurs in a broad valley. No flowing water was present at the time of surveys (Plates 7 and 8) however three small remnant pools occurred within the survey site. Riparian vegetation included trees greater than 10 metres, with the dominant species including River Red Gum *E. camaldulensis* and a number of exotic species including Phoenix Palm (*Phoenix canariensis)*, Norfolk Island Hibiscus (*Lagunaria patersonia)* and Pepper Tree (*Schinus molle)*, which combine to provide 50 per cent shading of the watercourse. The middle stratum was sparse (2%) and consisted of emergent macrophytes Rushes *Juncus sp.* and Umbrella sedge (*C. eragrostis)* while the lower stratum was a dense 80 per cent cover of exotic herbs and grasses including Paspalum (*Paspalum dilatatum)*, Purpletop (*V. bonariensis)*, White clover (*T. repens)* and Flatweed (*Hypochaeris radicata)*. Vegetation mapping has not been undertaken for this survey site as it is outside of the proposal site. The Mitchell Landscape for this survey site is Brokong Plains.	The fish habitat sensitivity of Buckaringah Creek is defined as Type 1 highly sensitive KFH as it is expected threatened species habitat for Southern Pygmy Perch (i.e. indicative distribution maps (DPI, 2016)), however no instream gravel beds, snags or native aquatic plants (other than emergent sp.) are present. It is Class 2 moderate KFH as it is an intermittently flowing, providing sporadic refuge only after rain events. The receiving waterbody for this watercourse is Doodle Comer Swamp, an important wetland (DAWE, 2021).	 Plate 7. Buckaringah Creek looking east upstream

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	Outside of the rail corridor, the land use on both banks consisted of rural properties. The substrate within the watercourse consisted mainly of silts and clays, with some sand and gravel, possibly from past bridge construction works. No riffle sections were present. Edge habitat and trailing bank vegetation were both limited to less than 20 per cent of the total survey site. There were snags greater than 300 millimetres in diameter or three metres in length. The depth of the remnant pools was approximately 0.4 metres, with no flows. The water quality, instream habitat and riparian zone is defined as moderately disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the stagnant, turbid coloration of the water, the presence of instream rubbish, the presence of instream invasive species (Mosquitofish *G. holbrooki*), the clearing of the VRZ width to approximately 8 metres and the rural land use within the catchment.		 **Plate 8. Buckaringah Creek looking west downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
8 Yerong Creek Yard clearances Sandy Creek	At the survey site, this watercourse had no defined bank or channels (Plates 9 and 10). No riparian vegetation was present, with exotic grasses, herbs and crop species dominating the landscape. The PCT within the proposal site at this survey site has been defined as Miscellaneous ecosystem - highly disturbed areas (Technical Paper 8). The Mitchell Landscape for this survey site is Brokong Plains. The area is defined as extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of road and rail bridges), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.	The habitat sensitivity is defined as Type 3 minimally sensitive KFH (despite being mapped as expected threatened species habitat for Southern pygmy perch by DPI (2016)), as the watercourse did not have defined banks, was highly ephemeral and no native aquatic or wetland vegetation. It is a Class 4 waterway as it has intermittent flow following rain events only, little or no defined channel and no aquatic flora present.	 Plate 9. Sandy Creek looking east upstream  Plate 10. Sandy Creek looking west downstream

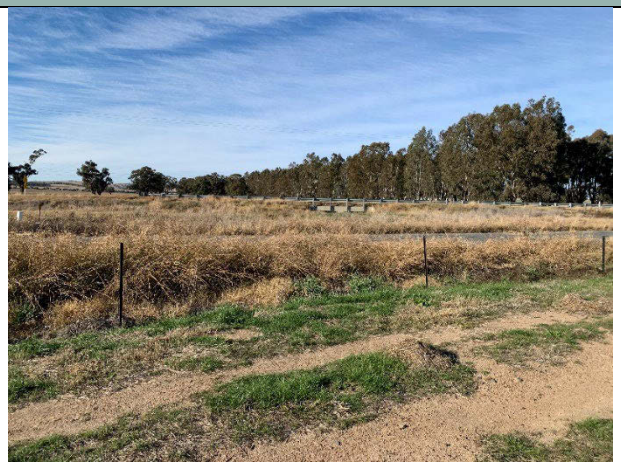
Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
Wagga Wagga Precinct			
7 Uranquinty Yard clearances Sandy Creek	At the survey site, this watercourse ranges between 2-12 meters wide and occurs in a broad valley. No flowing water was present at the time of surveys and no natural remnant pools occurred within the survey site (Plates 9 and 10). Riparian vegetation included a sparse (5%) cover of trees >10m, the dominant species being River Red Gum (*E. camaldulensis).* The middle stratum was sparse (1%) and consisted of some juvenile eucalypts, possible planted and emergent macrophytes such as Rushes (*Juncus sp*.) and Umbrella sedge (*C. eragrostis)* while the lower stratum was a dense 90% cover of exotic herbs and grasses including Paspalum (*P. dilatatum),* Couch *(Cynodon dactylon)* and cereal crop species. The PCT within the proposal site on the upstream side at this survey site has been defined as River Red Gum herbaceous - grassy very tall open forest wetland while the downstream side also consisted of Miscellaneous ecosystem - highly disturbed areas (Technical paper 8). The Mitchell Landscape for this survey site is Brokong Plains. Outside of the rail corridor, the land use on both banks consisted of rural properties. The substrate within the watercourse consisted mainly of silts and clays, with some sand and gravel, possibly from past bridge construction works. No riffle sections were present. Edge habitat and trailing bank vegetation were both limited to <2% of the total survey site. There were no snags greater than 300 mm in diameter or 3 metres in length.	The habitat sensitivity of Sandy Creek within the proposal site is defined as Type 1 highly sensitive due to the expected threatened species habitat for Flathead Galaxias (i.e. indicative distribution maps (DPI, 2016)) however no instream gravel beds, snags or native aquatic plants (other than emergent sp.) were present. It is a Class 2 waterway as it has intermittent flow and sporadic refuge only after rain events.	 **Plate 11. Sandy Creek looking south upstream**  **Plate 12. Sandy Creek looking north downstream**

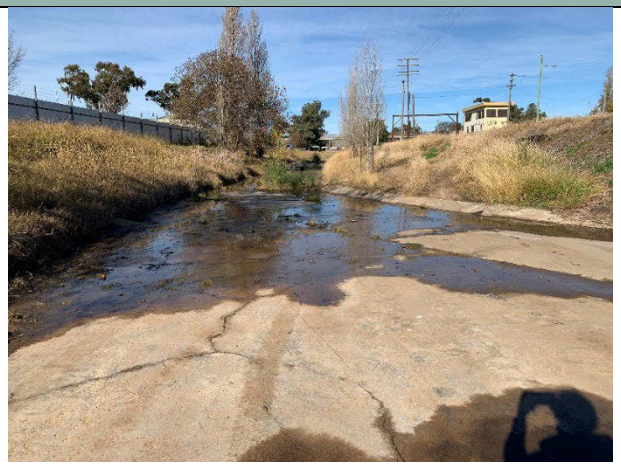
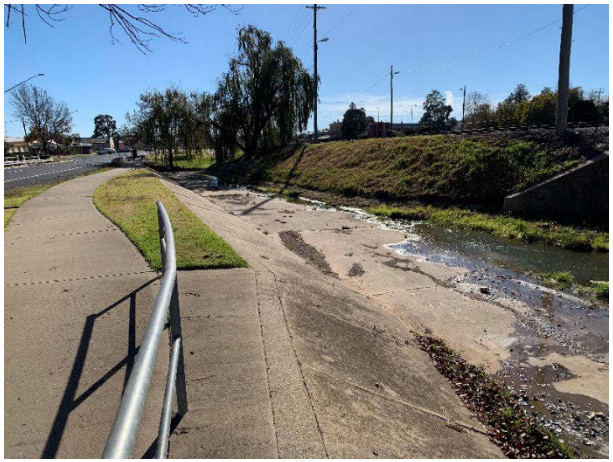
Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	The water quality, instream habitat and riparian zone is defined as highly disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges), the presence of instream rubbish and exotic species, the clearing of the VRZ width to approximately 5 metres and the rural land use within the catchment.		

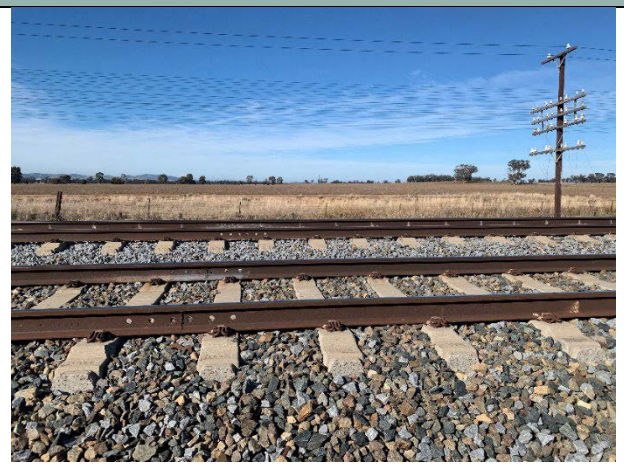
Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
6 Pearson Street bridge Unnamed	At the survey site, this watercourse was a concrete lined, artificial drainage line (Plates 11 and 12), ranging between 2-6 meters wide and occurs in a broad valley. No flowing water was present at the time of surveys and no natural remnant pools occurred within the survey site. Riparian vegetation included a sparse (5%) cover of trees >10m, with the dominant species being Blakely's Red Gum (*Eucalyptus blakelyi)* and Yellow Box (*Eucalyptus melliodora)*. The middle stratum was sparse (5%) and consisted of Acacia sp. and exotic emergent macrophytes Umbrella sedge (*C. eragrostis)* while the lower stratum was a dense 100% cover of exotic herbs and grasses including Kikuyu (*Pennisetum clandestinum)*, White clover (*T. repens)*, Paspalum (*Paspalum dilatatum)* and Lambs Tongue (*P. lanceolata)*. A small patch of Blakely's Red Gum -Yellow Box grassy tall woodland was mapped on the downstream side of the survey site with the remaining areas unmapped or Miscellaneous ecosystem - highly disturbed areas (Technical paper 8). The Mitchell Landscape for this survey site is Wonga Hills and Ranges. Outside of the rail corridor, the land use on both banks consisted of urban and industrial. Natural substrate was absent as the channel was concrete lined. No riffle sections were present. Edge habitat and trailing bank vegetation were both absent from the survey site. There were no snags greater than 300 mm in diameter or 3 metres in length.	This watercourse has not been mapped by DPI (2016) as KFH. The habitat sensitivity of the drainage line is defined as Type 3 minimally sensitive KFH as it does not contain important aquatic habitat features and class 4 unlikely KFH as it is not connected to a network of natural watercourses and is highly ephemeral.	 **Plate 13. Unnamed artificial drainage line looking south upstream**  **Plate 14. Unnamed artificial drainage line looking north downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
	The water quality, instream habitat and riparian zone is defined as extremely disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges and lining of the watercourse), the stagnant, turbid coloration of the water, the presence of instream rubbish and exotic species, the clearing of the VRZ width to approximately 3 metres and the urban and industrial land use within the catchment. ERM (2020) identified potential habitat for Sloane's Froglet *C. sloanei* in an artificial wetland at this site. The artificial wetland was mapped as Miscellaneous ecosystem - highly disturbed areas (Technical paper 8) and is considered unlikely to provide habitat for threatened fish species as it is not connected to a network of watercourses. However, the artificial wetland may provide habitat for eels and freshwater turtles.		

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
Junee Precinct			
5 Harefield Yard clearances Reedy Creek	At the survey site, this watercourse ranges between 2-5 meters wide and occurs in a broad valley. No flowing water was present at the time of surveys and no remnant pools occurred within the survey site (Plates 13 and 14). Riparian vegetation included a sparse (30%) cover of trees >10m, with the dominant species River Red Gum (*E. camaldulensis)*. The middle stratum was absent and the lower stratum consisted of 100% cover of exotic herbs and grasses including Couch *(C. dactylon)*. The PCT within the proposal site at this survey site has been defined as River Red Gum herbaceous - grassy very tall open forest wetland (Technical paper 8). The Mitchell Landscape for this survey site is Murrumbidgee - Tarcutta Channels and Floodplains. Outside of the rail corridor, the land use on both banks consisted of rural properties. The substrate within the watercourse consisted mainly of silts and clays, with some sand and gravel, possibly from past bridge construction works. No riffle sections were present. Edge habitat and trailing bank vegetation were both absent within the survey site. There were no snags greater than 300 mm in diameter or 3 metres in length. The instream habitat and riparian zone is defined as highly disturbed based on the disruption to the natural hydrology (through the presence of rail bridges), the stagnant, turbid coloration of the water, the presence of instream rubbish and exotic species, the clearing of the VRZ width to approximately 5 metres and the rural land use within the catchment.	This watercourse is not mapped as KFH (DPI, 2016) however following a site inspection, this creek does contain defined banks and riparian vegetation. It is a Class 4 waterway as it has intermittent flow following rain events only with little or no flow or pools post rain events and limited aquatic vegetation.	 **Plate 15. Reedy Creek looking southeast upstream**  **Plate 16. Reedy Creek looking west downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
4 Harefield Yard clearances Bucks Creek	At the survey site, this watercourse had no defined bank or channels (Plates 15 and 16). No riparian vegetation was present, with exotic grasses, herbs and crop species dominating the landscape. The PCT within the proposal site at this survey site has been defined as Miscellaneous ecosystem - highly disturbed areas (Technical paper 8). The Mitchell Landscape for this survey site is Murrumbidgee - Tarcutta Channels and Floodplains. The area is defined as extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of rail bridges), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.	This watercourse has not been mapped as KFH (DPI 2016) and following a site visit, it did not contain water, defined banks, riparian vegetation, or any fish habitat features and was therefore not considered likely to provide any fish habitat.	 Plate 17. Bucks Creek looking northeast upstream  Plate 18. Bucks Creek looking west downstream

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
3 Kemp St Bridge Unnamed	At the survey site, this watercourse ranges between 4-6 meters wide and occurs in a broad valley. No flowing water was present at the time of surveys and no natural pools occurred within the survey site (Plates 17 and 18). There were no trees within the riparian vegetation and middle and lower stratum consisted 100% of exotic herbs and grasses. The vegetation at the survey site was not mapped as a PCT due to its highly disturbed nature however within the Kemp Street bridge area of impact, vegetation mapping included Miscellaneous ecosystem - highly disturbed areas and Miscellaneous ecosystem - ornamental plantings (Technical paper 8). The Mitchell Landscape for this survey site is Junee Hills and Slopes. Outside of the rail corridor, the land use on both sides of the bank consisted of urban and industrial development. The substrate within the watercourse was absent as it was concrete lines. Edge habitat and trailing bank vegetation were both absent from the survey site. There were no snags greater than 300 mm in diameter or 3 metres in length. The water quality, instream habitat and riparian zone is defined as extremely disturbed based on the disruption to the natural hydrology (through the presence of road and rail bridges and channel alteration), the stagnant, turbid coloration of the water, the presence of instream rubbish and exotic species, the complete clearing of the VRZ and the urban and industrial development within the catchment.	This watercourse has not been mapped as KFH (DPI 2016) and following a site visit, it was a highly modified, concrete lined drain, without native riparian or aquatic vegetation. As such, it is considered unlikely to provide any fish habitat.	 **Plate 19. Artificial drainage line looking south upstream**  **Plate 20. Artificial drainage line looking northwest downstream**

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
2 Junee to Illabo clearances Jeralgambeth Creek	Jeralgambeth Creek crosses the proposal site in two locations. At the southern arm, this watercourse had no defined bank or channels (Plates 19 and 20). No riparian vegetation was present, with exotic grasses, herbs and crop species dominating the landscape. The PCT within the proposal site at this survey site has been defined as Miscellaneous ecosystem - highly disturbed (Technical paper 8). The Mitchell Landscape for this survey site is Murrumbidgee - Tarcutta Channels and Floodplains. The area is defined as extremely disturbed based on the disruption to the natural hydrology (through channel alteration and the presence of rail bridges), the dominance of exotic species, the absence of riparian vegetation and the rural land use within the catchment.	The southern arm is not mapped as KFH (DPI, 2016) and following site inspection, it is considered unlikely to provide any fish habitat.	 Plate 21. Jeralgambeth Creek (south arm) looking south upstream  Plate 22. Jeralgambeth Creek (south arm) looking north downstream

Survey Site, enhancement site & watercourse	Description of the watercourse within a 100m reach [a]	Habitat Type[b] & Class[c]	Photos
1 Junee to Illabo clearances Jeralgambeth Creek	At the northern arm, Jeralgambeth Creek consists of 3 remnant ponds approximately 18 x 40 meters and occurs in a broad valley. No flowing water was present at the time of surveys however two remnant pools occurred within the survey site (Plates 21 and 22). Trees were absent from the riparian vegetation and middle stratum consisted of sparse 1% cover of emergent macrophytes Rushes (*Juncus sp.*) and Umbrella sedge (*C. eragrostis)* and a lower stratum consisting of exotic herbs and grasses such as Paspalum (*P. dilatatum),* Couch(*C. dactylon)* and crops. The PCT within the proposal site at this survey site has been defined as Miscellaneous ecosystem - highly disturbed (Technical paper 8). The Mitchell Landscape for this survey site is Murrumbidgee - Tarcutta Channels and Floodplains. Outside of the rail corridor, the land use on both side of the bank consisted of rural landscape. The substrate within the watercourse consisted mainly of silts and clays, with no riffle sections. Edge habitat and trailing bank vegetation were both limited to <10% of the total survey site. There were no snags greater than 300 mm in diameter or 3 metres in length. The depth of the remnant pools was approximately 0.5m, with no flows. The water quality, instream habitat and riparian zone is defined as moderately disturbed based on the disruption to the natural hydrology (through the presence of rail bridges), the stagnant, turbid coloration of the water, the presence of instream exotic species, the complete clearing of the VRZ and the rural land use within the catchment.	The habitat sensitivity is defined as Type 2 moderately sensitive as there were no instream gravel beds, snags or native aquatic plants (other than emergent sp.) present. It is a Class 2 waterway as it has semi-permanent water in pools outside of rain events present however no freshwater aquatic vegetation is present.	 **Plate 23. Jeralgambeth Creek looking west upstream**  **Plate 24. Jeralgambeth Creek looking southeast downstream**

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix D Likelihood of occurrence assessment

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix D. Likelihood of occurrence assessment

The likelihood of occurrence for rare or threatened species was assessed using the categories and criteria listed in Table D1.

Table D1. Likelihood of Occurrence Assessment criteria

Likelihood	Criteria
Known	Recorded in project area during current or recent surveys within past 5 years
	Aquatic species recorded in connected waterbodies within 10 kilometres of the project area during current or recent surveys within past 5 years
Likely	Suitable habitat present in project area
	Project area within species' natural distribution range
	Recorded in project area more than 5 years ago but less than 25
	Suitable good quality habitat present in connected waterbodies within 5 kilometres of the project area
	Recorded within the local area within the past 5 years
Possible	Aspects of habitat present and / or habitat modified
	Aspects of aquatic habitat in connected waterbodies within 10 kilometres of the project area
	Project area within species' natural distribution range
	Numerous records within the local area between 5 to 25 years
	Recorded in project area more than 25 years ago
Unlikely	Limited aspects of habitat present in project area or in connected waterbodies within 5 kilometres of project area and / or habitat highly modified
	Historical records within 10 kilometres of project area greater than 25 years
	Project area on fringe or outside species natural distribution range
	No historical records in project area
Very Unlikely	Habitat not present in project area
	Habitat for aquatic species not present in connected waterbodies in proximity to project area (within 5 kilometres)
	Project area is located outside of species natural range
	Considered locally extinct
	No records of the species within the local area in the last 25 years
Unable to determine	Insufficient data to make a determination

Table D2. Likelihood of occurrence of threatened aquatic species listed under the Fisheries Management Act and/or Environment Protection & Biodiversity Conservation Act within the study area

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Flathead Galaxias *(Galaxias rostratus)* CE (FM Act) CE (EPBC Act)	Flathead Galaxias is generally found mid-water in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation. Flathead Galaxias feeds predominately on aquatic insects and crustaceans. Spawning occurs in spring, when water temperatures are above 10.5°C. The species produces 2000-7000 transparent, slightly adhesive demersal eggs, with fecundity increasing with length of fish. The eggs hatch after 9 days at temperatures between 9-14°C. Fry are 6-8 mm long after hatching. Individuals probably mature in their first year (approximately 80 mm long). Flathead Galaxias has experienced significant declines in distribution and abundance in all river systems in NSW. Extensive scientific sampling over recent decades has recorded extremely few specimens. The last record in the Murrumbidgee River was in 1971, and it is thought that the species may be locally extinct from the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers.	**Murray River** **Possible to occur** in the Murray River, known to occur upstream of Albury. Five historic records (>25 years) from the Murray River at Albury, with one record from 2003. However, the proposal site is outside the indicative distribution mapped for this species (DPI, 2016) and the bridge location provides only sub-optimal habitat as it contains limited aquatic vegetation, with only a small percentage of emergent macrophytes recorded within the survey site. Targeted surveys for this species at the Murray River survey site using bait traps did not result in detection of this species. **Sandy Creek** **Possible to occur** in Sandy Creek as the proposal site at survey site 7 on Sandy Creek at Uranquinty Yard clearances is within the indicative distribution mapped for this species (DPI, 2016). The watercourse at this survey site was dry at the time of survey and while there were some sparse emergent, mainly exotic macrophytes, there were no submerged or floating macrophytes. As such, this survey site is not considered to provide good quality habitat for this species. **All other watercourses in proposal site** **Unlikely** at all other sites due to lack of records within past 25 years (ALA, 2021), the remaining survey sites are not within the indicative distribution mapped for this species (DPI, 2016) and lack of suitable habitat such as coarse sand and aquatic vegetation. Targeted surveys at survey sites containing remnant pools did not result in detection of this species.
Macquarie Perch	Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. Typically found in	**All watercourses in proposal site**

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
(Macquaria australasica) E (FM Act) E (EPBC Act)	the cool upper reaches of the Murray Darling River system, but can establish populations in suitable lakes where fish undergo migrations to riverine habitats in Spring. They prefer clearwater and deep, rocky sections with abundant cover such as aquatic vegetation, submerge logs, boulders, debris and overhanging banks. In NSW populations occur in the upper reaches of the Lachlan, Goulbourn and Murrumbidgee rivers. The species is relatively fecund, fast growing and early maturing. They are a relatively long-lived species with reports of fish from Victoria aged up to 17 years. Sexual maturity occurs at 15-20 cm or two years of age for males and 25 cm or three years for females however this varies between locations due to local conditions. Macquarie Perch spawn in spring or summer in flowing shallow upland streams and rivers. Females produce around 50,000-100,000 eggs which settle among stones and gravel of the stream or river bed. Hatching occurs after approximately 10 days and larvae are about 7 mm long. Adult fish feed on aquatic insects, crustaceans and molluscs.	**Very Unlikely** to occur at any sites within the proposal site due to lack of nearby, recent records (ALA, 2021), lack of suitable habitat and the proposal site is outside the indicative distribution mapped for this species (DPI 2016). The nearest record of this species to the proposal site is on the Murray River downstream from Albury near Tallangatta recorded in 1981. The second closest record is 100 kilometres upstream from Albury on the Murray River from 1950. All watercourses within the proposal site lack the preferred habitat for this species such as clear, deep rocky sections with abundant aquatic vegetation cover, bank overhangs and submerged logs and boulders.
Murray Cod *(Maccullochella peelii)* V (EPBC Act)	The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs. Murray Cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Murray Cod tend to occur in floodplain channels and anabranches when they are inundated, but the species' use of these floodplain habitats appears limited. Juveniles less than one year old have been found in main river channels where it appears they settle at a late larval (newly born) stage . Preferred microhabitat consists of complex structural features in streams such as large rocks, snags, overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water . They also serve as predatory ambush points for foraging, particularly during the day	**Murray River** **Likely to occur** in the Murray River as there are numerous records (ALA, 2021), however the bridge location provides only sub-optimal habitat as it does not contain many of the preferred habitat features such as large rocks, snags, bank overhangs, trailing bank vegetation, rock, boulder, gravel and sand substrates. **All other watercourses in proposal site** **Very Unlikely** at all other sites due to lack of records (ALA 2021), lack of suitable habitat features such as large rocks, snags, bank overhangs, trailing bank vegetation, rock, boulder, gravel and sand substrates.

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
	(DAWE, undated). The prefer cooler upper reaches of streams, usually in flowing pools between falls and rapids where the stream bottom is bed-rock, boulders and sand or gravel substrates.	
Murray Crayfish *(Euastacus armatus)* V (FM Act)	Murray Crayfish can be found in a variety of habitats ranging from pasture-lands to sclerophyll forest. They prefer cool, flowing water that is well oxygenated. The species is tolerant of water temperatures up to 27°C and moderate salinities, but are intolerant to low dissolved oxygen concentrations. They are most active between May to October when water temperatures are below 20°C and when the water warms in summer they tend to become less active. They create burrows that vary in complexity, from deep burrows with multiple entrances to simple burrows under a rock or log. The species is slow growing, with females taking up to 10 years to reach sexual maturity, and 4 years for males. They can live up to an estimated 28 years of age. Murray Crayfish are opportunistic feeders, feeding mainly on decaying aquatic plant matter, dead fish and other animals. Cannibalism has also been reported within high-density populations. Mating may be cued by a rapid decline in water temperature in May. Fecundity is size-dependent, with large mature females producing a maximum of 2,400 eggs. Females incubate eggs under their abdomen for 20 weeks. Hatchlings remain in the mother's care for a further month before dispersing.	**Murray River** **Likely to occur** with numerous records from the Murray River. Most recent record near Albury is from 2010 (ALA, 2021) and the bridge location is likely to provide habitat for this species. It is noted however the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). **All other watercourses in proposal site** **Very Unlikely** at all other sites due to lack of records (ALA, 2021), lack of suitable habitat and the proposal site is outside the indicative distribution mapped for this species (DPI 2016). One recent record near Wagga Wagga from 2019 is from the Murrumbidgee River which is outside the proposal site.
Silver Perch *(Bidyanus bidyanus)* V (FM Act) CE (EPBC Act)	Silver Perch was once widespread throughout the Murray darling basin but has experienced a dramatic decline throughout the region and is now only patchily abundant within the central Murray system. They have been 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.They are omnivorous, feeding on a variety of small prey including aquatic insects, molluscs, worms, crustaceans, zooplankton and algae. Males reach sexual maturity at three years of age, when around 25 cm in length, and	**Murray River** **Likely to occur** with numerous records from the Murray River. Most recent record near Albury is from 2010 (ALA, 2021). The bridge location is likely to provide habitat for this species. It is noted however that the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). **All other watercourses in proposal site**

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
	females at four to five years, when around 29 cm. Adult Silver Perch can move large distances, often associated with spawning activity in spring and summer. Juveniles disperse over large distances, and are often seen at fishways travelling upstream in large schools. Females can lay 300,000 or more nonadhesive, floating eggs that are about 2.7 mm in diameter. They are mostly released in one spawning, and hatch after approximately 30 hours. Eggs and larvae passively drift with the river current for a number of days.	**Unlikely** to occur as there are no records of this species in watercourses that cross the proposal site (other than the Murray River, ALA, 2021) and the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). In addition, there is no suitable habitat as this species prefers open sections of river.
Southern Purple Spotted Gudgeon *(Mogurnda adspersa)* E (FM Act)	Southern Purple Spotted Gudgeon are a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams. They feed mainly on terrestrial insects and their larvae, worms, small fish, tadpoles, and some plant matter. Males reach maturity at about 4.5 cm and females at about 5 cm in length. Males have an elaborate courtship display and spawning occurs over summer when water temperatures are warmer. Females may lay several batches of eggs per season (30 - 1,300 per batch). The eggs are small (2 - 4mm long), elongated, sticky and transparent. They are deposited in clusters on solid objects such as rocks, wood or broadleafed plants. The male guards and fans the eggs until they hatch (3 - 8 days). Newly hatched larvae are approximately 4mm long.	**All watercourses in proposal site** **Unlikely to occur** as there are only 3 historic records of this species in the locality however none occur in watercourses that cross the proposal site and the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). In addition, the watercourses within the proposal site lack important habitat features for this species such as aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks and snags. Targeted surveys at survey sites containing remnant pools did not result in detection of this species.

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Southern Pygmy Perch *(Nannoperca australis)* E (FM Act) V (EPBC Act)	The Southern Pygmy Perch is found in well vegetated, slow-flowing or still waters including streams, lakes, billabongs and other types of wetlands. The species is carnivorous, feeding on a range of aquatic crustaceans and insects. Southern Pygmy Perch reach sexual maturity in their first year, when males are about 30 mm and females about 33 mm long. Breeding occurs from late winter to early spring in response to rising water temperatures. During the breeding season, males defend a territory in which, after a courtship display, spawning takes place. Each female can produce up 4000 small, transparent, non-adhesive eggs which are scattered over vegetation or rocks on the bottom. Newly hatched larvae are 3 - 4 mm long and emerge 2 - 4 days after fertilisation.	**Buckaringah Creek** **Possible to occur** as the proposal site at survey site 9 on Buckaringah Creek at Henty Yard clearances is within the indicative distribution mapped for this species (DPI, 2016). The watercourse at this survey site was dry at the time of survey however there were some remnant pools, some instream habitat features such as branches and trailing bank vegetation but there was only sparse emergent, mainly exotic macrophytes, with no submerged or floating macrophytes. This creek feeds into Doodle Comer Swamp which may also provide habitat for this species. **Sandy Creek** **Unlikely to occur -S**urvey site 8 on Sandy Creek at Yerong yard clearances is within the indicative distribution mapped for this species (DPI, 2016), however this watercourse was not only dry at the time of survey, but it also lacked defined banks and all habitat features required for this species. **All other watercourses in proposal site** **Unlikely** at all other sites due to lack of records within watercourses that cross the proposal site (ALA, 2021) and lack of suitable habitat as survey sites contained limited aquatic vegetation, with only a small percentage of emergent macrophytes recorded. Targeted surveys at survey sites containing remnant pools did not result in detection of this species and remaining survey sites are outside of the indicative distribution mapped for this species (DPI, 2016).

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Trout Cod *(Maccullochella macquariensis)* E (FM Act) E (EPBC Act)	Trout Cod tend to occupy areas which have lots of large in-stream woody debris or 'snags', which provide complex habitats for each stage of the species' life cycle. They remain at the one site with limited home ranges. This species has a preference for larger River systems with deep pools with instream cover such as large boulders timber and woody debris. There are only three known self-sustaining populations left in the wild, with the largest being in the Murray River below Yarrawonga (approximately 100 kilometres upstream of the proposal site). Trout Cod are carnivores, preying mainly on crustaceans and aquatic insects but also on other fishes. Their maximum life span is thought to be 20 - 25 years, with sexual maturity reached at 3 - 5 years, when approximately 35 cm (males) or 43 cm (females) in length, and 0.75 - 1.5 kg in weight. They form pairs and spawn during spring and early summer when the water temperature is around 15ºC. Females produce 1,200 – 11,000 adhesive eggs (2.5 – 3.6 mm in diameter) that attach to hard substrates and are guarded by the male. Larvae hatch after 5 - 10 days when they are approximately 6 - 9 mm in length, and then disperse by drifting in the water column.	**Murray River** **Likely to occur** in the Murray River as there are numerous records (ALA, 2021), however the bridge location provides only sub-optimal habitat as it does not contain many of the preferred habitat features such as large in-stream woody debris or 'snags' and large boulders and the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). **All other watercourses in proposal site** **Very Unlikely** at all other sites due to lack of records (ALA, 2021), lack of suitable habitat and the proposal site is outside the indicative distribution mapped for this species (DPI 2016)

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Endangered Population		
Murray-Darling Basin population of Eel Tailed Catfish *(Tandanus tandanus)* Ep (FM Act)	Eel Tailed Catfish numbers in the Murray-Darling Basin have declined due to a range of impacts including invasive species, habitat degradation, cold water pollution and fishing pressures and are now virtually absent from the Murray, Murrumbidgee and Lachlan catchments. Eel tailed catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 kilometres range. Individuals are more active at night compared with during the day. The species inhabits a diverse range of freshwater environments including rivers, creeks, lakes, billabongs and lagoons. It prefers clear, sluggish or still waters, but can also be found in flowing streams with turbid waters. Substrates range from mud to gravel and rock. Individuals are sexually mature at 3-5 years of age and spawn in spring/summer when water temperatures are 20-24ºC. Males construct and defend a nest up to 2 metres in diameter, made from pebbles and gravel. The eggs are large (~3mm) and non-adhesive which settle towards the centre of the nest. The male fish remains with the nest to fan, clean and guard the eggs, which hatch after about 7 days. Larvae are approximately 7 mm long at hatching. Eel-Tailed Catfish is predominantly an opportunistic carnivore, feeding mainly on small fish, freshwater prawns, yabbies, snails, aquatic insects and zooplankton.	**Unlikely to occur** at all survey sites due to lack of records within watercourses that cross the proposal site (ALA, 2021), lack of suitable habitat and the proposal site is outside the indicative distribution mapped for this species (DPI 2016).
Western population of Olive Perchlet *(Ambassis agassizii)* Ep (FM Act)	Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slowflowing or still waters. They are usually found in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night. Males and females reach sexual maturity at one year of age, and live for 2-4 years. Spawning occurs from October to December, when water temperatures increase to approximately 23°C. Females lay 200-700 eggs which attach to aquatic plants and rocks on the streambed. Olive Perchlet feed on a range of zooplankton and aquatic and terrestrial insects.	**Unlikely to occur** at all sites due to lack of records within past 25 years (ALA. 2021), the proposal site is outside the indicative distribution mapped for this species (DPI, 2016) and lack of suitable habitat such as as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders.

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Endangered Ecological Community		
Lowland Murray River aquatic ecological community EEC (FM Act)	The lower Murray ecological community occurs in a lowland riverine environment, characterised by meandering channels and wide floodplains. The land is generally flat to gently sloping. In their natural state, these lowland rivers experienced extremely variable water flows, ranging from floods to droughts. Variability in environmental conditions has led to adaptations in the native aquatic flora and fauna; for example, many species rely on floods to trigger spawning and create suitable breeding habitats. Lowland rivers provide a wide range of habitats for fish and invertebrates, including pools, runs or riffles, backwaters and billabongs, large woody habitats and aquatic plants. Floodplains also provide a mosaic of habitat types, including permanent and temporary wetlands, as well as terrestrial habitats.	**Known to occur -** the lower Murray River endangered ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria. Excluded from this recommendation are the Lachlan River and the Darling River and their tributaries, and artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs. The following watercourses within the proposal site are considered part of this EEC and the impacts of the proposal have been considered in an assessment of significance of impact (Appendix E): • Jeralgambeth Creek (a tributary of Billabong Creek); • Reedy Creek (tributary of Houlaghans Creek); • Sandy Creek (a tributary of the Murrumbidgee River); • Buckaringah Creek (tributary of Doodle Comer Swamp); • Eight Mile creek (tributary of the Murray River); • Oddies Creek (a tributary of the Murray River); and • Murray River.

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Protected Species		
Platypus *(Ornithorhynchus anatinus)* P (FM Act)	Platypus are found in eastern Australia in a range of habitats from the tropics of far north Queensland to the Tasmania. Platypus make their home in and near freshwater creeks, slow-moving rivers, lakes joined by rivers, and built water storages such as farm dams. They build a simple burrow in a river bank, just above water level and often among a tangle of tree roots. Habitat requirements of the Platypus include a river or a stream with earth banks and native vegetation that provides shading of the stream and cover near the bank. The presence of logs, twigs, and roots, as well as cobbled or gravel water substrate are also required for foraging of microinvertebrates, which is their main food source (Divljan, 2019).	The BioNet has 526 records of platypus occurring within the locality in a variety of habitat types and watercourses. **Murray River an Oddies Creek** **Likely to occur** in the Murray River as there are numerous records (BioNet) and the bridge location provides permanent water and suitable habitat features for foraging such as roots, cobbles and gravel substrate **All other watercourses in proposal site** **Unlikely** at all other sites as they lack suitable habitat features for foraging such as roots, cobbles and gravel substrate and are highly ephemeral and are therefore unable for provide the aquatic habitat required by this species.

Threatened Species Name	Habitat Requirements	Likelihood of Occurrence?
Freshwater Turtles *(Chelodina sp Emydura sp)* P (FM Act)	New South Wales is home to 7 species of native freshwater turtle, two of which are found nowhere else. Australia's freshwater turtles spend most of their time in rivers, lakes, swamps and ponds, including farm dams. However, they sometimes come onto land to migrate between water bodies or to nest. Some species can also survive for months in a dormant state buried in soil or dry lake beds. However, they are not able to feed out of water. Nesting turtles dig a hole in the ground with their hind legs, lay their eggs in the hole, then cover the eggs with earth. A clutch may comprise as many as 25 eggs, depending on the species of turtle and her size. After a few months the eggs hatch and the hatchling turtles make their way to the water, where they typically take around 10 years to grow to maturity. Little is known about the life span of Australian freshwater turtles, but they can probably live for 50 years or more.	The BioNet has 1,039 records of freshwater turtles occurring within the locality in a variety of habitat types and watercourses. **Likely to occur** in all watercourses that contain water and/or remnant pools (i.e. Jeralgambeth Creek, Reedy Creek, Sandy Creek, Buckaringah Creek, Eight Mile Creek, Oddies Creek and the Murray River).

[1] Information on species, populations and endangered ecological communities was obtained from DPI website (www.dpi.nsw.gov.au/fishing/species-protection/what-current) and associated Primefacts unless otherwise stated. CE=Critically Endangered, E=Endangered, V=Vulnerable, EP=Endangered Population, EEC=Endangered Ecological Community, P=Protected under FM Act and EPBC Act.

[2] In line with NSW DPI definition, 'Fish' also includes freshwater, estuarine and marine aquatic invertebrates (such as crustaceans, molluscs and polychaetes), as well as marine vegetation, including saltmarshes, mangroves, seagrasses and macroalgae

EPBC/FM Act Status: V = Vulnerable; E = Endangered, CE = Critically Endangered; Ep = Endangered population

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix E Assessment of significance (FM Act)

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix E. Assessment of significance (FM Act)

Section 5.5 of the EP&A Act requires that a determining authority examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal and that assessment of significance is undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the FM Act. The test for determining whether the proposal is likely to affect threatened species, populations or ecological communities or their habitats is in section 221ZV of the FM Act.

Five aquatic species were identified as likely or possible to occur within the study area (Appendix D) and are assessed against an assessment of significance:

1. Flathead Galaxias (*Galaxias rostratus*) CE
2. Murray Crayfish (*Euastacus armatus*) V
3. Silver Perch (*Bidyanus bidyanus*) V
4. Southern Pygmy Perch (*Nannoperca australis*) E
5. Trout Cod (*Maccullochella macquariensis*) E

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities:

Impact on local population of a species

> *(a) in the case of a threatened species, whether the proposed development or activity 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,*

Trout Cod
Trout Cod are a large, predatory freshwater fish belonging to the family Percichthyidae. Trout Cod were once widespread throughout the southern tributaries of the Murray-Darling river system, but the species has undergone a dramatic decline in distribution and abundance over the past century. Natural Trout Cod populations are now limited to a single self-sustaining population in the Murray River between the Yarrawonga Weir and Barmah. Several populations have also been re-established in Victoria and NSW by stocking of captive bred fingerlings or through translocation.

Trout Cod tend to occupy areas which have lots of large in-stream woody debris or 'snags', which provide complex habitats for each stage of the species' life cycle. They tend to remain at the one site with limited home ranges. Trout Cod are carnivores, preying mainly on crustaceans and aquatic insects but also on other fishes. Maximum life span is thought to be 20 - 25 years, with sexual maturity reached at 3 - 5 years, when approximately 35 cm (males) or 43 cm (females) in length, and 0.75 - 1.5 kg in weight. They form pairs and spawn during spring and early summer when the water temperature is around 15ºC. Females produce 1,200 – 11,000 adhesive eggs (2.5 – 3.6 mm in diameter) that attach to hard substrates and are guarded by the male. Larvae hatch after 5 - 10 days when they are approximately 6 - 9 mm in length, and then disperse by drifting in the water column.

Threats include:

- Modification of natural river flows and temperatures as a result of river regulation has led to spawning failures, reduced fish dispersal, and reduced habitat quality for Trout Cod.
- Habitat degradation through the removal of snags, water quality impacts associated with agriculture and other land uses, and sedimentation caused by land clearing activities.
- Over-harvesting by recreational and commercial fishers has contributed to past declines. Trout Cod are now totally protected in NSW, Victoria and the ACT, but

illegal fishing and hooking injuries in accidentally caught fish, still pose a threat. Targeted or indirect capture of Trout Cod can directly reduce their numbers, remove breeding age adults and disrupt breeding activities such as egg and larvae guarding.
- Competition from, or interactions with, introduced fish species such as Brown Trout (*Salmo trutta*), Redfin Perch (*Perca fluviatilis*) and common Carp (*Cyprinus carpio*).

There are numerous records of this species from the Murray River near Albury, the most recent from 2011 (ALA, 2021) however the Murray River bridge is outside the indicative distribution mapped for this species (DPI, 2016). While the bridge location does have some habitat preferences for this species such as large snags, the site has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). As such, the proposal site at the Murray River bridge is considered unlikely to provide important habitat for this species.

The proposal does not require any works to the sub-structure of the existing bridge or within the bed of the Murray River. Thus, the level of impact to the aquatic environment is minor and the habitat being impacted is not considered to be important habitat for refuge and breeding. As such, the proposal is unlikely to have an adverse effect on the life cycle of Trout Cod such that a viable local population of the species is likely to be placed at risk of extinction.

Murray Crayfish

The Murray Crayfish is an iconic freshwater crayfish that is endemic to the southern tributaries of the Murray-Darling Basin. It has the widest distribution of all the Euastacus crays, historically occurring in New South Wales, Victoria, South Australia and Victoria.

Murray Crayfish can be found in a variety of habitats ranging from pasture-lands to sclerophyll forest. They prefer cool, flowing water that is well oxygenated. The species is tolerant of water temperatures up to 27°C and moderate salinities but are intolerant to low dissolved oxygen concentrations. They are most active between May to October when water temperatures are below 20°C and when the water warms in summer they tend to become less active. They create burrows that vary in complexity, from deep burrows with multiple entrances to simple burrows under a rock or log. The species is slow growing, with females taking up to 10 years to reach sexual maturity, and 4 years for males. They can live up to an estimated 28 years of age. Murray Crayfish are opportunistic feeders, feeding mainly on decaying aquatic plant matter, dead fish and other animals. Cannibalism has also been reported within high-density populations. Mating may be cued by a rapid decline in water temperature in May. Fecundity is size-dependent, with large mature females producing a maximum of 2,400 eggs. Females incubate eggs under their abdomen for 20 weeks. Hatchlings remain in the mother's care for a further month before dispersing.

Threats include:

- Habitat modification from the construction of weirs have created extensive weir pools with altered biofilm composition and associated artificial lentic (still water) environments that are thought to be unsuitable for Murray Crayfish;
- Sedimentation that can fill deeper holes, smother snags and other cover, and bury clay banks required for burrowing;
- River regulation may result in reduced overall flows, alter water temperatures (thermal pollution), and may expose burrows and burrowing sites during reduced winter flows;
- Agricultural pesticides are thought to have been a significant factor in the historical decline of Murray Crayfish. Crayfish are sensitive to many commonly used pesticides and agrochemicals, and historical use of organochlorine pesticides such as DDT may have been particularly damaging;
- Historic commercial and current illegal fishing activities may have an impact on Murray Crayfish stocks;

- Juveniles and immature Murray Crayfish may be impacted by pest species from competition and predation;
- Murray Crayfish are generally intolerant of low dissolved oxygen concentrations such as those experienced in blackwater events after flooding, and extreme events have shown to severely deplete populations;
- Adult Murray Crayfish have very low dispersal abilities and occupy small home-ranges; exacerbating the effect of environmental or human impacts and limiting their ability to recolonise river reaches if populations are lost.

There are numerous records of this species from the Murray River near Albury, the most recent from 2010 (ALA, 2021) however the Murray River bridge is outside the indicative distribution mapped for this species (DPI, 2016). While the bridge location does have some habitat preferences for this species, the site has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). As such, the proposal site at the Murray River bridge is considered unlikely to provide important habitat for this species.

The proposal does not require any works to the sub-structure of the existing bridge or within the bed of the Murray River. Thus, the level of impact to the aquatic environment is minor and the habitat being impacted is not considered to be important habitat for refuge and breeding. As such, the proposal is unlikely to have an adverse effect on the life cycle of Murray Crayfish such that a viable local population of the species is likely to be placed at risk of extinction.

Silver Perch

Silver Perch, also known as bidyan or black or silver bream, are a moderate to large freshwater fish native to the Murray-Darling river system. They were once widespread and abundant throughout most of this area, except for cooler high altitude streams. However, they have now declined to low numbers or disappeared from most of their former range.

Silver Perch have been 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. They are omnivorous, feeding on a variety of small prey including aquatic insects, molluscs, worms, crustaceans, zooplankton and algae. Males reach sexual maturity at three years of age, when around 25 cm in length, and females at four to five years, when around 29 cm. Adult Silver Perch can move large distances, often associated with spawning activity in spring and summer. Juveniles disperse over large distances, and are often seen at fishways travelling upstream in large schools. Females can lay 300,000 or more non adhesive, floating eggs that are about 2.7 mm in diameter. They are mostly released in one spawning, and hatch after approximately 30 hours. Eggs and larvae passively drift with the river current for a number of days.

Threats include:

- Modification of natural river flows and temperature regimes due to the construction of dams and weirs lead to disrupted cues for migration and spawning and reduce opportunities for dispersal and availability of food.
- Loss of riparian (river bank) vegetation by deliberate removal result in sedimentation, increased salinity and declines in water quality subsequently degrading instream habitats important to Silver Perch.
- Loss of submerged macrophytes which are important nursery areas for juvenile Silver Perch and important sites for feeding at all life stages.
- Competition from introduced species such as Carp, Redfin Perch and Mosquitofish.

- Stocking of inappropriate genetic strains, poor quality Silver Perch or Silver Perch hybrids.
- Silver Perch are one of several native fish species found to be highly susceptible to the EHNV (Epizootic Haematopoietic Necrosis Virus) disease, which is carried by the introduced Redfin Perch.

There are numerous records of this species from the Murray River, with the most recent record near Albury from 2010 (ALA, 2021). The bridge location does have some habitat preferences for this species such as open sections of water however it lacks fast flowing rapids and races. It is noted however that the proposal site is outside the indicative distribution mapped for this species (DPI, 2016). The habitat at the bridge location has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). As such, the proposal site is considered unlikely to provide important habitat for this species.

The proposal does not require any works to the sub-structure of the existing bridge or within the bed of the Murray River. Thus, the level of impact to the aquatic environment is minor and the habitat being impacted is not considered to be important habitat for refuge and breeding. As such, the proposal is unlikely to have an adverse effect on the life cycle of the Silver Perch such that a viable local population of the species is likely to be placed at risk of extinction.

Flathead Galaxias

Flathead Galaxias, also commonly known as Murray Jollytail, is a small native fish species from the family Galaxiidae. The species is endemic to the southern tributaries of the Murray-Darling River system; the Murray, Murrumbidgee and Lachlan Rivers and their tributaries and the upper Macquarie River catchment.

Flathead Galaxias has experienced significant declines in distribution and abundance in all river systems in NSW. Extensive scientific sampling over the last two decades has recorded extremely few specimens. The last record in the Murrumbidgee River was in 1971, and it is thought that the species may be locally extinct from the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers. In addition, only very small numbers of specimens have been sampled from wetlands of the Murray River floodplain between Hume Dam and Lake Mulwala and the upper Murray River near Tintaldra.

Flathead Galaxias is generally found mid-water in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation. Flathead Galaxias feeds predominately on aquatic insects and crustaceans. Spawning occurs in spring, when water temperatures are above 10.5°C. The species produces 2000-7000 transparent, slightly adhesive demersal eggs, with fecundity increasing with length of fish. The eggs hatch after 9 days at temperatures between 9-14°C. Fry are 6-8 mm long after hatching. Individuals probably mature in their first year (approximately 80 mm long).

Threats include:

- Spawning or recruitment failure due to water regulation and cold water release from impoundments.
- Loss of or altered connectivity between rivers and floodplains.
- Loss of or degradation of habitats in lakes, wetlands and billabongs such as the loss of aquatic vegetation like Ribbon Weed (Vallisneria spp)
- Predatory and competitive interactions with introduced species such as Carp (Cyprinus carpio), Redfin Perch (Perca fluviatilis) and Mosquitofish.

- Construction of barriers to migration and recolonisation such as weirs and dams without fish ways.
- Habitat modifications as a result of agricultural practices including siltation and loss of riparian vegetation.
- Pollution from domestic, agricultural and industrial sources.

This species is known to occur in the Murray River upstream of Albury, with five historic records (>25 years) from the Murray River at Albury and one record from 2003. However, the proposal site is outside the indicative distribution mapped for this species (DPI, 2016) and the bridge location provides only sub-optimal habitat as it contains limited aquatic vegetation, with only a small percentage of emergent macrophytes recorded within the survey site. Targeted surveys for this species at the Murray River survey site using bait traps did not result in detection of this species. In addition, the habitat at the survey site has been highly modified and the status of fish communities in this section of the Murray River is defined as very poor (DPI, 2016). As such, the survey site is considered unlikely to provide important habitat for this species.

Sandy Creek at Uranquinty Yard clearances is within the indicative distribution mapped for this species (DPI, 2016). Sandy Creek was dry at the time of site visits so targeted surveys could not be undertaken for this species at this location. Sandy Creek is highly ephemeral, flowing only after rain events, and there were no refuge pools observed at the survey site during site inspections. While there were some sparse emergent, mainly exotic macrophytes, there were no submerged or floating macrophytes. As such, Sandy Creek at the survey site is not considered to provide good quality habitat for this species. In addition, the habitat at the survey site has been highly modified and the status of fish communities in Sandy Creek is defined as poor (DPI, 2016). As such, the proposal site is considered unlikely to provide important habitat for this species.

The proposal does not require any works to the sub-structure of the existing Murray River bridge or within the bed of the Murray River. Thus, the level of impact to the aquatic environment is minor and the habitat being impacted is not considered to be important habitat for refuge and breeding of this species. In addition, the proposal does not require any works to the sub-structure of the existing bridge over Sandy Creek or within the bed of Sandy Creek however a temporary crossing is proposed. This has the potential to impact fish passage during flow events however Sandy Creek is highly ephemeral, and the blockage of fish passage for 4 weeks is a relatively minor impact as the habitat being impacted is not considered to be important habitat for refuge and breeding of this species. As such, the proposal is unlikely to have an adverse effect on the life cycle of the Flathead Galaxias such that a viable local population of the species is likely to be placed at risk of extinction.

Southern Pygmy Perch

The Southern Pygmy Perch was once widely distributed throughout the Lachlan, Murrumbidgee and Murray River systems, as well as coastal streams in South Australia, Victoria, north-eastern Tasmania and King and Flinders Islands in Bass Strait. However, there have been large-scale reductions in its range, particularly in inland regions.

The Southern Pygmy Perch is found in well vegetated, slow-flowing or still waters including streams, lakes, billabongs and other types of wetlands. The species is carnivorous, feeding on a range of aquatic crustaceans and insects. Southern Pygmy Perch reach sexual maturity in their first year, when males are about 30 mm and females about 33 mm long. Breeding occurs from late winter to early spring in response to rising water temperatures. During the breeding season, males defend a territory in which, after a courtship display, spawning takes place. Each female can produce up 4000 small, transparent, non-adhesive eggs which are scattered over vegetation or rocks on the bottom. Newly hatched larvae are 3 - 4 mm long and emerge 2 - 4 days after fertilisation.

Threats include:

- Habitat degradation including loss of aquatic and riparian (riverbank) vegetation.
- Loss or modification of floodplain wetland habitats by flood mitigation works, such as levees and wetland drainage.
- Modification of natural river flows and temperatures as a result of river regulation, leading to drying and fragmentation of wetland habitats and spawning failures.
- Predation by, and competition with, introduced fish species, such as Redfin Perch (*Perca fluviatilis*) and Mosquitofish.

Southern Pygmy Perch was considered possible to occur at Buckaringah Creek at Henty Yard clearances as it is within the indicative distribution mapped for this species (DPI, 2016). The watercourse at this survey site was dry at the time of survey however there were some remnant pools, some instream habitat features such as branches and trailing bank vegetation but there was only sparse emergent, mainly exotic macrophytes, with no submerged or floating macrophytes. As such, Buckaringah Creek at the survey site is not considered to provide good quality habitat for this species as it does not contain well vegetated, slow flowing waters. In addition, the habitat at the survey site has been highly modified and the status of fish communities in Buckaringah Creek is defined as poor (DPI, 2016). As such, the proposal site is considered unlikely to provide important habitat for this species.

Buckaringah Creek is outside of the proposal site and therefore would not be directly impacted by the proposal. As such, the proposal is unlikely to have an adverse effect on the life cycle of the Southern Pygmy Perch such that a viable local population of the species is likely to be placed at risk of extinction.

Impacts on an endangered population

> *(b) in the case of an endangered population, whether the proposed development or activity 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,*

N/A. The endangered populations previously recorded in the locality (Murray-Darling population of Eel-Tailed Catfish and Western Population of Olive Perchlet) were determined to be very unlikely to occur within the proposal site.

Impact on Endangered Ecological Community

> *(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity—*
>
> *(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, or*
>
> *(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 study area occurs within the *Lowland Murray River aquatic ecological community* (including Jeralgambeth Creek, Reedy Creek, Sandy Creek, Eight Mile Creek, Buckaringah Creek, Oddies Creek and Murray River)

The aquatic ecological community of the lower Murray River drainage system has been greatly modified since European settlement, through activities such as river regulation, agricultural practices and the introduction of non-native species. 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, 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.

The listing of the lower Murray River aquatic ecological community has several legal implications, including the establishment of heavy penalties for harming (without appropriate authority) species or habitats that form part of the community. Potential impacts on the ecological community must be considered during assessment processes.

The lower Murray aquatic ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut rivers, as well as all their tributaries and branches.

The community includes 23 native fish species and over 400 recorded native invertebrate species.

The lower Murray ecological community occurs in a lowland riverine environment, characterised by meandering channels and wide floodplains. The land is generally flat to gently sloping. In their natural state, these lowland rivers experienced extremely variable water flows, ranging from floods to droughts. Variability in environmental conditions has led to adaptations in the native aquatic flora and fauna; for example, many species rely on floods to trigger spawning and create suitable breeding habitats. Lowland rivers provide a wide range of habitats for fish and invertebrates, including pools, runs or riffles, backwaters and billabongs, large woody habitats and aquatic plants. Floodplains also provide a mosaic of habitat types, including permanent and temporary wetlands, as well as terrestrial habitats.

Threats include:

- Modification of natural river flows as a result of river regulation (dams, weirs etc.), leading to reduced habitat quality and complexity, loss of spawning cues, and reduced opportunities for dispersal and migration of aquatic species.
- Spawning failures and habitat loss resulting from cold water releases from dams.
- Predation, competition, diseases and habitat modification from introduced fish species, such as Carp, Goldfish, Redfin Perch, Mosquitofish, Weatherloach and Tench.
- Degradation of the riparian (riverbank) zone through stock access and clearing of native vegetation, leading to loss of shelter and increased sedimentation.
- Removal of in-stream large woody debris, which is an important habitat component and territory marker for many fish and invertebrates.
- Agricultural practices, such as irrigation, clearing, grazing and the use of fertilisers and pesticides, which have affected water quality.
- Over-fishing has probably contributed to declines in some species. Illegal fishing, together with hooking injuries in accidentally caught fish, still pose a threat to some species.

Twenty six mapped hydrolines and two wetlands occur within the study area. While some of these are not defined as a natural creek or river, most fall under the definition of this aquatic ecological community. The risk of impact was determined as medium at two watercourses where instream works are required:

1. Sandy Creek (Uranquinty Yard clearances) - The proposal would directly impact Sandy Creek through the removal of 64 square metres of riparian vegetation and instream reclamation works for a temporary crossing on the southern side of the existing rail bridge at Uranquinty. This would result in loss of riparian vegetation and associated bank stability and root structure which is an important habitat

feature in aquatic environments. The temporary crossing would prevent fish passage (during times of flow) for a 4 week period while the temporary crossing is in place. The temporary crossing also has the potential to impact water quality through the introduction of unconsolidated and un stabilised sediment during a rain event.

2. Jeralgambeth Creek (Junee to Illabo clearances) – instream works include the replacement of bridges and culverts within this creek and or its tributaries. No riparian vegetation would be impacted however instream vegetation, including exotic grasses which help to stabilise the bed and banks during flow events, would be disturbed. This has the potential to impact water quality as sediments become mobilised during a rain event.

The risk of direct impact to the remaining watercourses was determined as low as many were outside of the area of impact or the watercourses themselves were ranked as low priority.

The proposal results in direct impacts to Sandy Creek and Jeralgambeth Creek however following completion of works, the watercourses would be remediated in accordance with the rehabilitation strategy. In addition, the proposal has the potential to indirectly impact water quality at all watercourses, through the mobilisation of sediments and other contaminants via wind or stormwater runoff. This has the potential to result in fish kills from changes in water quality, provide more suitable habitat for pest species, negatively impact aquatic vegetation, increase sedimentation within watercourses and increase algal blooms. These potential indirect impacts would be mitigated through appropriate erosion and sediment control to minimise any impacts to watercourses not only within the proposal site, but to receiving waters that form part of this aquatic ecological community.

As the proposal would not result in any long-term changes to Sandy Creek and Jeralgambeth Creek, and indirect impacts can be managed, it is unlikely 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.

All of the natural watercourses within the study area have already been modified through past disturbance through the construction and operation of road and rail infrastructure, and land use practices within the catchment. As a result, there is already a high level of exotic flora present in the riparian vegetation. The riparian vegetation at most watercourses were mapped as Miscellaneous ecosystem - highly disturbed areas (Technical paper 8). Similarly, the instream habitat has limited aquatic vegetation, with the exotic Umbrella sedge *C. erogrostis* being the dominant species. The exotic Mosquitofish *G. holbrooki* were captured at Oddies Creek, Buckaringah Creek and Jeralgambeth Creek and are likely to occur in most watercourses within the proposal site when water is present. As such, the proposal is unlikely to further substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Habitat of a threatened species, population, ecological community

(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 proposed development or activity, and

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

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

Three watercourses were identified as having potential habitat for threatened species within the study area:

1. Murray River (Murray River bridge)
2. Buckaringah Creek (Henty Yard clearances)
3. Sandy Creek (Uranquinty Yard clearances)

The proposal does not require any direct impacts to the Murray River or Buckaringah Creek and potential indirect impacts can be mitigated through appropriate erosion and sediment control. Direct impacts at Sandy Creek include the removal of 64 square metres of riparian vegetation, instream impacts to stabilising vegetation and banks and temporary obstruction of fish passage. The removal of riparian vegetation is relatively minor and would be mitigated as part of the rehabilitation strategy. The construction of the temporary crossing would use geofabric to protect the bed and banks, and coarse gravel to minimise potential impacts to water quality during rain events. Sandy Creek is not defined as sensitive KFH and DPI determined that temporary fish passage is not required for the 4 week duration of the temporary crossing. Potential indirect impacts to the creek and receiving watercourses can be managed through appropriate erosion and sediment control. As such, the proposal is unlikely to impact the extent of the habitat available for Trout Cod, Murray Crayfish, Silver Perch or Flathead Galaxias within the study area nor would the proposal result in the habitat of these species to become fragmented or isolated from other areas of habitat.

The Murray River was identified as potential habitat for Trout Cod, Murray Crayfish, Silver Perch and Flathead Galaxias, however the proposal site at the Murray River bridge was not identified as being within the indicative distribution for these species (DPI, 2016). In addition, the site has been highly modified through land use practices in the catchment and adjoining bridge and road infrastructure and the fish community status in this area has been mapped as very poor (DPI, 2016).

Buckaringah Creek was identified as potential habitat for Southern Pygmy Perch, however the site has been highly modified through land use practices in the catchment and adjoining bridge and road infrastructure and it is highly ephemeral, holding water only after rain events. This creek lacked important habitat features for Southern Pygmy Perch such as instream macrophytes and the fish community status in this area has been mapped as poor (DPI, 2016).

Sandy Creek was identified as potential habitat for Flathead Galaxias, however the site has been highly modified through land use practices in the catchment and adjoining bridge and road infrastructure and it is highly ephemeral, holding water only after rain events. This creek lacked important habitat features for Flathead Galaxias such as instream macrophytes and the fish community status in this area has been mapped as poor (DPI, 2016).

All other watercourses within the study area were considered unlikely to provide habitat for threatened species. Thus, the habitat within the study area, including sites with moderate likelihood of occurrence of threatened species (i.e. the Murray River, Buckaringah Creek and Sandy Creek) is considered as low importance for the long-term survival of threatened species and TECs in the locality.

Critical Habitat

(e) whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),

N/A

Priorities Action Statement

(f) whether the proposed development or activity is consistent with a Priorities Action Statements.

All of the threatened species considered above have priority actions statements associated with their listing. The species action statements generally include:

- Advice to consent and determining authorities
- Collate and review existing information
- Community and stakeholder liaison, awareness and education
- Compliance / enforcement
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
- Habitat rehabilitation
- Pest eradication and control
- Research / monitoring
- Stocking / translocation
- Survey / mapping

The proposal is not inconsistent with any priorities action statement for the assessed threatened species and the lowland Murray River aquatic EEC. Most recovery actions listed are not directly relevant to the proposal and relate to actions required by DPI to ensure the protection of these species and the EEC. Habitat rehabilitation is however of relevance and would be undertaken as part of a rehabilitation strategy for the area of impact (outside of the operational area) following completion of works.

Priority actions statements for each species are detailed below:

Trout Cod
Recovery actions include:

- Enhance, modify or implement NRM planning processes to minimise adverse impacts on threatened species
    - Maintain contributions to the national recovery plan (High priority).
- Community and stakeholder liaison, awareness and education
    - Increase community awareness and support of Trout Cod issues and recovery actions (Medium priority).
    - Enhance angler knowledge of and skills in Trout Cod identification, and the protected status of the species (Medium priority).
    - Improve understanding about the traditional and cultural importance of Trout Cod to indigenous communities (Low priority).
- Compliance / enforcement
    - Reduce or prevent fishing induced mortality (High priority).
- Habitat rehabilitation
    - Ensure that the risk of degradation of Trout Cod habitat is minimised (High priority).
    - Investigate options and implement measures that provide increased protection and rehabilitation opportunities for key areas of Trout Cod habitat (High priority).
    - Investigate options and implement measures that provide increased protection and rehabilitation opportunities for key areas of Trout Cod habitat (Medium priority).
- Research / monitoring
    - Monitor Trout Cod populations and contribute to research requirements in conjunction with other agencies (Medium priority).

- Stocking / translocation
    - Minimise the risk of impacts associated with stocked, translocated and introduced species on Trout Cod (High priority).
    - Maintain genetic management protocols for the Trout Cod conservation stocking program (High priority).
    - Enhance the strategic conservation stocking program (Medium priority).
    - *(NB: the PAS actions for Trout Cod are taken from the approved NSW recovery plan for the species).

Murray Crayfish

- Advice to consent and determining authorities
    - Provide information on the distribution of the Murray Crayfish to local councils and determining authorities to ensure appropriate consideration during development assessment processes (Medium priority).
- Collate and review existing information
    - Compile existing information on Murray Crayfish and identify knowledge gaps for the purpose of targeting future research activities (High priority).
    - Collate data on the historical distribution of Murray Crayfish including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
    - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Murray Crayfish (High priority).
    - Educate fishers about the open and closed Murray Crayfish fishing seasons and locations as well as bag and size restrictions (High priority).
    - Implement education initiatives to improve awareness of the status of the Murray Crayfish and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Medium priority).
    - Encourage community reporting of Murray Crayfish via the NSW DPI Threatened and Pest Species Sightings Program online form (Low priority).
    - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Murray Crayfish (Low priority).
- Compliance / enforcement
    - Maximise compliance activities at identified important sites (High priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
    - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Murray Crayfish habitats and water quality (High priority).
    - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Murray Crayfish habitats in NSW (Medium priority).
- Habitat rehabilitation
    - Undertake work to identify, restore and protect known and potential Murray Crayfish habitats and address key threats such as habitat degradation and water quality decline (High priority).
    - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns (High priority).
    - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority).

    - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Murray Crayfish populations (High priority).
- Pest eradication and control
    - Investigate and implement integrated management of introduced species in and adjacent to identified Murray Crayfish habitats and take action to prevent the spread of introduced species into these habitats (High priority).
- Research / monitoring
    - Conduct research on the biology and ecology of Murray Crayfish, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority).
    - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Murray Crayfish (High priority).
    - Actively seek grants or investor partnerships to fund research and monitoring programs for Murray Crayfish (High priority).
    - Monitor populations of Murray Crayfish over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority).
    - Actively encourage community involvement in aspects of Murray Crayfish research and monitoring programs (Low priority).
    - Undertake research into the translocation and/or captive breeding of Murray Crayfish (Low priority).
    - Obtain and analyse genetic material from remnant populations of Murray Crayfish to identify genetic units to inform conservation breeding or translocation (Low priority).
- Stocking / translocation
    - Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Murray Crayfish populations (High priority).
    - Identify potential candidate sites for possible future translocation of Murray Crayfish (Low priority).
    - Undertake emergency rescues of Murray Crayfish in response to droughts, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid imminent impacts in accordance with the emergency response policy (Low priority).
    - Review and assess the potential of artificial refuge areas for the protection of Murray Crayfish (Low priority).
- Survey / mapping
    - Conduct targeted surveys to determine the current distribution and abundance of Murray Crayfish (High priority).
    - Collect data on the presence/absence of Murray Crayfish during incidental surveys (Medium priority).

Silver Perch

- Advice to consent and determining authorities
    - Provide other relevant information to support appropriate planning and impact assessment (e.g. Environmental Impact Assessment Guidelines) (Medium priority).
    - Negotiate with local councils and industry groups regarding the type and scale of development near key areas known to support significant remnant populations of Silver Perch (Medium priority).

- Community and stakeholder liaison, awareness and education
    - Ensure that councils, government agencies and other relevant organisations are aware of the location of important areas for Silver Perch, for example by providing maps of known and potential habitat and the location of significant barriers (High priority).
    - Ensure that the Threatened, Protected and Pest Species Sighting Program is widely promoted throughout the NSW section of the Murray-Darling Basin, and encourage reporting of any sightings of Silver Perch in rivers (Medium priority).
    - Produce and distribute information brochures (e.g. Primefacts) and other advisory materials to angling groups and other stakeholders, and make them available in NSW DPI offices and at appropriate functions (e.g. expos, public meetings) (Medium priority).
    - Develop appropriate advisory materials (e.g. Primefacts) (Medium priority).
    - Produce information and materials for use by Fishcare volunteers (Low priority).
    - Encourage and support the involvement of indigenous communities in implementing Silver Perch recovery actions (Low priority).
    - Incorporate information on the threatened status of Silver Perch, and the steps that should be taken to reduce impacts on wild populations, in aquaculture advisory programs (Low priority).
- Compliance / enforcement
    - Improve recreational fishers' compliance with fishing regulations in priority Silver Perch areas (Medium priority).
    - Review the available evidence on impacts of fishing on Silver Perch and the current regulations to determine the need for any changes, e.g. a seasonal closure to protect spawning populations and/or restrictions on certain gear types (Medium priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
    - In consultation with aquatic ecologists, develop guidelines and principles to help determine the ecological needs of Silver Perch and flow levels required to complete their lifecycle, and distribute this information to water management committees and other relevant agencies (High priority).
    - Encourage the development of a dedicated NSW Cold Water Pollution Reduction Program, including a program of works and funding options, for whole-of-government endorsement and action. Investigate the contribution of smaller impoundments (e.g. weir pools) to reductions in river temperatures, and low-cost options for their management (Medium priority).
    - Negotiate with relevant authorities to encourage identification, assessment and modification of natural resource management plans and policies to minimise impacts on stream flows, connectivity of habitats, riparian vegetation and water quality (Medium priority).
    - Continue to implement the NSW Indigenous Fisheries Strategy (Low priority).
- Habitat rehabilitation
    - Continue to work on restoring fish passage in the Murray-Darling Basin, for example through the Weir Review Program, Aquatic Habitat Rehabilitation Program and MDBC 'Lake Hume to the Sea' project (High priority).
    - Identify the most significant barriers to migration of Silver Perch on a Statewide basis and seek funding for capital works to provide fish passage at these sites (High priority).

    - Work with councils and relevant government agencies to mitigate the effects of other barriers to fish passage (e.g. roads and culverts) (High priority).
    - Continue to advocate (e.g. through environmental flows reference groups) increased allocation and improved management of environmental flows, particularly in areas known to support remnant natural populations and at critical phases of the life cycle, and reduced diversion volumes during the spawning and larval period (Medium priority).
    - Encourage the development of a strategy for the Murray-Darling Basin to address the need for variable level off-takes or alternative options for large dams where thermal pollution is a problem, including a priority list (Medium priority).
    - Encourage community groups, relevant natural resource management agencies, local councils and landholders to protect and rehabilitate riparian vegetation and instream habitats along key river stretches where remnant Silver Perch populations are known to occur (Medium priority).
- Research / monitoring
    - Develop a sampling protocol and conduct targeted sampling to identify the location of remaining natural populations of Silver Perch ensuring that genetic samples (fin clips) are collected from any captured Silver Perch (High priority).
    - In collaboration with a university or other research institution, initiate a project (or projects) to investigate key areas of the biology and ecology of Silver Perch to provide information critical to the recovery program (e.g. migration, habitat requirements, factors critical to successful spawning and recruitment, interactions with introduced species, and environmental tolerances). They may include encouraging university students (honours or postgraduate) to undertake relevant projects (High priority).
    - Conduct research to determine the status of identified remnant populations (High priority).
    - Continue to collect and collate data on Silver Perch using fishways such as that at Torrumbarry Weir (Medium priority).
    - In collaboration with a university or other research institution, initiate a project to determine population genetic variation of Silver Perch in NSW (Medium priority).
    - If possible, establish the origin (wild vs stocked) of identified remnant populations in rivers (Medium priority).
    - Ensure priority is given to research in areas where relatively large, natural populations currently exist, to enable identification of key features of these environments (e.g. key components of flow regimes) and the species' habitat requirements, including use of floodplain habitats (Medium priority).
    - In collaboration with a university or other research institution, initiate a project to investigate the occurrence of EHNV and other disease agents in wild populations of Silver Perch, and assess their potential impacts (Medium priority).
    - Conduct research to determine the cumulative impacts of stocking on wild populations (Medium priority).
    - Use the Sustainable Rivers Audit as a long term monitoring program to assess the ongoing status of Silver Perch in the Murray-Darling Basin (Medium priority).
    - Complement Sustainable Rivers Audit monitoring with targeted monitoring and survey of the status of remnant wild populations and re-established

populations resulting from conservation-stocking programs (Medium priority).
    - Investigate the contribution of smaller impoundments (e.g. weir pools) to reductions in river temperatures, and low-cost options for their management (Low priority).
- Stocking / translocation
    - Implement appropriate controls on Silver Perch farms at the development application stage to minimise the risk of fish escaping into the wild (High priority).
    - Improve management of genetic stocks through the Hatchery Quality Assurance Program to ensure use of appropriate broodstock and tracking of sale of different genetic stocks (Medium priority).
    - Develop and implement approvals processes for Silver Perch hatcheries that recognise different requirements and standards for production for aquaculture as opposed to stocking into the environment (Medium priority).
    - Review and assess stocking proposals to ensure no significant impacts on wild Silver Perch populations (Medium priority).
    - Review genetics information to ensure genetically appropriate broodstock are collected to form the basis of a conservation-stocking program (Medium priority).
    - Identify and assess appropriate conservation-stocking sites in accordance with stocking review guidelines in the NSW Freshwater Fish Stocking Fishery Management Strategy and having regard to the habitat requirements of the species and the requirements of this recovery plan (Medium priority).
- Survey / mapping
    - Compile existing records of Silver Perch (both scientific and anecdotal) and map the species' current known distribution in NSW (High priority).
    - Continue to collate data on the presence / absence of Silver Perch collected during incidental and formal surveys including the Sustainable Rivers Audit (High priority).
    - Incorporate any information obtained from the public into the species database, available via the web, and use it to assist in mapping the current distribution of Silver Perch (Low priority).

Flathead Galaxias

- Advice to consent and determining authorities
    - Provide information on the distribution of the Flathead Galaxias to local councils and determining authorities to ensure appropriate consideration during development assessment processes (High priority).
- Collate and review existing information
    - Compile existing information on Flathead Galaxias and identify knowledge gaps for the purpose of targeting future research activities (High priority).
    - Collate data on the historical distribution of Flathead Galaxias including anecdotal and indigenous knowledge (Medium priority).
- Community and stakeholder liaison, awareness and education
    - Encourage community reporting of Flathead Galaxias sightings via the NSW DPI Threatened and Pest Species Sightings Program online form (Low priority).
    - Implement education initiatives to improve awareness of the status of the Flathead Galaxias and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Low priority).
    - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Flathead Galaxias (Low priority).

    - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Flathead Galaxias (Low priority).
- Compliance / enforcement
    - Maximise compliance activities at identified important sites (Low priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
    - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Flathead Galaxias habitats and water quality (High priority).
    - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Flathead Galaxias habitats in NSW (Medium priority).
- Habitat protection
    - Review and assess the potential of artificial refuge areas for the protection of Flathead Galaxias (High priority).
- Habitat rehabilitation
    - Undertake work to identify, restore and protect known and potential Flathead Galaxias habitats and address key threats such as habitat degradation (High priority).
    - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns, and to reduce the impact of cold water downstream of dams (High priority).
    - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority).
    - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Flathead Galaxias populations (High priority).
- Pest eradication and control
    - Investigate and implement integrated management of introduced species in and adjacent to identified Flathead Galaxias habitats and take action to prevent the spread of introduced species into these habitats (Medium priority).
- Research / monitoring
    - Conduct research on the biology and ecology of Flathead Galaxias, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority).
    - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Flathead Galaxias (High priority).
    - Actively seek grants or investor partnerships to fund research and monitoring programs for Flathead Galaxias (High priority).
    - Monitor Flathead Galaxias population over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority).
    - Conduct targeted sampling at stocked sites to assess the status of stocked populations including growth and recruitment rates (Medium priority).

    - Collect habitat and environmental information at remnant extant populations in Victoria to determine habitat preferences to assist in identifying remnant NSW populations (Medium priority).
    - Actively encourage community involvement in aspects of Flathead Galaxias research and monitoring programs (Low priority).
    - Obtain and analyse genetic material from remnant populations of Flathead Galaxias to identify genetic units to inform conservation breeding or translocation (Low priority).
    - Conduct research to evaluate the effectiveness of translocation of adult fish compared to stocking of juveniles to inform future conservation actions (Low priority).
- Stocking / translocation
    - Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Flathead Galaxias populations (High priority).
    - Develop an emergency response policy to guide the collection and captive husbandry of Flathead Galaxias. The policy should address the circumstances in which wild individuals may be collected, held and re-released, and identify holding facilities, potential funding sources and legal requirements (Medium priority).
    - Identify potential candidate sites for possible future translocation of Flathead Galaxias (Medium priority).
- Survey / mapping
    - Collect data on the presence/absence of Flathead Galaxias during incidental surveys (High priority).
    - Conduct targeted surveys to determine the current distribution and abundance of Flathead Galaxias (High priority).

Southern Pygmy Perch

- Advice to consent and determining authorities
    - Provide information on the distribution of the Southern Pygmy Perch to local councils and determining authorities to ensure appropriate consideration during development assessment processes (High priority).
- Collate and review existing information
    - Compile existing information on Southern Pygmy Perch and identify knowledge gaps for the purpose of targeting future research activities (Medium priority).
    - Collate data on the historical distribution of Southern Pygmy Perch including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
    - Encourage community reporting of Southern Pygmy Perch via the NSW DPI Threatened and Pest Species Sightings Program online form (Medium priority).
    - Implement education initiatives to improve awareness of the status of the Southern Pygmy Perch and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Medium priority).
    - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Southern Pygmy Perch (Medium priority).
    - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Southern Pygmy Perch (Low priority).
- Compliance / enforcement
    - Maximise compliance activities at identified important sites (Low priority).

- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
    - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Southern Pygmy Perch habitats and water quality (High priority).
    - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Southern Pygmy Perch habitats in NSW (Medium priority).
- Habitat rehabilitation
    - Undertake work to identify, restore and protect known and potential Southern Pygmy Perch habitats and address key threats such as habitat degradation and water quality decline from expanding development (High priority).
    - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns, and to reduce the impact of cold water downstream of dams (High priority).
    - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority).
    - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Southern Pygmy Perch populations (High priority).
- Pest eradication and control
    - Investigate and implement integrated management of introduced species in and adjacent to identified Southern Pygmy Perch habitats and take action to prevent the spread of introduced species into these habitats (High priority).
- Research / monitoring
    - Conduct research on the biology and ecology of Southern Pygmy Perch, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority).
    - Actively encourage community involvement in aspects of Southern Pygmy Perch research and monitoring programs (Medium priority).
    - Monitor Southern Pygmy Perch population over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority).
    - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Southern Pygmy Perch (Medium priority).
    - Actively seek grants or investor partnerships to fund research and monitoring programs for Southern Pygmy Perch (Medium priority).
    - Obtain and analyse genetic material from remnant populations of Southern Pygmy Perch to identify genetic units to inform conservation breeding or translocation (Medium priority).
- Stocking / translocation
    - Maintain and monitor translocated populations (High priority).
    - Develop an emergency response policy to guide the collection and captive husbandry of Southern Pygmy Perch. The policy should address the circumstances in which wild individuals may be collected, held and re-

released, and identify holding facilities, potential funding sources and legal requirements (Medium priority).
    - Identify potential candidate sites for possible future translocation of Southern Pygmy Perch (Medium priority).
    - Undertake emergency rescues of Southern Pygmy Perch in response to droughts, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid imminent impacts in accordance with the emergency response policy (Medium priority).
    - Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Southern Pygmy Perch populations (Medium priority).
    - Review and assess the potential of artificial refuge areas for the protection of Southern Pygmy Perch (Low priority).
- Survey / mapping
    - Conduct targeted surveys to determine the current distribution and abundance of Southern Pygmy Perch (High priority).
    - Collect data on the presence/absence of Southern Pygmy Perch during incidental surveys (High priority).
    - Conduct targeted sampling at stocked sites to assess the status of stocked populations including growth and recruitment rates (Medium priority).

Lower Murray ecological community

- Advice to consent and determining authorities
    - Provide local councils, government agencies and Local Land Service's (LLS's) with resource materials and training regarding habitat protection and threatened species provisions of the NSW Fisheries Management Act 1994 to support planning, determination, impact assessment and concurrence decision making processes. This may include impact assessment guidelines, mitigating prescriptions, offsets, and generic consent conditions (Medium priority).
    - Distribute guidelines regarding flow requirements of key characteristic species to relevant Natural Resource Management (NRM) agencies (Medium priority).
- Collate and review existing information
    - Compile existing records of characteristic native species occupying the Endangered Ecological Community (EEC) and map their current known distribution **(Medium priority)**.
- Community and stakeholder liaison, awareness and education
    - Develop and disseminate advisory materials on priority issues relevant to the recovery of the EEC **(Medium priority)**.
    - Actively encourage community involvement in aspects of the recovery of the EEC including for example, research, reporting, monitoring and management activities **(Medium priority)**.
    - Encourage community reporting of key species through the Protected, Threatened and Pest Species Sighting Sheet Program **(Low priority)**.
- Compliance / enforcement
    - Identify and implement measures to improve the reporting of illegal activities and enhance feedback to stakeholders (such as anglers) on actions taken **(Medium priority)**.

  - Implement and enforce relevant fishing regulations (e.g. seasonal closures, bag and size limits, gear restrictions etc.) **(High priority)**.
  - Undertake and continue targeted enforcement activities by regional Fisheries Officers **(High priority)**.

- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
  - Ensure information on the location of characteristic native species within the EEC is considered in state and national management programs for introduced species and diseases **(Medium priority)**.

- Habitat protection
  - Review regulatory and voluntary incentive based mechanisms available in the EEC to enhance protection for key habitat areas and apply as required. This may include the use of critical habitat provisions, aquatic reserves, environmentally sensitive land provisions, voluntary conservation agreements etc. **(Medium priority)**.

- Habitat rehabilitation
  - Advocate appropriate allocation and improved management of environmental flows, particularly in areas known to support remnant natural populations of threatened species and reduced diversion volumes during the spawning and larval period **(High priority)**.
  - Improve fish passage at major regulating structures through existing programs **(High priority)**.
  - Identify and prioritise the most significant barriers to fish passage within the geographic area of the EEC having regard to relevant existing programs **(Medium priority)**.
  - Work with LLS's to encourage implementation of relevant aquatic habitat rehabilitation / threatened species actions outlines in catchment action plans **(Medium priority)**.
  - Determine key threatening processes within each zone and prioritise zones for action according to management capability, ecological function and threatened species considerations **(Medium priority)**.
  - Work with local councils and relevant government agencies to mitigate the impacts of cold water pollution within the EEC **(Medium priority)**.
  - Develop a NSW Cold Water Pollution Program including a program of works and funding options **(Medium priority)**.
  - Support and assist community groups, NRM authorities, local councils and landholders to protect and rehabilitate riparian vegetation and instream habitats along key river reaches where populations of threatened species are known to occur **(Medium priority)**.
  - Develop new projects in consultation with community groups, relevant natural resource management agencies, local councils and landholders to address key water quality issues within the EEC (e.g. sedimentation, algal blooms, salinity, and agricultural chemicals) **(Medium priority)**.

- Pest eradication and control
  - Assess information on current management techniques for pest species and their application in the EEC **(Medium priority)**.

  - Reduce the risk of disease and pest species introduction from aquaculture operations by ensuring compliance with the Hatchery Quality Assurance Program and appropriate grow-out facility permit conditions **(Medium priority)**.
  - Monitor populations of introduced fish species at key sites and undertake eradication and/or control programs where appropriate **(Medium priority)**.
- Research / monitoring
  - Develop and implement a targeted investigation program to quantify the distribution and abundance of native species in the EEC, focusing on threatened species and populations. The investigation program should form the basis for monitoring over time **(High priority)**.
  - Develop and implement research projects investigating key areas of the biology and ecology of characteristic native species within the EEC to inform the recovery program. Projects are to include for example, investigation into flow requirements, taxonomic status, levels of genetic diversity, migration, habitat requirements, factors critical to the successful spawning and recruitment, interactions between trophic guilds, interactions with introduced species and environmental tolerances **(High priority)**.
  - Develop guidelines and principles to help determine the ecological needs of key characteristic species within the EEC and the flow levels required to complete their lifecycle **(High priority)**.
  - Develop and implement a research program to investigate the impacts of introduced species and diseases that affect native species occupying the EEC, and assess their potential impacts **(High priority)**.
  - Investigate available evidence on the impacts of commercial and recreational fishing activities on key native species in the EEC **(High priority)**.
  - Develop reference criteria for each river management zone to allow meaningful insights into ecological condition and changes over time to be made **(High priority)**.
  - Review the available evidence on the impacts of fishing activities on characteristic native species within the EEC, and the current fishing regulations to determine the need for changes **(High priority)**.
  - Disseminate results from investigation and research activities to inform recovery and threat abatement efforts for threatened species and populations in the EEC **(Medium priority)**.
  - Investigate the contribution of smaller impoundments (e.g. weir pools) to reductions in river temperatures, and low-cost options for their management **(Medium priority)**.
  - Identify the characteristic native species likely to be sensitive to cold water pollution and the extent of instream habitat affected **(Medium priority)**.
  - Design and implement targeted monitoring programs linked to river management zones to enable the effectiveness of recovery actions to be evaluated **(Medium priority)**.
  - Identify opportunities for collaboration on monitoring and evaluation activities in the EEC **(Medium priority)**.
  - Investigate the impacts of water diversion on fish larvae **(Low priority)**.

- Stocking / translocation
    - Implement the NSW Hatchery Quality Assurance Program and the NSW Freshwater Fish Stocking Fishery Management Strategy to ensure that harvest and conservation stocking activities are carried out in a manner that will not adversely impact wild populations of native fish **(High priority)**.
    - Where appropriate enhance and/or initiate conservation stocking programs for threatened species within the ECC **(Medium priority)**.
- Survey / mapping
    - Develop mapping products for stakeholders regarding the distribution and abundance of native species in the EEC to assist in targeting habitat rehabilitation projects **(High priority)**.
    - Establish a system of distinct river management zones for the EEC, consistent with other strategies and plans (where possible), in conjunction with stakeholders including LLS's and natural resource management agencies **(Medium priority)**

Key threatening Process

(g) whether the proposed development 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 following KTPs are listed under the FM Act:

- Degradation of native riparian vegetation along New South Wales water courses
- Hook and line fishing in areas important for the survival of threatened fish species
- Human-caused climate change
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Introduction of fish to waters within a river catchment outside their natural range
- Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales
- Removal of large woody debris from New South Wales rivers and streams
- The current shark meshing program in New South Wales waters

Of these eight KTPs, only three are of relevance to the proposal:

- Degradation of native riparian vegetation along New South Wales water courses
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Removal of large woody debris from New South Wales rivers and streams

The proposal is modifying or replacing exiting bridges and culverts however it does not change the style of instream structure from what currently exists. As such, the proposal does not contribute further to the ‘installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams’. All bridges and culverts would be designed in accordance DPI fish passage guidelines (Fairfull and Witheride, 2003).

Similarly, as the proposal does not require instream works at sites identified as having large snags (Murray River, Oddies Creek and Buckaringah Creek), it is unlikely to contribute to ‘removal of large woody debris from NSW rivers and streams’.

Thus, the ‘degradation of native riparian vegetation along New South Wales water courses’ is the only KTP that would be impacted by the proposal.

Riparian vegetation degradation along NSW watercourses has been listed as a KTP because of its negative impacts on many threatened species, populations and ecological communities.

Compounds and stockpile sites would be located an appropriate distance from riparian habitat to avoid indirect impacts on aquatic habitat and direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable. Following completion of works, disturbed areas outside of the operation area would be restored in accordance with a rehabilitation strategy. As such, the proposal is unlikely to significantly contribute to this KTP.

TECHNICAL PAPER 09

Aquatic biodiversity impact assessment

Appendix F Assessment of significance (EPBC Act)

ALBURY TO ILLABO ENVIRONMENTAL IMPACT STATEMENT

Appendix F. Assessment of significance (EPBC Act)

Under the EPBC Act, the approval of the Minister is required for any action that may have a significant impact on MNES. Four aquatic species were identified as likely or possible to occur within the study area (Appendix D):

1. Silver Perch (*Bidyanus bidyanus)* CE
2. Flathead Galaxias (*Galaxias rostratu)s* CE
3. Trout Cod (*Maccullochella macquariensis)* E
4. Murray Cod (*Maccullochella peelii)* V

The impacts of the proposal on these species is assessed below against the test of significance in accordance with the EPBC Act.

Threatened species distribution and habitat requirements

Silver Perch
Silver Perch is listed as Critically Endangered under the EPBC Act (DAWE, 2013)

Silver Perch, are a moderate to large freshwater fish native to the Murray-Darling river system. They were once widespread and abundant throughout most of this area, except for cooler high altitude streams. However, they have now declined to low numbers or disappeared from most of their former range.

Silver Perch have been 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. They are omnivorous, feeding on a variety of small prey including aquatic insects, molluscs, worms, crustaceans, zooplankton and algae. Males reach sexual maturity at three years of age, when around 25 cm in length, and females at four to five years, when around 29 cm. Adult Silver Perch can move large distances, often associated with spawning activity in spring and summer. Juveniles disperse over large distances, and are often seen at fishways travelling upstream in large schools. Females can lay 300,000 or more non-adhesive, floating eggs that are about 2.7 mm in diameter. They are mostly released in one spawning, and hatch after approximately 30 hours. Eggs and larvae passively drift with the river current for a number of days.

Flathead Galaxias
Flathead Galaxias is listed as Critically Endangered under the EPBC Act (DAWE, 2016)

Flathead Galaxias is endemic to the southern tributaries of the Murray-Darling River system; the Murray, Murrumbidgee and Lachlan Rivers and their tributaries and the upper Macquarie River catchment.

Flathead Galaxias has experienced significant declines in distribution and abundance in all river systems in NSW. Extensive scientific sampling over the last two decades has recorded extremely few specimens. The last record in the Murrumbidgee River was in 1971, and it is thought that the species may be locally extinct from the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers. In addition, only very small numbers of specimens have been sampled from wetlands of the Murray River floodplain between Hume Dam and Lake Mulwala and the upper Murray River near Tintaldra.

Flathead Galaxias is generally found mid-water in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation. Flathead Galaxias feeds predominately on aquatic insects and crustaceans. Spawning occurs in spring, when water temperatures are above 10.5°C. The species produces 2000-7000 transparent, slightly adhesive demersal eggs, with fecundity increasing with length of fish. The eggs hatch after 9 days at temperatures between 9-14°C. Fry are 6-8 mm long after hatching. Individuals probably mature in their first year (approximately 80 mm long).

Trout Cod
Trout Cod is listed as Endangered under the EPBC Act (DAWE, 2020).

Trout Cod were once widespread throughout the southern tributaries of the Murray-Darling system, including tributaries of the Murray River in Victoria, the Murrumbidgee (including upland tributaries in the ACT), and the upper half of the Macquarie River. In 1971, the species was extremely rare upstream of the Murray River at Yarrawonga, where it has been common 20 years before. Except for the first officially reported Trout Cod and one other unconfirmed report, there have been no further documented reports of Trout Cod occurring naturally in the Macquarie River system. Trout Cod have never been recorded in the Lachlan River, however they must have occurred historically in this system as their distribution includes both neighbouring rivers to the north and south.

The Trout Cod is known from a single natural population, two stable translocated populations and many stocked populations. All stocked sites require continued stocking and there is only limited evidence that some stocked populations are self-sustaining.

The natural distribution of Trout Cod has declined since European settlement. The single naturally occurring population is restricted to a small (approximately 120 kilometres) stretch of the Murray River from below Yarrawonga Weir to Strathmerton but is occasionally taken downstream as far as the Barmah State Forest and further downstream to Gunbower. Unconfirmed records have also been made further downstream from near Murrabit, Swan Hill and near Tooleybuc.

Since the mid-1980s both the NSW Department of Primary Industries (DPI) and the Victorian DPI have been operating a breeding and conservation stocking program for the Trout Cod. This program has resulted in Trout Cod being stocked at numerous sites throughout their former distribution in the Murray-Darling River system of Victoria, New South Wales and the Australian Capital Territory. Between 1986 and 2005, over one million Trout Cod were released as fingerlings or juveniles into a range of selected sites .

Stocking sites include the Murray, Murrumbidgee, Macquarie and Abercrombie River catchments in NSW; the Goulburn, Ovens, Broken, Coliban and Mitta Mitta River catchments in Victoria; and the Murrumbidgee River catchment in the Australian Capital Territory.

In NSW, stocked populations occur in the upper Murray River above the Hume Dam, upper Murrumbidgee River between Adaminaby and Murrells Crossing, near Cooma, middle sections of the Murrumbidgee River from Burrinjuck to Yanco Weir, the Macquarie River near Dubbo and Talbingo Dam in the Kosciusko National Park. The primary stocking sites in NSW include Angle Crossing, Wantabadgery, Collingullie, Narrandera and Yanco in the Murrumbidgee River system and Namina Falls and Devils Elbow in the Macquarie River System. To date, recruitment of stocked populations has been detected in the Murrumbidgee River at Angle Crossing and Narrandera.

Recent research in the Murray and Murrumbidgee Rivers show that Trout Cod occupy stream positions characterised by a high abundance of large woody debris (or 'snags') in water that is comparatively deep and close to riverbanks. However, midstream snags are also an important habitat component.

Murray Cod
Murray Cod is listed as Vulnerable under the EPBC Act (DAWE, 2003)

The Murray Cod was historically distributed throughout the Murray-Darling Basin, the Australian Capital Territory (ACT) and Victoria to South Australia, with the exception of the upper reaches of some tributaries. The species still occurs in most parts of this natural distribution (the species' distribution) up to approximately 1000 metres above sea level). The Basin contains approximately 13,245 kilometres of waterways that may encompass areas

of suitable habitat for the Murray Cod. The species' estimated extent of occurrence, based on areas with an average river width of 50m, is 660 square kilometres.

The distribution of the Murray Cod occurs in the following bioregions according to the Interim Biogeographic Regionalisation for Australia (IBRA7) (DSEWPaC 2012ae): Murray-Darling Depression, Riverina, NSW South Western Slopes, South Eastern Highlands, Cobar Peneplain, Darling Riverine Plains, Brigalow Belt South and Nandewar.

There have been numerous attempts to translocate hatchery-bred and wild-caught Murray Cod by government authorities, acclimatisation societies and private individuals outside the species' natural range. Many introduced populations persisted for several years though few self-sustaining populations have been established.

Introduced populations persist in some waterways, impoundments or artificial lakes in Queensland, NSW, the ACT, Victoria, South Australia and Western Australia. In NSW, introduced populations persist in Cataract Dam and the Nepean River system.

The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs.

Murray Cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Murray Cod tend to occur in floodplain channels and anabranches when they are inundated, but the species' use of these floodplain habitats appears limited. Juveniles less than one year old have been found in main river channels where it appears they settle at a late larval (newly born) stage.

Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water. They also serve as predatory ambush points for foraging, particularly during the day.

Riparian vegetation, for example River Red Gum (*Eucalyptus camaldulensis*) woodland in the lowland river systems of the Murray-Darling Basin, not only provides an ongoing supply of structural habitat for the Murray Cod in the form of coarse woody debris or snags, but aids stream bank stability and protects riparian soils from water and wind erosion.

Critically Endangered/Endangered Species

Relevant species include:

1. Silver Perch (*B. bidyanus)* CE
2. Flathead Galaxias (*G. rostratus)* CE
3. Trout Cod (*M. macquariensis)* E

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it would:

lead to a long-term decrease in the size of a population

Silver Perch and Trout Cod were considered likely to occur and Flathead Galaxias was considered possible to occur within the Murray River and Sandy Creek (Appendix D) based on previous records of these species (ALA, 2021). However, the habitat in the Murray River at the bridge location is considered sub-optimal as it lacks preferred habitat features such as faster flowing waters preferred by Silver Perch, an abundance of woody debris which is preferred habitat for Trout Cod and aquatic vegetation in small streams which is the preferred habitat for Flathead Galaxias. Similarly, the habitat at Sandy Creek was sub-optimal for Flathead Galaxias as the creek was dry at the time of survey and while there

were some sparse emergent, mainly exotic macrophytes, there were no submerged or floating macrophytes, which are important habitat requirements of this species. In addition, the banks, instream habit and broader catchment at both the Murray River and Sandy Creek has been highly modified though adjoining land-use and infrastructure. Thus, the study area is not considered to provide important habitat for these three species.

The proposal requires temporary instream works and minor removal of riparian habitat at Sandy Creek however the impacts are short term and relatively minor. No other habitat suitable for these species within the study area would be directly impacted. There is potential for indirect impacts to the Murray River and Sandy Creek through the mobilisation of sediments and other contaminants via wind and stormwater run-off during construction and operation phases of the proposal however these would be managed appropriately. As such, impacts from the proposal are considered to be minor, and the proposal is unlikely to lead to a decrease in the size of a population of these three species in the locality.

reduce the area of occupancy of the species

Due to the absence of preferred habitat features and past modifications to the habitat at the Murray River bridge and Sandy Creek, these sites are not considered important habitat for Silver Perch, Flathead Galaxias or Trout Cod. As the proposal would have relatively minor impacts on the aquatic environment, it is considered unlikely to result in a reduction in the area of occupancy for these species.

fragment an existing population into two or more populations

There are no known populations of Silver Perch, Flathead Galaxias or Trout Cod occurring in the study area and previous nearby records of these species are from greater than 10 years ago. Therefore, the proposal is unlikely to fragment an existing population of these species.

adversely affect habitat critical to the survival of a species

The study area has not been identified as habitat critical to the survival of Silver Perch, Flathead Galaxias or Trout Cod.

disrupt the breeding cycle of a population

No aquatic habitat potentially impacted within the study area has been identified as having important breeding habitat for Silver Perch, Flathead Galaxias or Trout Cod as it lacks important habitat features for these species such as snags and macrophytes. In addition, the Murray River at the proposal site has been mapped as very poor fish community status (DPI, 2016). As such, the proposal is unlikely to disrupt the breeding cycle of a population of these species.

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

Riparian vegetation not only provides bank stability, but the roots also provide habitat in bank overhangs and undercuts. The proposal would result in only minor impact to riparian vegetation. Potential indirect impacts through the mobilisation of sediments and other contaminants via wind and stormwater run-off during construction and operation phases of the proposal would be managed appropriately and are unlikely result in a decline in quality habitat to the extent that Silver Perch, Flathead Galaxias and Trout Cod are likely to decline.

result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The study area has a history of past disturbance and a subsequent high level of weed invasion in the riparian vegetation. The proposal is unlikely to exacerbate the existing poor condition of the riparian vegetation and as there are limited instream works the proposal is unlikely to result in an increase in exotic macrophytes. The exotic Mosquitofish *G. holbrooki* were captured during surveys within the study area. This species, along with other pest species known to occur (Carp *Cyprinus carpio* and Redfin Perch *Perca fluviatilis*) are already present in the study area and the proposal is unlikely to result in additional invasive species becoming established that are harmful to Silver Perch, Flathead Galaxias or Trout Cod.

introduce disease that may cause the species to decline, or

The proposal is unlikely to result in the introduction of a harmful disease.

interfere with the recovery of the species.

The proposal would have a minor impact on riparian vegetation and potential impacts from sediment mobilisation would be managed appropriately. As such, the proposal is considered unlikely to interfere with the recovery of Silver Perch, Flathead Galaxias or Trout Cod.

Vulnerable species

Relevant species include:

1. Murray Cod (*Maccullochella peelii)* V

Under the meaning of the Act, an "important" population is one that is necessary for a species' long-term survival and recovery and may include key source populations for breeding and dispersal, populations necessary for maintaining genetic diversity and populations near the limit of the species range.

While there are past records of Murray Cod in the Murray River, and there is suitable habitat available for the Murray Cod within the proposal site at the Murray River bridge, there have been no records (ALA, 2021) of this species within the past 10 years (within a 5 kilometres radius of the Murray River bridge). In addition, the Murray River bridge is not within the indicative distribution of this species. Thus, it is considered unlikely that the proposal site at the Murray River bridge provides important habitat for this species or that the site supports an "important" population of this species. As such, the proposal is considered unlikely to have a significant impact on the Murray Cod as it would not:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline, or
- interfere substantially with the recovery of the species.

TECHNICAL PAPER

09

Aquatic biodiversity impact assessment

Appendix G DPI correspondence

NSW GOVERNMENT | Department of Primary Industries

26 October 2021

Kristy McQueen
Terrestrial and Aquatic Ecologist
Coast Ecology
PO Box 3005
WAMBERAL NSW 2260

Dear Kirsty,

Re: Temporary crossing – Sandy Creek – Uranquinty

I refer to your email dated 22 October 2021 and the attached information. Thank you for requesting input from DPI Fisheries regarding the proposed temporary crossing over Sandy Creek at Uranquinty.

DPI Fisheries is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, DPI Fisheries ensures that developments comply with the requirements of the *Fisheries Management Act 1994* (namely the aquatic habitat protection and threatened species conservation provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*. In addition, DPI Fisheries is responsible for ensuring the sustainable management of commercial, recreational and Aboriginal cultural fishing, aquaculture and marine protected areas within NSW.

I have reviewed the proposed scope of works and am very happy to advise that the works identified will not require any offsetting and that Sandy Creek at this location does not contain suitable habitat for Flatheaded Galaxias due to the highly ephemeral and degraded nature of the creek, despite it being mapped as indicative distribution for this species.

Fish passage will not be required to be provided for the duration of the temporary crossing.

If you have any further queries, please call me on (02) 6051 7768

Yours sincerely,

L K Pearce

Luke Pearce
Fisheries Manager
Freshwater Environment
NSW Department of Primary Industries

Aquatic Habitat Protection Unit
Unit 5, 620 Macauley St ALBURY NSW 2640
Tel: (02) 6051 7768
ABN 72189 919 072-002
www.dpi.nsw.gov.au