Toorale Water Infrastructure Project – Phase 2

Review of Environmental Factors

Prepared for
NSW Department of Planning, Industry and Environment

December 2019

DOCUMENT TRACKING

Item	Detail
Project Name	Toorale Water Infrastructure Project Review of Environmental Factors
Project Number	18ARM 9568
Project Manager	Robert Cawley Phone: (02) 8081 2689 92 Taylor St, Armidale NSW 2350
Prepared by	Eliza Biggs, Mark Southwell, Linden Burch, Kate Blackwood, Ronnie Hill, Chris Wicks, Karyn McLeod, Matt Elsley, Richard Creswell.
Reviewed by	Mark Southwell, Robert Cawley
Approved by	Robert Cawley
Status	DRAFT
Version Number	1
Last saved on	24 December 2019
Cover photo	Toorale sign, 24/10/17, Tim Henderson

This report should be cited as 'Eco Logical Australia. (2019). *Toorale Water Infrastructure Project (Phase 2) Review of Environmental Factors*. Prepared for NSW Department of Planning, Industry and Environment'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from the NSW Department of Planning, Industry and Environment.

Contents

Executive Summary **13**

1 Introduction **1**
1.1 Project Overview 1
1.1.1 Toorale Water Infrastructure Project 1
1.1.2 Phase 1 1
1.1.3 Phase 2 1
1.2 The Proponent 2
1.3 Project Location 2
1.4 Land Use and Ownership 5
1.5 Water Management 5
1.5.1 Existing Water Infrastructure 5
1.5.2 Water Access, Licences and Approvals 7
1.5.3 Relevant Historical and Current Structural Arrangements and Operations 10

2 Permissibility and Justification **15**
2.1 Commonwealth legislation 15
2.1.1 Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) 15
2.1.2 Native Title Act 1993 16
2.2 State legislation and policies 17
2.2.1 Environmental Planning and Assessment Act 1979 (EP&A Act) 17
2.2.2 Environmental Planning and Assessment Regulation 2000 (EP&A Reg) 18
2.2.3 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) 18
2.2.4 National Parks and Wildlife Act 1974 (NPW Act) 20
2.2.5 Heritage Act 1977 26
2.2.6 Native Title Act 1994 26
2.2.7 Biodiversity Conservation Act 2016 (BC Act) 27
2.2.8 Rural Fires Act 1997 27
2.2.9 Fisheries Management Act 1994 (FM Act) 28
2.2.10 Water Management Act 2000 (WM Act) 29
2.2.11 Biosecurity Act 2015 29
2.2.12 Contaminated Land Management Act 1997 and Protection of the Environment Operations Act 1997 30
2.2.13 Bourke Local Environment Plan 2012 30
2.3 Summary of Licences and Approvals Required 31
2.3.1 Consistency with DPIE policy 31

3 The Proposed Phase 2 Activity 36
3.1 Project Objectives 37
3.2 Description of the Proposed Structural Modifications and Associated Activities 38
3.2.1 Boera Dam Structural Modifications 38
3.2.2 Booka Dam Structural Modifications 40
3.2.3 Homestead Dam Structural Modifications 40
3.2.4 Proposed Operating Arrangements 41
3.3 Activities Associated with Proposed Works Stages 46
3.3.1 Pre-construction 46
3.3.2 Construction 46
3.3.1 Operation and Maintenance 49
3.3.2 Future Works 49
3.3.3 Spatial Scope of Assessment 50
3.3.4 Construction works extent and construction disturbance footprint 51
3.4 Reasons for the Activity and Consideration of Alternatives with Justification 56
3.4.1 Reasons for the activity 56
3.4.2 Alternatives Considered 57
3.4.3 Justification for preferred option 59

4 Consultation 63
4.1 Consultation During Project Planning and Design 63
4.2 Consultation on Environmental Assessment Requirements 66

5 Environmental Assessment 68
5.1 Landscape, Topography, Geology and Soils 69
5.1.1 Existing environment 69
5.1.2 Potential Impacts 74
5.1.3 Mitigation measures 75
5.2 Groundwater 77
5.2.1 Existing environment 77
5.2.2 Potential impacts 82
5.2.3 Mitigation measures 83
5.3 Surface Water and Aquatic Ecology 84
5.3.1 Existing environment 84
5.3.2 Potential impacts 91
5.3.3 Mitigation measures 104
5.4 Terrestrial Ecology 105
5.4.1 Existing environment 106
5.4.2 Potential impacts 128
5.4.2.1 Boera Dam 130

5.4.2.2 Booka Dam 135
5.4.2.3 Homestead Dam 138
5.4.2.4 Warrego River downstream of Homestead Dam 142
5.4.2.5 Floodplains and the potential impacts associated with the change in hydrology 142
5.4.3 Mitigation measures 146
5.5 Social and Community Impacts 148
5.5.1 Existing environment 148
5.5.2 Potential impacts 149
5.5.3 Mitigation Measures 154
5.6 Aboriginal Cultural Heritage 156
5.6.1 Existing Environment 156
5.6.2 Potential Impacts 161
5.6.3 Mitigation Measures 162
5.7 Historic Heritage 164
5.7.1 Existing environment 164
5.7.2 Potential impacts 169
5.7.3 Mitigation measures 173
5.8 Waste and Resource Use 174
5.8.1 Existing Environment 174
5.8.2 Potential impacts 174
5.8.3 Mitigation measures 175

6 Environmental Management 176
6.1 Residual environmental risk and impacts 176
6.2 Key risks 176
6.3 Environmental Controls and Residual Risk 178

7 Ecologically Sustainable Development 191

8 Conclusion 193

References 198

List of figures

Figure 1-1: Regional setting 3

Figure 1-2: Toorale National Park and State Conservation Area (OEH,2019) 4

Figure 1-3: Existing water infrastructure and distance (km) between each 6

Figure 1-4: Existing conditions at Boera Dam. Platforms lead to the gates that can be opened to pass water through the dam and downstream into the Warrego River. 11

Figure 1-5: Existing conditions at Booka Dam. Two pipes pass water through the dam and downstream into the Warrego River. 12

Figure 1-6: Existing conditions Homestead Dam 13

Figure 1-7: Current management strategy for environmental water at Toorale (CEWHCEWH, 2013) ... 14

Figure 3-1: Arrangement for the proposed lay flat gate at Boera Dam 39

Figure 3-2: Boera Dam construction disturbance footprint 53

Figure 3-3: Booka Dam construction disturbance footprint 54

Figure 3-4: Homestead Dam construction disturbance footprint 55

Figure 5-1: Land systems 70

Figure 5-2: Regional groundwater sources in the vicinity of Toorale 79

Figure 5-3: Groundwater source regions and groundwater dependent ecosystems (WaterNSW, 2019; BoM, 2017c). 81

Figure 5-4: Boera Dam western and eastern bywashes 86

Figure 5-5: Breach in the eastern embankment allowing floodplain water to return to the Warrego River. Date: 15 May 2019 87

Figure 5-6: Water levels in Boera and Dicks Dams compared to the operation of Boera regulating gates. 88

Figure 5-7: The distribution of Warrego River flows to Barwon-Darling inflows. (MDBA, 2016) 88

Figure 5-8: Comparison between current full supply level and the proposed full supply level of Booka Dam (Alluvium, 2016) 94

Figure 5-9: Flow duration curve for the Western Bywash (Alluvium, 2019a) 96

Figure 5-10: Inundation Frequency on Toorale showing the six dams: (1) Boera, (2) 12 Mile, (3) Booka, (4) Keernie, (5) Dicks, (6) Peebles; (7) the Ross Billabong Storage; (8) the Western Embankment and the downstream properties of Uteara and Talowla. Area partitioned into subsections (dotted lines) (A) Toorale Western Floodplain, (B) Toorale East, (C) Uteara Western Floodplain (D) Talowla Western Floodplain (From Cox *et al*., 2012) 98

Figure 5-11: Comparison of several flow events modelled base case and operating strategy scenarios measured as flows to the Western Floodplain. 99

Figure 5-12: Vegetation Communities in Toorale 109

Figure 5-13: Coolibah – Black Box Woodland within Toorale 110

Figure 5-14: Plant Community Types at Boera Dam 111

Figure 5-15: Plant Community Types at Booka Dam 112

Figure 5-16: Plant Community Types at Homestead Dam 113

Figure 5-17: PCT types notes in the impact areas of the proposed development. 114

Figure 5-18: Threatened and significant flora records within Toorale 118

Figure 5-19: *Dentella minutissima* at Boera Dam (photos by L. Copeland) 119

Figure 5-20: *Dentella minutissima* habitat near Boera Dam (photo by L. Copeland) 119

Figure 5-21: Flooding at Homestead Dam, May 2019 (photo by R. Hill) 121

Figure 5-22: Water in Homestead Dam, May 2019 (photo by R. Hill) 121

Figure 5-23: Threatened fauna records within Toorale 125

Figure 5-24: Thickly clumped lignum on the northern section of the Western Floodplain (Top) and smaller sparser lignum on the southern section of the Western Floodplain (bottom) 144

Figure 25: 2007 event managed to pass 1200 ML/d 152

Figure 5-26: Boera Dam AHIP area and recorded AHIMS sites (Biosis, 2018b) 158

Figure 5-27: Booka Dam AHIP areas and recorded AHIMS sites (Biosis, 2018b) 159

Figure 5-28: Homestead Dam heritage assessment and artefacts found (Biosis, 2018b) 160

Figure 5-29: Historic heritage listings in the vicinity of the proposed works. 166

List of tables

Table 1-1: DPIE Proponent's details 2

Table 1-2: Existing water licences and works approvals 8

Table 2-1: EPBC factors for consideration and likely impact 15

Table 3-1: Design objectives 37

Table 3-2: Summary of proposed modifications at each site 38

Table 3-3: Proposed Operating Strategy for the management of environmental water within Toorale 45

Table 3-4: Spatial Definitions 50

Table 3-5: Definition of construction disturbance footprint extents at each Dam 51

Table 5-1: Summary climate statistics for Bourke Airport AWS (BoM, 2019a; BoM, 2019b) 71

Table 5-2: Registered bore details near the Site 80

Table 5-3: Fish species surveyed within the Warrego River dams and waterholes during the LTIM project (2015 - 2018). 90

Table 5-4. Species listed as threatened under the FM Act or EPBC Act and expected to occur on Toorale (OEH, 2018a). 90

Table 5-5: Percentage of time flow rate is exceeded for Base Case and proposed arrangements (as modelled downstream of Peebles Dam site) 95

Table 5-6: Watering events used to compare changes to the flow regimes as a result of the proposed activities. 97

Table 5-7: ARI values for Q30 river flows from the 39 year hydrograph and the corresponding mapped area within the Toorale boundary. Area is cumulative including the area of more frequent ARI values (adapted from Cox *et al.,* 2012). 97

Table 5-8: Modelling results for % of years event was achieved, average duration, average dry spell between events and longest dry spell between events for the Western Floodplain watering events considered. 99

Table 5-9: Recommended survey periods for threatened flora species 105

Table 5-10: Endangered Ecological Communities (EECs) that occur in Toorale 107

Table 5-11: Plant Community Types within the project impact areas and locality 107

Table 5-12: Biobanking plots at Homestead, Booka and Boera Dam 115

Table 5-13: Plant species found at within the Boera, Booka and Homestead Dam impact areas. 115

Table 5-14: Weeds identified in Toorale including their distribution and status 122

Table 5-15: Threatened fauna known from Toorale 124

Table 5-16: Species that are rare or have limited breeding abilities 126

Table 5-17 Pest vertebrates recorded within Toorale 126

Table 5-18: Bird species identified at Boera, Booka and Homestead Dams 127

Table 5-19: Listed flora species with potential to occur within the study area 128

Table 5-20: Listed terrestrial fauna species with potential to occur within the study area 128

Table 5-21 Consideration of species of conservation significance at Boera Dam 132

Table 5-22: Consideration of species of conservation significance at Booka Dam 137

Table 5-23: Consideration of species of conservation significance at Homestead Dam 141

Table 5-24: Inundation requirements of several major wetland species (Cassanova, 2015) 145

Table 5-25: Relevant Bourke LEP 2012 Clauses 171

Table 6-1: Risk Assessment Matrix 176

Table 6-2: Summary of environmental controls and residual risk relevant to proposed works 178

Table 7-1: Consideration of ecologically sustainable development principles 191

Table 8-1: Compliance with clause 228(2) of the EP&A Reg 193

Appendices

Appendix A : Alluvium Engineering Plans for Boera, Booka and Homestead Dams (Detailed Designs and Technical Specifications) 204

Appendix B : Joint Management Committee Consultation Log 205

Appendix C : Environment Protection Authority Requirements 210

Appendix D : Flora Species List 212

Appendix E : Fauna Species List 233

Appendix F : Likelihood of Occurrence 252

Appendix G : Biodiversity Conservation Act Assessment 270

Appendix H : Environment Protection and Biodiversity Conservation Act Assessment 286

Appendix I : Fisheries Management Act Assessment 300

Appendix J : Aboriginal Cultural Heritage Assessment 305

Appendix K : Statement of Heritage Impact 306

Abbreviations

Abbreviation	Description
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Alluvium	Alluvium Pty Ltd
BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016
Biosis	Biosis Pty Ltd
BoM	Bureau of Meteorology
Bourke LEP	Bourke Local Environmental Plan 2012
Biosecurity Act	Biosecurity Act 2015
CEMP	Construction Environmental Management Plan
CEWHCEWH	Commonwealth Environmental Water Office
CEWH	Commonwealth Environmental Water Holder
CLM Act	Contaminated Land Management Act 1997
CNVMP	Construction Noise and Vibration Management Plan
DPI	Department of Primary Industries
DPIE	Department of Planning Industry and Environment
ECM	Environmental Control Maps
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Reg	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
ESCP	Erosion and Sediment Control Plan
FM Act	Fisheries Management Act 1994
Heritage Act	Heritage Act 1977

Abbreviation	Description
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
JMC	Joint Management Committee
KFH	Key Fish Habitat
LEP	Local Environment Plan
LLS	Local Land Services
LTIM Project	Long-Term Intervention Monitoring Project
MDBA	Murray Darling Basin Authority
MNES	Matters of National Environmental Significance
Native Title Act	Commonwealth Native Title Act 1993
NOW	NSW Office of Water
NPW Act	NSW National Parks and Wildlife Act 1974
NPW Reg	National Parks and Wildlife Regulation 2009
NPW	National Parks and Wildlife
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NRAR	Natural Resource Access Regulator
NTAP	Nature Tourism Action Plan
OEH	New South Wales Office of Environment and Heritage
PASS	Potential Acid Sulfate Soils
PCT	Plant Community Type
POEO Act	Protection of the Environment and Operations Act 1997
PoM	Plan of Management
RAPs	Registered Aboriginal Parties
REF	Review of Environmental Factors
RSWMP	Regional Strategic Weed Management Plan
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SHR	State Heritage Register
Toorale	Toorale National Park and State Conservation Area
TSC Act	Threatened Species Conservation Act 1995
WAL	Water Access Licence
WM Act	Water Management Act 2000

Executive Summary

Background

This Review of Environmental Factors (REF) has been prepared for the New South Wales (NSW) Department of Planning, Industry and Environment (DPIE; previously Office of Environment and Heritage (OEH)) to satisfy environmental assessment and approval requirements to modify three dams at Toorale National Park and State Conservation Area (Toorale), within the Warrego River Catchment. Toorale is located approximately 65 km southwest of Bourke in north western NSW and is managed by the DPIE National Parks and Wildlife Service (NPWS).

Toorale was purchased and gazetted as a national park and state conservation area to protect its outstanding natural and cultural values for the people of NSW. It contains regionally significant floodplain, riverine and wetland habitats for a diverse range of plants and animals, including nationally and state listed threatened species and communities. The waterholes provided by the dams along the Warrego River within Toorale provide refuges to native fish, frogs and birds that persist for much longer than other areas of the lower Warrego River.

Toorale also has highly significant Aboriginal and historic heritage values. Although only a small part of the park has been surveyed, over 500 Aboriginal artefacts have been recorded to date, including one find dating to over 50,000 years old. Aboriginal people have had a long and ongoing association with Toorale that continues to this day. Elements of the historic heritage on Toorale meet state level significance criteria.

Toorale contains various water infrastructure, including dams across the Warrego River that were initially constructed as part of property improvements during the late 1880s, primarily to increase floodplain watering and hence grazing capacity at Toorale. These works have been damaged and reinstated over time. Since construction, the environment on Toorale has naturalised in response to the historic water management arrangements. Water management structures and practices have evolved over time to meet changing agricultural, and more recently, conservation outcomes.

Toorale water entitlements include irrigation licences, and stock and domestic water entitlements. The Australian and NSW governments funded the purchase of Toorale in 2008, and the water access licences were purchased and transferred to the Commonwealth Environmental Water Holder (CEWH). These entitlements included three separate licences to extract a total of 8,106 ML from the Warrego River, and a high-flow area-based licence to irrigate 1,620 hectares, which was subsequently converted to a volumetric licence to extract 9,720 ML from the Warrego River at Boera Dam. These entitlements are now used to generate environmental outcomes in on Toorale and in the Darling River.

An agreement between the Australian and NSW governments at the time of its purchase requires the NSW Government to modify the infrastructure currently used for water management at Toorale for environmental purposes. The proponent of the Toorale Water Infrastructure Project is the NSW Government acting through the DPIE Environment, Energy and Science Group.

This document identifies environmental risks associated with the project and highlights key areas where mitigation measures and/or ongoing actions are required to manage these risks. Where additional approvals and permits are necessary, these have been identified.

Proposed Activity

The Toorale Water Infrastructure Project involves modifications to four dams that have been previously constructed across the Warrego River to support former agricultural practices associated with Toorale Station. This REF is the second of two assessments prepared for the Toorale Water Infrastructure Project. Phase 1 of the project removed the instream structures at Peebles Dam, and was completed in October 2019. Phase 2 of the project proposes the following modifications to existing water infrastructure at Boera, Booka and Homestead Dams. Phase 2 of the Project proposes::

- At Boera Dam - automated regulator gates will be constructed at the location of the existing pipes, with vertical gates to regulate discharge and allow targeted watering of the Warrego River and/or the Western Floodplain. A vertical slot fishway will be constructed at the embankment to provide fish passage independent of the regulator gates. The new arrangements will have the capacity to pass up to 1,650 megalitres per day (ML/d) downstream, and/or to be closed to promote watering of the western floodplain.
- At Booka Dam - the embankment will be lowered to function as a spillway. A rock ramp fishway will be installed. Booka Dam will be operated as a fill and spill system whereby inflows up to 900ML/d will passively flow into and out of the storage.
- At Homestead Dam - the embankment (currently breached) will be reconstructed and a new spillway with rock ramp fishway installed. Homestead Dam is also proposed to be operated as a fill and spill system that is designed to pass flows of up to 900ML/d. A bridge will be constructed in the same location to enable safe vehicle access across this part of the river.

Further detail on the proposal at each dam as well as proposed operating arrangements can be found in section 3 of the REF.

This REF also assesses the predicted impacts of changing the management of inflows to Toorale following the completion and operation of these new structures.

Permissibility

The proposed activity is required to be assessed under the provisions of Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This REF documents the proposed activity, assesses the potential environmental impacts and provides environmental mitigation measures to be implemented to minimise the risk of potential impacts as a result of the proposed activities in accordance with the EP&A Act and the associated *Environmental Planning and Assessment Regulation 2000* (EP&A Reg). It also contains reference to the legislative requirements pertaining to various others Acts relevant to the proposed water infrastructure works.

The proposed activity is described as a modification to an existing water storage facility, which is part of a water supply system. The proposed works can be assessed under Part 5 of the Act providing that the activity is permissible without consent, is not a prohibited development, and the works are carried out, or approved, by a determining authority.

The proposed activity (water storage facility) is permissible without consent pursuant to clause 65 of *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act). Under the provisions of the *Bourke Local Environmental Plan 2012* development for the purposes of water storage facilities or water supply systems on land zoned E1 National Parks is permissible without consent.

Pursuant to the provisions of the *Fisheries Management Act* (FM Act), the proposed activities constitute barriers to fish passage in the Warrego River. As such, fishways are required to be installed under section

218 of the FM Act. Modifications proposed at the three dams include installation of fishways to facilitate fish passage along the Warrego River between Boera Dam and the confluence with the Darling River. Boera Dam will have a *vertical slot* fishway installed, Homestead and Booka (possibly) will have *rock ramp-style fishways* installed. When there are no inflows into Boera Dam, the fishway will need to be closed off. Prior to closing the fishway, a section 219 permit under the FM Act will be required to lawfully block fish passage.

A summary of approvals and licences required are outlined below:

- Internal DPIE authorisation under EP&A Act.
- Two Aboriginal Heritage Impact Permits (AHIP) have already been obtained as required by the NPW Act. DPIE is currently applying for an AHIP variation to consider the modified impact areas as a consequence of amendments to the proposed project footprint.
- Approvals under the *NSW Water Management Act* to modify and operate the proposed new structures, and interim arrangements during construction
- Approval from NSW DPI Fisheries is required under the FM Act for the fishway designs
- A FM Act Section 219 permit will be required to block fish passage. Under the proposed operational regime, when there are no inflows into Boera Dam, the fishway will need to be closed off.

Summary of Potential Impacts

Landscape, Topography, Geology & Soils

Topography across the site is near level to gently sloping with small areas of low sandy ridges and knolls. The Warrego River flows from north to south through the centre of the Park to its junction with the Darling River in the south east.

The soils comprise a combination of black clays of the alluvium floodplains, sandy loams, red textured or sandstone outcrops and self-mulching sandy loams in low lying Gilgais. Soil type across the site is greatly influenced by proximity to the river and history of inundation by the historic flood out irrigation schemes constructed in the late 1880s.

The proposed modifications to the existing water management arrangements will have various impacts to the existing landscape, correlated with the proposed changes to flow regimes in the river and reduced occurrence of 'flood outs' on the Western Floodplain. There will also be periodical changes to water levels in the river to meet the project objectives as described within the operational strategy. The full assessment on landscape, topography, geology and soils can be found in Section 5.1.

Groundwater

The Homestead, Boera and Booka Dams are sited on two separate alluvial groundwater sources, namely the Upper Darling Alluvium (Homestead) and Warrego Alluvium (Booka and Boera). The alluvium and surface waters of these catchments and the major unregulated tributaries are periodically connected, however, there is no evidence of existing groundwater interaction at the sites with water tables likely in excess of 5 metres below ground surface. Groundwater quality is variable, but mostly poor and elsewhere along the Upper Darling there are known groundwater-dependent ecosystems utilising the shallow alluvial aquifer, though none are identified in the areas around the sites. There is potential impact to groundwater from contamination via the use of construction machinery and equipment and this is considered to be a standard risk of this type of activity. Potential impacts will be minimised to the full extent possible via the proposed implementation of a Construction Environmental Management Plan. The full assessment on impacts to groundwater can be found in Section 5.2.

Surface Water & Aquatic Ecology

Water Quality

Overall, the Project will allow for better water management/quality outcomes compared to the current conditions in both the Warrego and Darling Rivers by providing increased dilution flows.

There is a risk of pollution of waters through hazardous materials management and localised erosion/sedimentation if banks are not stabilised, especially if heavy rainfall and/or high flows are encountered during construction. Through proper design and site management during construction, the risk of water pollution, erosion and sedimentation would be considered low.

Aquatic Ecology

The waterholes, wetlands and channels associated with the Warrego River provide aquatic refuge to animals and plants in an otherwise dry landscape. The Warrego River and its associated floodplain wetlands are part of the Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River, which is listed under the NSW FM Act as an Endangered Ecological Community (EEC).

Areas of Toorale, and the Darling River downstream, are identified as priority environmental assets in the Intersecting Streams and the Barwon Darling draft Long Term Watering Plans. The Long Term Watering Plans identify water management strategies for maintaining and improving the long-term health of the riverine, floodplain and wetland environmental assets and the ecological functions they perform.

Nine species of fish have been surveyed in the dams and waterholes within Toorale since 2015. In addition to these, a further four fish species that are listed as threatened under the FM Act or *Environment Protection and Biodiversity Act* (EPBC Act) are expected to occur on Toorale. These are *Maccullochella peelii* (Murray Cod), *Ambassis agassizii* (Olive Perchlet), *Morgurnda adspersa* (Purple-spotted Gudgeon) *Bidyanus* (Silver Perch). *Notopala sublineata* (River Snails) are another aquatic species listed as Endangered under the FM Act, that was suggested to be expected to occur on Toorale (OEH 2018a).

Water bird and frog data collected has shown that the dams in the Warrego River provide important refuge habitat during periods of low flow. Species richness, abundance and diversity have tended to change with habitat type and inundation, rather than season. Frog abundance has tended to be higher at sites such as Booka Dam and the Western Floodplain that have higher quality habitat (woody debris and shrubs such as lignum and River Cooba) near the edge of the waterholes. While Homestead Dam was not surveyed for frogs, the habitat likely to be present when the dam is reinstated will provide good quality frog habitat.

When inundated, waterholes and channels on the Western Floodplain support relatively diverse and abundant aquatic populations, likely driven by high primary productivity and the presence of high-quality habitat. It also provides potentially important feeding grounds for waterbirds and vertebrates when it is inundated, which likely improves their overall condition.

Depending on the timing of the proposed works, partial dam dewatering behind coffer dams may be required if there is water within the dams during construction. Should this occur, any stranded fauna will be relocated.

The addition of fishways on Boera, Booka and Homestead dams along with the removal of Peebles dam is likely to increase the passage of fish and other aquatic animals through the lower Warrego system, and

between the Warrego and Darling rivers. While this will be positive for the movement of native species, there is also the potential for increased migration of exotic species through the system.

This may impact on the aquatic ecology of the lower Warrego River through increased competition for resources, and deterioration of habitat quality. This is considered a medium risk of this occurring.

The proposed installation and operation of new lay flat regulator gates at Boera Dam will increase connectivity and movement opportunities for aquatic animals through the main channel of the Warrego River. The ability to provide and maintain improved connecting flows will help sustain fish recruitment events.

Under the proposed operational strategy, the duration of time Boera Dam will be at or near full supply level will be similar to the base case scenario. Therefore, there would be negligible change to the functioning of the storage as an important low flow aquatic refugia, and also minimal impact to fringing vegetation.

The main ecological impacts relating to the proposed activities at Booka Dam are centred on the reduction to the full supply level. Booka Dam has been shown to support relatively abundant populations of frog species, linked to the inundation of high-quality fringing habitat in its upper reaches which is part of the rationale for it being retained, not removed. The reduced capacity of this dam expected following the proposed activities will reduce access to these fringing habitats, in turn reducing the quality of habitat available to frogs and other aquatic species at the site. These losses in habitat are likely to be somewhat offset by increases in habitat availability with the reinstatement of Homestead Dam, but at a local scale, habitat loss will likely occur at Booka Dam, at least initially. In the longer-term fringing vegetation may encroach into the storage in response to the lower water levels, although to what extent and over what timeframe is unknown.

Similarly, when connected, the western bywashes that convey water around Booka Dam provide downstream passage and habitat for fish and invertebrates. Any reduction to the connection frequency of these channels will impact on both fish passage and habitat availability in this section of the Warrego River. Again, the overall risk to the aquatic ecology of these losses will be offset but the installation of the rock-ramp fishway in the dam wall, which will allow increased passage through the dam itself.

The reinstatement of a dam wall at Homestead Dam will reduce connectivity and movement opportunities for aquatic animals within the main channel of the Warrego River relative to the currently breached condition. At present, in its breached condition, Homestead Dam provides a minor barrier to movement in this section of the Warrego. However, this loss of connectivity will be reduced by the installation of a rock ramp fishway at the spillway.

The reinstatment of Homestead Dam will increase the inundated area and permanence within the dam itself following installation. In its upper reaches, Homestead Dam has substantial areas of fringing lignum and river cooba, which has been shown to provide good habitat for frogs and other aquatic species at other locations within Toorale. Reinstating the permanence of the dam, even at a reduced full supply level of 1 m than the original embankment, will also benefit the aquatic ecology by providing suitable refuge habitat for longer periods of time. This is especially important in semi-arid systems like the Warrego, which only flow periodically.

While no modifications are planned downstream of Homestead Dam during Phase 2, there are associated potential impacts. Increases to the flows into Dicks dam should benefit the aquatic ecology in this location, as it will form a more permanent refuge than it does presently. Increased inundation over the road crossing will also increase the potential for fish passage, which should benefit fish species present. As mentioned above, this will also increase the movement of exotic species into this section of the river.

Flow into Ross Billabong, east of the Peebles Dam site, may reduce with the proposed activities. This may subsequently impact the aquatic ecology of this waterhole. Reductions to the depth, area and duration of inundation would be expected, and hence its value as an aquatic refuge in the Warrego system for a range of species, including fish, invertebrates, frogs and birds may be reduced. For mobile species such as birds and frogs, a reduction in the permanence of Ross Billabong may be somewhat offset by an increase in the permanence of Dicks and Homestead Dams.

The relative impact of the proposed reductions to inundation of the Western Floodplain on the aquatic ecology of the area is difficult to quantify. There are uncertainties about the historic flow regime that this ecosystem has adapted to. There are also uncertainties surrounding the potential impacts on aquatic communities to a possible reduction in the availability of habitat on the Western Floodplain, and if a reduction in access to the highly productive habitats on the floodplain would impact on regional scale aquatic populations. Modelling of flow patterns under pre-existing and proposed arrangements has helped to inform an understanding of the potential changes to the flooding of the western floodplain under the proposed arrangements. Furthermore, the proposed modifications and their operation are conservative and allow for an adaptive approach that can respond to unforeseen or unacceptable impacts.

The proposed activity is likely to increase flows within the Darling River downstream of the confluence. This is likely to benefit the aquatic ecology of the river in due to improvements in water quality during connection events and improved connectivity of flow for ecosystem processes, including fish spawning and migration. of ecological processes in the Barwon-Darling River. The increased flows are expected to help suppress algae growth in the Darling River. Flows entering the Darling River from the Warrego River have recently been shown to provide re-connection of relatively large (400 km) stretches of the Darling River downstream of the confluence improving the quality and persistence of water in these previously isolated Darling River waterholes.

An assessment of the nature and severity of any potential impacts arising during construction and operation of the Project on those threatened species and communities listed under the *Fisheries Management Act, 1994* (FM Act) and considered ‘known’, ‘likely’ or ‘possible’ to occur in the Project locality. This assessment concludes that the Project is not likely to have a significant impact on threatened threatened aquatic species and communities.

The Project will result in some impacts to aquatic biodiversity in some parts of the system, and benefits in others. The nature and magnitude of these impacts is difficult to quantify and delineate with confidence. However, the measures taken to minimise the risks associated with this uncertainty include:

- Installing a structure that allows flexibility in the timing and volumes of water passed from Boera Dam
- Retention of the existing full supply level in Boera Dam
- Development of an operating strategy that prioritises flow delivery based on the relative water demand, which can be revised over time as the understanding of the system response improves
- Water balance modelling to evaluate and refine the proposed operating arrangements relative to previous management arrangements and in line with ecosystem watering requirements as currently understood
- Continued monitoring of Western Floodplain and in-channel habitats to detect trends in ecosystem response
- Aligning flow management arrangements with related Basin Plan processes, particularly environmental watering requirement triggers and targets in the draft Barwon-Darling Long-Term Watering Plan.

The aquatic habitats of the Warrego and Darling Rivers will continue to be monitored following implementation of the Project and the information collected used to inform adjustments to water management operations.

The full assessment on surface water and aquatic ecology can be found in Section 5.3 and appendices D-I.

Terrestrial Ecology

There are unlikely to be significant impacts to habitat for terrestrial species, and the proposed activity is considered unlikely to result in the endangering of any species of animal, plant or other form of life, nor result in any significant adverse impacts on the ecosystem of the locality in accordance with State or Federal assessments.

While the proposed modifications at Boera, Booka and Homestead dams will result in direct impacts to local vegetation and habitat within the development footprint, the Project will improve the delivery of environmental flows and fish passage, hence providing broader benefits to the ecosystems within the Warrego and lower Darling Rivers. Measures to mitigate impacts to terrestrial ecology have been identified and proposed in this REF and will be described in further detail in the CEMP.

Boera **–** There is likely to be some direct impact to vegetation by construction activities at Boera Dam. Maintaining Boera Dam at its current full supply level well help to maintain fringing vegetation and habitat. This will also benefit terrestrial fauna, including migratory waterbirds, through the maintaining of habitat and drought refuge at this site.

Booka **-** There is likely to be minor direct impact to vegetation by construction activities at Booka Dam. The reduction of the storage capacity of Booka Dam from current (historic) levels will likely impact on the availability of water to the fringing vegetation, especially lignum shrublands which provides habitat for local fauna. This impact may be partially offset by more frequent inflows to the storage.

Homestead **-** Increased retention of water at Homestead Dam is likely to provide increased instream habitat and riparian and drought refugia relative to the currently breached arrangement. There is unlikely to be significant negative impacts on habitat for protected fauna. Rather, the proposed works at Homestead Dam will result in improved habitat/refugia conditions for terrestrial fauna.

Western Floodplain **–** Average inundation of the Western Floodplain is likely to reduce in magnitude, duration and frequency under the proposed operating strategy, which is the consequence of balancing environmental demands in this location and downstream. Impacts will vary by event and are likely to be most pronounced for small-moderate flows when conditions in the Darling River are dry. Analyses indicate that the proposed inundation regime should still meet the environmental watering requirements of key floodplain vegetation species and communities that occur in the Western Floodplain (for example Lignum which provides great habitat for breeding waterbirds in the area). Given the proposed changes to hydrology, continued monitoring to assess floodplain vegetation condition is a critical mitigation measure that is proposed as part of this REF. The results of the monitoring will inform adaptive management of the site and future reviews of the operating strategy.

Peebles and Ross Billabong **-** The removal of Peebles Dam, undertaken in October 2019 as part of Phase 1, resulted in some minor impacts to local vegetation within the activity footprint. The area where the dam once was has been compacted to avoid erosion, and regeneration of native vegetation will occur. The removal of Peebles Dam will likely reduce flow and inundation of Ross Billabong. This may have implications for the condition of the fringing Coolibah woodland community, though given the uncertainties

around the change to the future inundation regime, and the historical inundation regime on which the fringing vegetation developed, monitoring of the condition of these communities is proposed.

Any impacts identified during the construction phase will be managed through the implementation of the mitigation measures.

The full assessment on terrestrial ecology can be found in Section 5.4 and in Appendices D-I.

Social and Community Impacts

Consultation with representative community members and stakeholders has been undertaken as the project has progressed, and the final proposal has been substantially modified in response to their input. Design changes have been made to adapt and modify the Project to lessen potential impacts to the community and address the requirements of the relevant stakeholders. Post approval, consultation will continue to be undertaken throughout the construction and operation of the Project.

The proposed works aim to enable greater passing flow capacity (up to 1,650ML/d) from Boera Dam through the lower reaches of the Warrego River and into the Darling River for downstream environmental benefits, while at the same time protecting and maintaining the important environmental values currently present at Toorale. Adjoining landholders will be most affected by these changes that will likely reduce the area of and frequency that their properties receive beneficial watering from events in the Warrego River. The storage capacity of Booka will be reduced although it is anticipated that more frequent passing of flows will assist to offset this impact. Downstream landholders will benefit from increased flows in the Darling River, particularly during prolonged dry periods.

The Project is not predicted to result in any significant change to the depth or frequency of flooding of the causeway at Dicks Dam so is unlikely to impact on local traffic movement.

The new works at Homestead and Boera Dams will allow NPWS staff and other park visitors to more safely access and cross the Warrego River at these locations, and provide NPWS staff with more reliable access to the western side of the park. The new arrangements are expected to have a reduced operating and maintenance liability for NPWS than the current structures.

The new structures will have a greater visual impact from that of the current arrangements. However, these locations are not visited by many tourists who will not be exposed to the impact. The visual impact of the both Homestead and Booka Dams has been mitigated through the planning process during which a unique, bespoke design acceptable to both the Toorale Joint Management Committee and DPI Fisheries has been prepared.

Impacts from construction related activities, including amenity of each development site, will be temporary for the duration of the works only. Access to the river at these locations will be prohibited to tourists and visitors for a short period of time.

The full assessment of Social and Community impacts can be found in Section 5.5.

Aboriginal Cultural Heritage

The area around the junction of the Warrego and Darling rivers is part of Country for the Kurnu-Baakandji Aboriginal People. Many Aboriginal people and families have a strong and ongoing connection to Toorale, having worked on the station for many generations over the past 150 years as stockmen, drovers, shearers, fencers and domestic workers. Toorale therefore represents a unique opportunity for these individuals as well as the broader Kurnu-Baakandji community to maintain connections or reconnect with Country, renew kinship relations, support the teaching of younger generations, and develop and practice traditional customs.

Toorale has extensive evidence of Aboriginal occupation and activity, including over 500 known Aboriginal sites. These include artefacts, quarries, scarred trees, ovens, middens, stone arrangements, burials, tool manufacturing sites and Aboriginal post-contact sites. Subsurface artefacts recorded during test excavations undertaken during 2018 near Boera Dam have been dated at over 50,000 years old, supporting the long connection of Aboriginal people to the area and its historical significance.

The planning and design of the Project has taken into account input from the Toorale Joint Management Committee (JMC) through which representatives of Kurnu-Baarkandji advise on management of the park. The JMC has:

- emphasised a desire to see Homestead Dam reinstated as a priority to enable cultural activities to be supported.
- expressed a requirement that the Western Floodplain protected and maintained
- sought to have impacts to cultural heritage minimized
- sought to have fishways at Booka and Homestead to have as minimal visual impact as possible, and to have a “rock-like” appearance.

Survey and assessment for Aboriginal Cultural Heritage and archaeological testing has been undertaken for the Project in accordance with statutory processes and agency guidelines. The final design of the Project has been developed with the aim of minimising direct impacts to Aboriginal Cultural Heritage located within the construction footprint; however, where direct impacts are unavoidable, works will be conducted in accordance with Aboriginal Heritage Impact Permits (AHIPs).

Training and/or employment opportunities will continue to be provided to Aboriginal people during implementation of works and associated activities consistent with the wishes of the Toorale JMC.

The full assessment on Aboriginal Cultural Heritage can be found in Section 5.6 and Appendix J.

Historic Heritage

Toorale National Park and State Conservation Area has important colonial historical value and is home to several heritage precincts within an area formerly known as Toorale Station. NPWS has implemented a repair and conservation project which has been ongoing since the land’s gazettal to protect this property and its farming history. The construction of the floodwaters and irrigation schemes in the late 1880s is an iconic and significant feat of civil engineering and water management in remote NSW.

Searches of the NSW State Heritage Register (SHR), the Aboriginal Heritage Information Management Systems (AHIMS) and Bourke Local Environmental Plan 2012 have been undertaken to determine the listed heritage items within and adjacent to the Project site. A heritage impact assessment (Statement of Heritage Impact (SoHI)) has also been undertaken for the Project, to assess the extent and nature of impacts to historic features of the Park as a result of the proposed construction works and changes to flow regimes in the Warrego River. This REF and the SOHI were prepared in accordance with the Draft Toorale Conservation Management Plan and are consistent with its heritage policies.

Historic heritage site inspections undertaken did not identify any historically significant features or fabric associated with the sections of Boera and Booka Dams that will be modified, or the section of Homestead Dam that will be repaired. No negative impacts to historic heritage are anticipated as a result of the proposed works. Re-establishment of existing historic water management infrastructure is a positive heritage outcome for the historic Toorale Homestead setting.

The full assessment on historic heritage can be found in Section 5.7 and a Statement of Heritage Impact is included as Appendix K.

Waste and Resource use

Natural resources relating to the proposed works include the surrounding environment (such as the water resources of the Warrego River) as well as the resources and materials to be used during the construction stage of the proposed works.

The proposal is not likely to involve the significant use, wastage, destruction or depletion of natural resources including water, fuels, timber or extractive materials. The proposal provides for the sustainable, equitable and efficient use of water resources and proposes to minimise and reuse materials onsite where possible.

Conclusion

Warrego River inflows to Toorale are managed to fulfil water licence and works approval conditions, and to contribute to a number of environmental, social and cultural objectives. In meeting these conditions and objectives, consideration is given to broader regional water requirements as well as actions that maintain or improve the Park's natural and cultural values (in particular, water-dependent ecosystems), and facilitate effective land management operations and visitor experiences. To best achieve these outcomes there is a need to modify the water infrastructure at Toorale to enable greater capacity to deliver flows through the Warrego River to the Darling River, whilst maintaining infrastructure and operating strategies that also protect and maintain the important ecological and cultural values of the Park.

The proposed changes to the water infrastructure at Toorale are subject to consideration by DPIE under Part 5 of the EP&A Act. This REF considers the statutory requirements relating to, and the potential environmental impacts resulting from Phase 2 of the proposed Toorale Water Infrastructure Project.

The nature and magnitude of potential impacts arising from the Project are difficult to quantify and delineate with confidence. However, the measures taken to minimise the risks associated with this uncertainty include:

- Installing structures that allows flexibility in the timing and volumes of water passed from Boera Dam
- Retention of the existing full supply level in Boera Dam
- Development of an operating strategy that prioritises flow delivery based on the relative water demand, which can be revised over time as the understanding of the system response improves
- Water balance modelling to evaluate and refine the proposed operating arrangements relative to previous management arrangements and in line with ecosystem watering requirements as currently understood
- Continued monitoring of Western Floodplain and in-channel habitats to detect trends in ecosystem response
- Aligning flow management arrangements with related Basin Plan processes, particularly environmental watering requirement triggers and targets in the draft Barwon-Darling Long-Term Watering Plan.

Environmental and cultural impacts have been assessed in accordance with clause 228(2) of the EP&A Act and are presented in Section 5 and Section 8 of this REF.

The REF concludes that an Environmental Impact Statement is **not** required in this instance due to the following:

- Assessments of significance conclude that there is unlikely to be a significant impact on the environment or any threatened species, population or ecological community, or their habitat, listed under the Biodiversity Conservation Act or FM Act (Appendix G and Appendix I) and therefore a Species Impact Statement (SIS) will not be required.

- The activity will not adversely affect the heritage significance of the site, nor will it unacceptably impact cultural heritage items, and the works are not likely to have any high or major impact on the fabric, setting or community values.

- The activity is also **not:**

  - on land that contains coastal wetlands, littoral rainforest or koala habitat under SEPP 14, SEPP 26 or SEPP 44.
  - of a similar kind to those described as State Significant Development or Infrastructure in the State and Regional Development SEPP.
  - of a similar kind described in Schedule 3 of the EP&A Regulation (designated development likely to significantly affect the environment under Part 4 of the EP&A Act).
  -

Furthermore, the proposed activity is not likely to result in the degradation of the Park or any other area reserved for conservation purposes.

This REF concludes that construction and operation of Phase 2 of the Toorale Water Infrastructure Project is unlikely to result in a significant adverse environmental impact. Although there may be some localised impacts, the proposed development is not expected result in negative permanent change to the environment. Any low or medium impacts are short term in nature (during the construction stage) and long-term arrangements of the three dams are considered to provide a net positive impact upon the environment. Monitoring of the response of the environment to changed watering, ongoing consultation with key stakeholders and an adaptive water management arrangement will mitigate those potential impacts that are less well understood.

1 Introduction

1.1 Project Overview

This Review of Environmental Factors (REF) assesses proposed modification works and flow management arrangements for Phase 2 of the Toorale Water Infrastructure Project, to be undertaken at Boera, Booka and Homestead Dams along the Warrego River on Toorale National Park and State Conservation Area (Toorale). Phase 2 of the Project is estimated to commence, pending approvals, in early 2020 and is scheduled for completion by 30 June 2021.

1.1.1 Toorale Water Infrastructure Project

As part of an agreement between the Australian and New South Wales (NSW) governments, the Toorale Water Infrastructure Project is being undertaken to remove, modify or decommission existing water infrastructure on Toorale for environmental purposes. The aim of the Project is to enable greater water flow capacity through the lower reaches of the Warrego River and into the Darling River for downstream environmental benefits, while at the same time protecting and maintaining the environmental values currently present at Toorale.

The Toorale Water Infrastructure Project commenced in January 2016 and involves modifications to four dams that were constructed across the Warrego River to support former agricultural practices associated with Toorale. These dams were initially installed as part of property improvements during the late 19th century, primarily to increase floodplain watering and grazing capacity. Since construction, the environment has naturalised in response to the prevailing water regime. Water management structures and practices have evolved over time to meet changing agricultural, and more recently, conservation outcomes. This REF is the second of two REF documents prepared for the Project.

1.1.2 Phase 1

Phase 1 of the Project formed the basis of the first REF (EcoLogical Australia, 2019) and involved removal of an earthen embankment across the Warrego River and reinstatement of the channel profile at the Peebles Dam storage site. Removal of Peebles Dam was completed in October 2019. Repair works at Homestead Dam were also proposed for Phase 1 but were not implemented and have been included in Phase 2. Phase 1 works are now complete and cumulative impacts of Phase 1 and Phase 2 are assessed as part of the Phase 2 REF.

1.1.3 Phase 2

Phase 2 of the Project is described in detail in Section 3.

At Boera Dam, automated vertical regulator gates will be installed in the existing earthen embankment and regulated to control discharge and allow water management in accordance with a proposed water management strategy (Section 3.2.1). A vertical slot fishway, to provide fish passage independent of the regulator gates, will be constructed near the location of the existing pipes at Boera Dam.

The earthen embankment at Booka Dam will be lowered and a fixed crest will be constructed for operation as a fill and spill arrangement. A rock ramp fishway will be constructed at Booka Dam.

At Homestead Dam the embankment (currently breached) will be reconstructed to a lower crest height than prior to breaching. A specially designed rock ramp fishway will be constructed at the new spillway to meet community and ecological needs. Homestead Dam will be operated as a fill and spill system. A bridge will be constructed in the same location to enable safe vehicle access across this part of the river.

1.2 The Proponent

The proponent is the NSW Department of Planning, Industry and Environment (DPIE) (Table 1-1). The DPIE is managing the Toorale Water Infrastructure Project on behalf of the Australian Government to achieve outcomes sought by both the Australian and NSW governments. The DPIE cares for and protects NSW's environment and heritage, which includes the natural environment, Aboriginal country, culture and heritage, and built heritage. DPIE supports the community, business and government in protecting, strengthening and making the most of a healthy environment and economy in NSW.

Table 1-1: DPIE Proponent's details

Area or Section/Division	Biodiversity and Conservation Division
Contact name	Ms Sonya Ardill
Position	Senior Environmental Water Planner
Address	92 Macquarie Street, Dubbo, NSW 2830
Phone numbers	Business: 02 6841 0945
Email	c/o Toorale Water Infrastructure Project Mailbox: toorale.project@environment.nsw.gov.au

1.3 Project Location

Toorale is located on the junction of the Warrego and Darling Rivers, approximately 60 kilometres (km) to the south-west of Bourke, in the in the semi-arid environment of north-western NSW (Figure 1-1). Toorale encompasses a combined area of approximately 85,251 ha (Figure 1-2).

Toorale is located within the administrative areas of Bourke Shire Council Local Government Area, Western Local Land Services, and the NSW State Electorate of Barwon.

Approximate coordinates (GDA 1994, MGA Zone 55) and Lots of the dams to be modified are:

- Boera Dam
    - Easting 348513, Northing 6669152.
    - Latitude 30°05'58.0"S, Longitude 145°25'40.3"E
    - Lot 3896, DP 766369.
- Booka Dam
    - Easting 349330, Northing 6658621.
    - Lot 3896, DP 766369.
- Homestead Dam
    - Easting 343300, Northing 6649320.
    - Lot 5189, DP 720974.

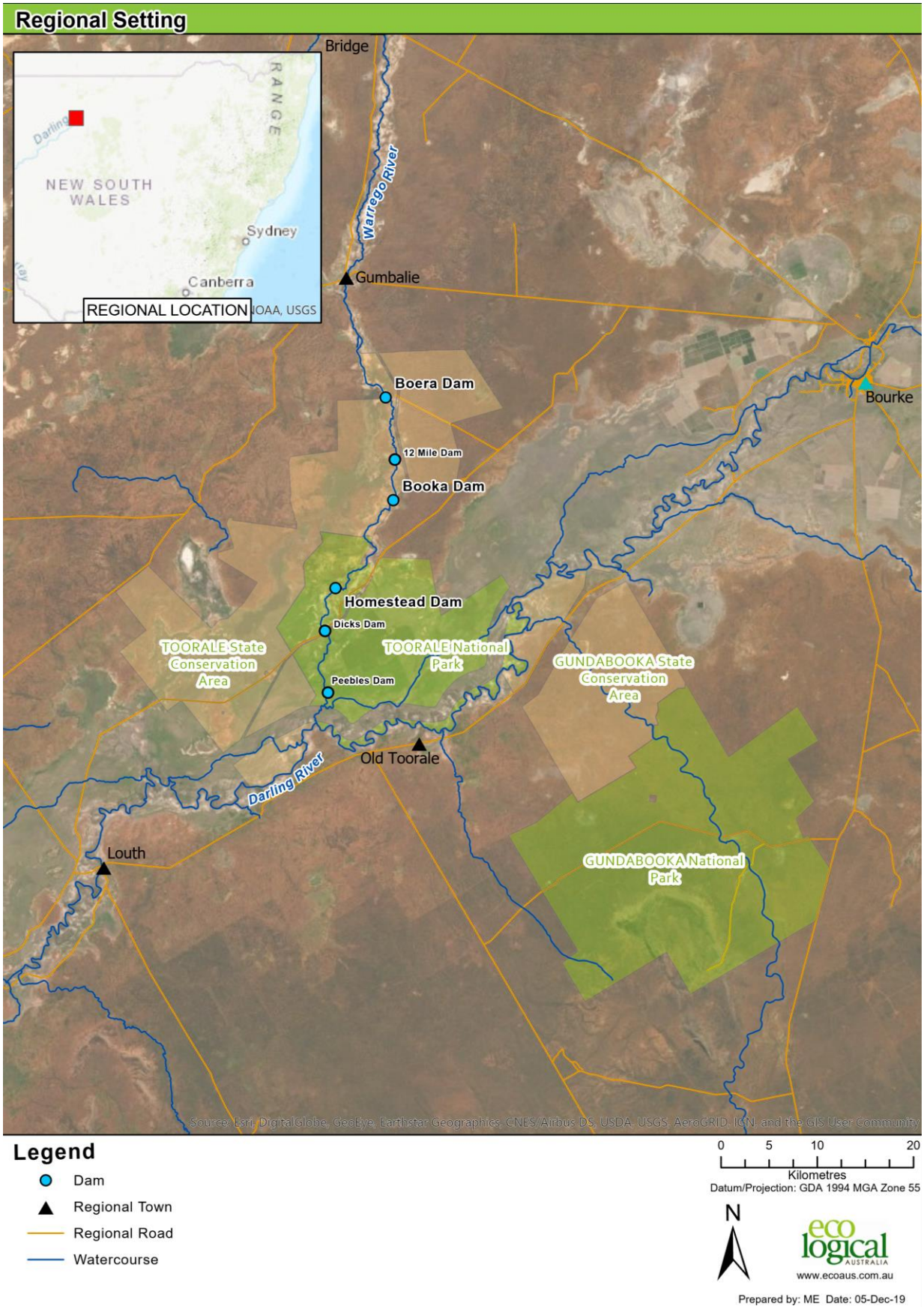


Figure 1-1: Regional setting

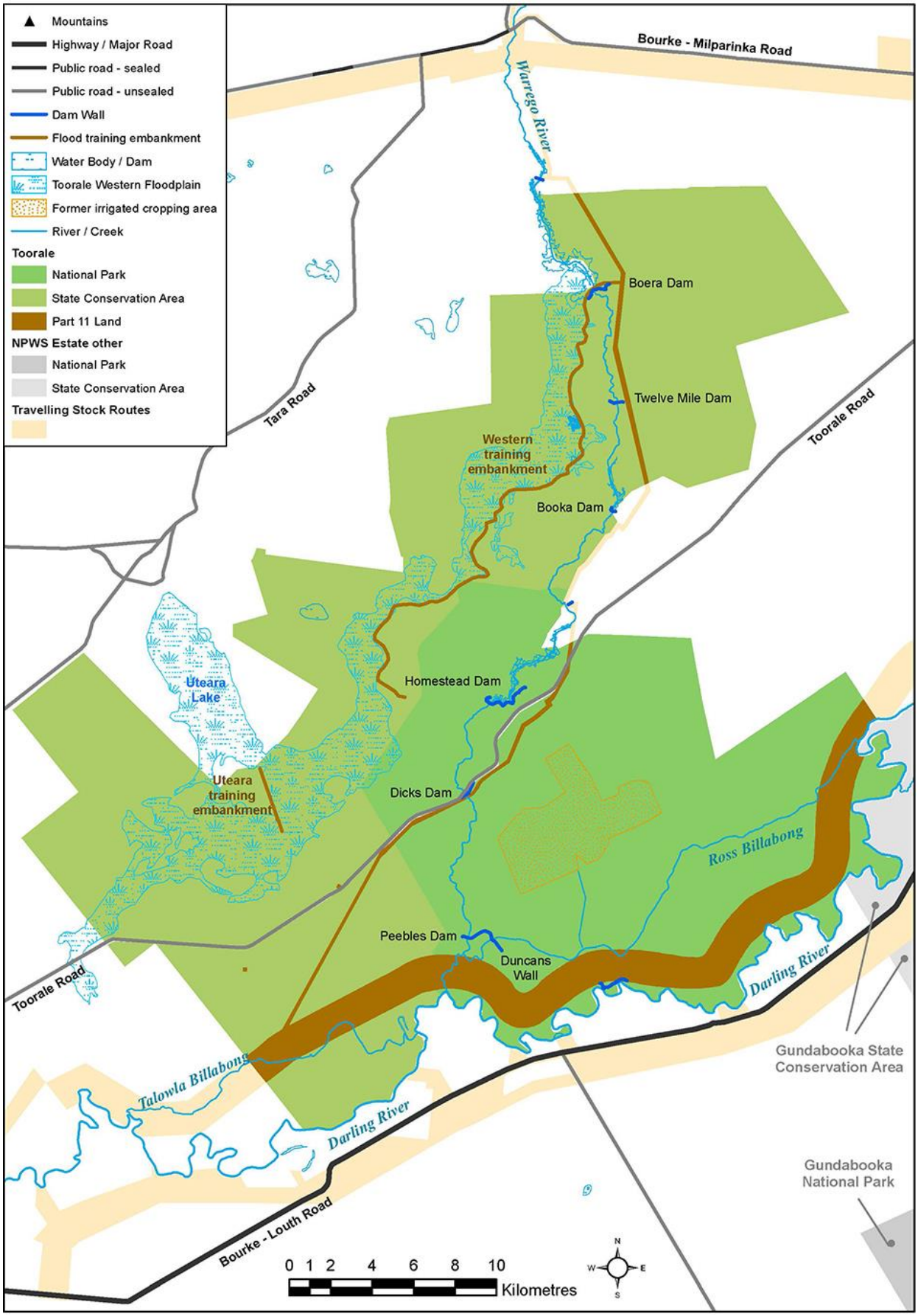


Figure 1-2: Toorale National Park and State Conservation Area (OEH,2019)

1.4 Land Use and Ownership

Toorale is owned by the NSW Government and managed by the NSW National Parks and Wildlife Service (NPWS). Toorale is managed in accordance with the draft Plan of Management (PoM) (OEH 2018a) and Statement of Management Intent as specified by the NSW *National Parks and Wildlife Act 1974* (NPW Act).

The 60-metre wide Toorale Road and road reserve has been withdrawn from the associated Western Lands leases as part of a legal road network process and has been dedicated as a public road administered by Bourke Shire Council.

Prior to the NSW Government purchasing the property in 2008, Toorale was owned by Clyde Agriculture. The property was purchased by NPWS because of its outstanding natural and cultural values, the unique contribution Toorale would make to the national reserve system, to ensure protection and ongoing management of the significant environmental, Aboriginal and historical cultural values associated with the property, and to secure the property's extensive water entitlements (OEH, 2018a). Water entitlements for Toorale were transferred to the Commonwealth government and are now administered by the Commonwealth Environmental Water Holder (CEWH) in consultation with NPWS.

1.5 Water Management

At the time of purchase, Toorale held approvals, licences and infrastructure to irrigate 2,064 ha of cropped land and water the western floodplain from water entitlements held for both the Darling and Warrego Rivers. Since its addition to the NSW reserve system, both planned and Commonwealth-held water is managed to achieve environmental benefits both on and downstream of Toorale within the operating requirements of the existing licences and infrastructure.

1.5.1 Existing Water Infrastructure

The Toorale dams were initially constructed during the 1880s to capture and divert flow primarily to facilitate floodplain irrigation and for enhanced pasture production across the property. The water management infrastructure has been modified in an ongoing manner since this time to support agricultural growth and have been the subject of numerous rebuilds and upgrades as well in response to structural failures during flood events (Jill Sheppard Heritage Consultants, 2013).

Even though some are breached, these historic dam embankments remain largely in place across the Warrego River. This has resulted in the establishment of water bodies and floodplain wetlands with important ecological, cultural and social values.

The location of the existing dam embankments within the Warrego River is provided in Figure 1-3.

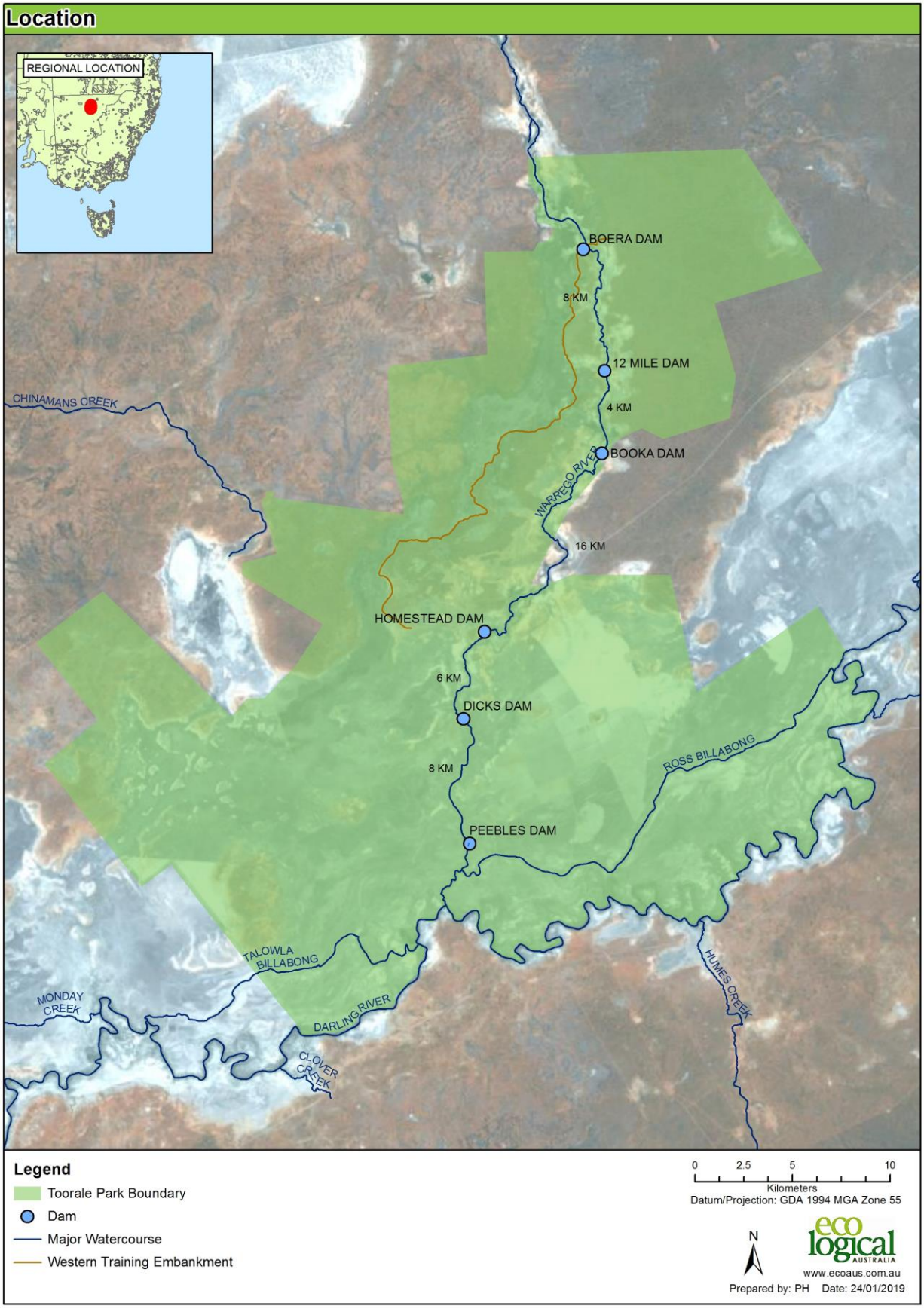


Figure 1-3: Existing water infrastructure and distance (km) between each

Water management infrastructure on Toorale at the time of purchase includes:

- **Boera Dam**: An embankment across the Warrego River that serves as a Stock and Domestic water supply for Toorale and two adjoining properties, Yandaroo and Delta Stations (Section 1.5.3 provides further detail).
- **Western Floodplain training embankment**: This structure comprises a low-lying embankment extending in a south-westerly direction from Boera Dam. The embankment retains flow bywashing from Boera Dam on the floodplain and constrains the return of flows from the Western Floodplain to the Warrego River. The structure includes several pipe regulators that were intended to be opened and closed to allow controlled releases from the Western Floodplain to the Warrego River prior to the installation of regulating pipes in the dam wall. The pipes are no longer functional, and flow periodically breaches the embankment and returns to the Warrego River.
- **12 Mile Dam**: An embankment across the Warrego River between Boera and Booka Dams that has remained breached since the 1970s and does not impede flows.
- **Booka Dam**: An embankment across the Warrego River near Booka Station, historically providing Stock and Domestic supplies for Toorale Station and Booka Station, east of the Warrego River (Section 1.5.3 provides further detail).
- **Homestead Dam**: An embankment across the Warrego River providing Stock and Domestic water supply for the Toorale Homestead. Homestead Dam is currently breached (Section 1.5.3 provides further detail).
- **Dicks Dam**: An impoundment created by a causeway on the public Toorale-Louth Road across the Warrego River that bisects the Toorale National Park.
- **Ross Billabong, including Duncan's Wall and Darling River levees:** Ross Billabong was previously used to store water sourced from both the Darling and Warrego Rivers. Removal of Peebles Dam (Phase 1) has reduced capacity to divert flows from the lower reaches of the Warrego River into Ross Billabong.
- **Irrigation water supply infrastructure**: Embankments and channels constructed across the floodplain to distribute water to the agricultural areas.

1.5.2 Water Access, Licences and Approvals

Arrangements until 2009

Past operation of water infrastructure on Toorale is not well documented, so there is a limited understanding of how flow events were managed in practice on Toorale prior to its purchase by government. Information gained from licencing records as well as consultation with the local community have helped inform a baseline water regime for the purposes of this assessment. Analyses of flows to the Western Floodplain and the Warrego River have also been undertaken using flood mapping and hydrological modelling.

Though initially constructed in the 1880s, formal regulation and licensing of the Warrego River water infrastructure did not occur until the1950s and 1960s in response to neighbours' concerns about the inequitable sharing of water, especially for stock watering. Hence the conditions for operating the dams were designed to ensure a riparian flow occurred throughout the lower Warrego River and some replenishment flows into the Darling (if it was low) before additional water was stored, diverted or used for irrigation on Toorale (P Terrill, unpub. 2009).

Operation of the structures also altered after the 1980s following irrigation development at Toorale, when the priorities for water use changed.

Current Arrangements

Water management arrangements changed again after Toorale was acquired by the NSW government in 2008 and the water entitlements were purchased by the Commonwealth Government. The existing Warrego River water infrastructure on Toorale is subject to water licencing and approvals consistent with those that applied at the time of purchase. The four Water Access Licences (WAL) under the *NSW Water Management Act 2000 (*WM Act*)* are now held by the Commonwealth Government and managed by the Commonwealth Environmental Water Holder (CEWH). While the inflows continue to be regulated under the same operating conditions, water held under licence is no longer extracted for irrigation and used to achieve environmental objectives on both Toorale and in the Darling River.

Water access and sharing within the NSW-section of the Warrego River is set out in the NSW Water Sharing Plan (WSP) for the Intersecting Steams Unregulated and Alluvial Water Sources (NOW, 2011), under the WM Act.

Two types of approvals for the management of water and the works in a river apply at Toorale:

- Water supply works approvals
- Water access licences (WALs)

Works approvals are held by the landholder, represented by the Director of the NPWS for administration of the structures. The water supply works approvals allow the construction of water supply infrastructure such as water pumps and dams to take water from a river. They also include conditions under which the infrastructure must be operated.

Toorale's WALs include:

- three separate Warrego River unregulated river access licences with a total volume of 8,106 ML (from above Boera Dam, Boera Dam and Peebles Dam) and;
- a special high-flow licence to extract 9,720 ML from the Warrego River at Boera Dam (Western Floodplain).

A summary of relevant water entitlements for storages associated with the Toorale Water Infrastructure Project is provided in Table 1-2.

Table 1-2: Existing water licences and works approvals

Location	Water Access Licence no.	Water Entitlements	Works Approval. Nominated works approval no.	Currently licensed works
Above Boera Dam	WAL27555	972 ML entitlement held by Commonwealth Government.	Held by the Minister administering the NPW Act (85WA751691). 85CA751704	2 x diversion channels
Boera Dam	WAL27558	1,134 ML entitlement held by Commonwealth Government.	85CA751696 (also linked to NPWS 27556)	1x by wash dam 1 x diversion channel 1 x block dam
Boera Dam	-	Domestic and stock water entitlement is held by the Minister administering the NPW Act.	-	-

Location	Water Access Licence no.	Water Entitlements	Works Approval. Nominated works approval no.	Currently licensed works
Western Floodplain (special high flow)	WAL31152	9,720 ML entitlement held by the Commonwealth Government for irrigation of the Western Floodplain.	85CA752842 (works) 85AL752845 (use)	1 x diversion channel
Booka Dam	-	Stock water entitlement is held by the Minister administering the NPW Act.	85WA751692	-
Homestead Dam	-	Domestic and stock water entitlement of 7 ML is held by the Minister administering the NPW Act.	Held by the Minister administering the NPW Act (85WA751693).	-
Peebles Dam/Ross Billabong	WAL27552	6,000 ML entitlement held by the Commonwealth Government	85CA751708 (also linked to NPWS 27551)	4 x 760 mm axial flow pumps

Relevant operating conditions from the works approvals relating to infrastructure operation include:

Boera Dam

The level of the invert of the 2 x 1220 mm pipes are prescribed, as is the size and location of 6 pipes through the Western Floodplain training embankment. Inflow up to the capacity of 2 x 1220 mm pipes at Boera Dam must be passed until:

- Warrego River flow has reached the Darling River, and
- Darling flow at Louth exceeds 330 ML/d.

The pipes may be closed when:

- The above flows are reached at the Darling River, or
- Inflow to Boera Dam ceases.

If the pipes are closed, they may not be re-opened until there is a subsequent inflow.

Diversion to the Western Floodplain and the eastern bywash occurs as a result of the conditions on the Boera Dam works approval.

Booka Dam

The level of the invert of the 2 x 1220 mm pipes are prescribed. Inflow up to the capacity of 2 x 1220 mm pipes at Booka Dam must be passed until Warrego River flow has reached the Darling River.

Homestead Dam

The level of the invert of the 2 x 1220 m pipes are prescribed. Inflow up to the capacity of 2 x 1220 mm pipes at Homestead Dam must be passed until Warrego River flow has reached the Darling River.

Management of Water Access Licences

When a flow event comes down the Warrego River to Toorale, the CEWH liaises with the NPWS so that structures are operated in such a way to manage their entitlements in accordance with their intentions.

The Commonwealth WALs are subject to the same conditions as those that applied if they were used for extractive purposes. There are also conditions against its special high flow licence requiring a flow of 979 ML/d at Louth before it can be called. Therefore, no allocation can be claimed against them until the required the relevant flow triggers are satisfied.

Once the full volume of allocation (or a lesser nominated volume) against the WALs is exhausted and deemed to have been delivered, any additional flows onto or through Toorale may be managed, consistent with the conditions on structures, to satisfy requirements on Toorale or downstream in the Darling.

Since 2013, the CEWH has informed its decision about how to use its entitlement using a strategy to determine the relative watering priorities of the Darling River, the Warrego River and the Western Floodplain of Toorale. In broad terms, this strategy delivers flow to the Darling River, the Warrego River and/or the western floodplain depending on the volume of inflow and where the environmental demand is greatest. The current CEWH watering strategy referenced Murray Darling Basin Authority Environmental Watering Requirement targets for the Darling River, which were the best available information at the time it was drafted. Long Term Watering Plans are now being finalised, providing new information which will likely lead CEWH to revise its delivery strategy.

Planned environmental water

The existence of the structures together with their operation in accordance with the works approval accounts for a significant component of water management at Toorale, in addition to water associated with the respective WALs. To put this into context, average inflows to Toorale managed by the Boera structure are approximately 90 GL per year, whilst the combined volume of all entitlements is about 18 GL. Water managed by the operation of the structures in accordance with the works approval conditions is considered planned environmental water. The operation of the structures both now and into the future impacts on both held environmental water (the Commonwealth entitlements) and planned environmental water, and requires coordination between the CEWH and NPWS to achieve the many objectives for water management at Toorale.

1.5.3 Relevant Historical and Current Structural Arrangements and Operations

Boera Dam

Boera Dam, in the northernmost part of the Park, is the most significant in terms of water management within Toorale and the downstream environment. After initial construction in the 1880s the dam was renovated and expanded into the 'Boera Dam and Floodwaters Scheme' in 1882, altering the flow and flooding regime across the lower Warrego floodplain, and consequently increasing the flood frequency of the floodplain by tenfold and creating high productivity/biodiversity wetland habitats behind the western training embankment (Jill Sheppard Heritage Consultants, 2013). Boera Dam remains the primary infrastructure for the diversion of water onto the Western Floodplain.

Flow gauging equipment (stream water level in metres) was installed at the gate valve outlets and commenced recording on the 5th of December 2012 (gauging station 423008 – Warrego River at Boera Dam, Zero-gauge 102.595 m AHD).

The current infrastructure on Toorale allows for the release of an estimated 600 ML/d through the control gates on Boera Dam and the downstream storages. Depending on inflows, water can be diverted onto

the Western Floodplain or to the Warrego River via the opening and closing of regulator gates on two 1,200 mm diameter pipes in the 4 m high earthen embankment (Figure 1-4). To meet works approval requirements, if sustained inflows are entering Boera Dam, the gates must be opened to let water flow through to the Darling River. These gates must remain open until flow in the Darling River at Louth, downstream of the Warrego River confluence, reaches 330 ML/d. The gates can then be closed to allow water levels to rise in Boera and flow onto the Western Floodplain, or they can be left open to provide a longer duration flow to the lower Warrego River (e.g. if the CEWH wishes to pass their water allocations to the Darling River). If the gates are closed, or inflows to Boera Dam exceed the capacity of the pipes, the storage fills to a point (2.26 m on the NSW 423008 Boera Dam gauge or 104.85 AHD) at which water will flow out of the Western Bywash and onto the Western Floodplain. If flows continue to rise, the eastern bywash is engaged (2.91 m on NSW 423008 gauge or 105.5 AHD) which carries flows around Boera Dam and returns them back to the Warrego River downstream.

The gates at Boera are hand operated by NPWS staff and, once they are opened, the gates at Booka Dam are accordingly adjusted. Once the gates are closed at Boera Dam following a flow event to ensure storage is maintained, they are left closed until the next flow event comes down the Warrego River. The current full supply level is 104.85 m AHD and the full supply capacity is estimated at 1,500 ML (Alluvium, 2016). This is now the largest storage on Toorale, but very small in the context of the Murray-Darling Basin (to put this volume into context it is about 0.1% of the volume of the Menindee Lakes).

Figure 1-4: Existing conditions at Boera Dam. Platforms lead to the gates that can be opened to pass water through the dam and downstream into the Warrego River.

Booka Dam

Booka Dam was constructed circa1880, presumably as part of the improvement works occurring to the Boera Dam and Floodwaters Scheme (Jill Sheppard Heritage Consultants, 2013). Booka Dam provides storage from which the adjoining Booka Station can access water.

The dam is an earthen embankment approximately 3 m high with two 1,200 mm diameter outlet pipes at its base (Figure 1-5). The pipes can pass an estimated 600 ML/d to the Warrego River. A high flow bywash channel is located on the western side of Booka Dam. The current full supply level is 101.4 m AHD and the full supply capacity is estimated at 106 ML (Alluvium, 2019a).

In line with the works approval requirements, the regulating gates on the outlet pipes at Booka Dam are required to be manually opened in a similar manner as those at Boera Dam. That is, once the Boera Dam gates are adjusted, then the Booka Dam gates are adjusted shortly after. At all other times, the gates at Booka Dam remain closed.

Figure 1-5: Existing conditions at Booka Dam. Two pipes pass water through the dam and downstream into the Warrego River.

Homestead Dam (breached)

Homestead Dam was constructed in 1876 to provide stock water and amenity for domestic purposes (Jill Sheppard Heritage Consultants, 2013). A levee runs along the high-water level to protect the historic Toorale Homestead and outbuildings from elevated water levels caused by the main embankment. A bywash is located on the eastern side of the dam. Two 1,200 mm diameter regulator pipes have been installed through the embankment, not far from the breach site, at the original river bed level (Figure 1-6).

The dam was breached 100 m west of the regulator pipes during a flood event during 2012. The breach has significantly reduced the storage capacity of Homestead Dam. Prior to this breach, the full supply level of Homestead Dam was 99.5 m AHD, with an estimated volume of 665 ML, and the pipes were operated to pass an estimated 600 ML/d in accordance with works approval conditions.

The works approval for Homestead Dam requires that water up to the capacity of the pipes to be passed until the Warrego River flow enters the Darling River, or until flows at Louth on the Daring River exceed 330 ML/d. They can then be closed until the next inflow, impounding water within Homestead Dam. The gates on these two pipes are manually operated but have not been used since the dam breached in 2012. Currently a small body of water is retained within the storage controlled by an existing low-level road causeway located downstream of the original dam wall, with a crest level of 97.5 m AHD.

Figure 1-6: Existing conditions Homestead Dam

Current operating strategy

Currently, environmental water within Toorale that is owned by Commonwealth Government is managed in line with the CEWH's 5-year environmental watering strategy. This sets out a decision tree that should be followed once a flow event that may trigger licences on Toorale enters Boera Dam (Figure 1-7). These decisions are based on the anticipated size of the flow event, and the relative demand for water either downstream in the Warrego and Darling Rivers, or on the Western Floodplain.

As examples:

- if a small flow reaches Toorale, and downstream demands are high, then the gates in Boera and Booka dams will be left open once works approval conditions are met, and water will be accounted against the unregulated river access licence up to the available balance.
- If under the same situation, the Western Floodplain demand is high and downstream demand is low, then once works approval conditions are met, the gates at Boera and Booka Dams would be closed, and water would be allowed to flow out onto the Western Floodplain and accounted for against the Special additional high flow access licence.
- If demands are high for both downstream needs and the Western Floodplain, then once works approval conditions are met, inflows are split, and water is delivered to both areas.

The particular demand rating (high or low) is a function of a series of factors related to current flows in the Darling River, time since last connection, water quality and current ecological condition.

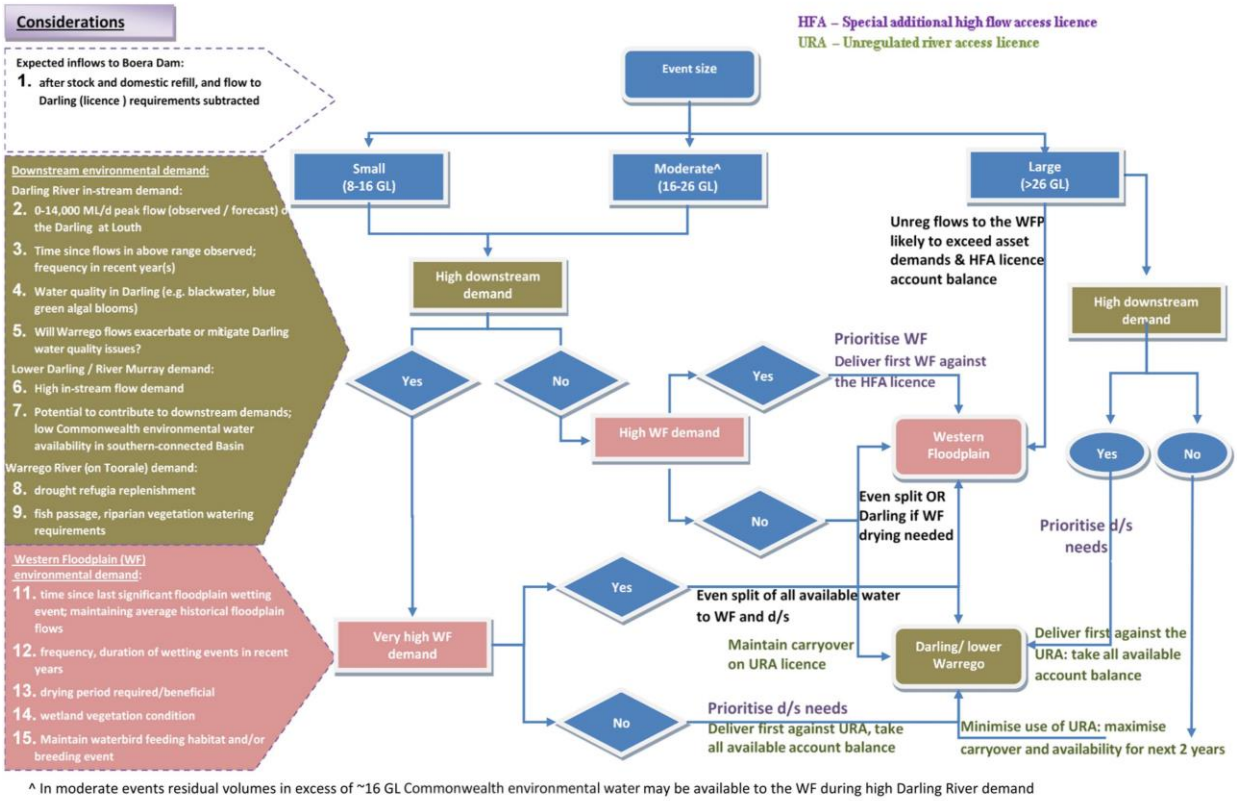


Figure 1-7: Current management strategy for environmental water at Toorale (CEWHCEWH, 2013)

2 Permissibility and Justification

This REF has been prepared to enable assessment of the proposed activities under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This REF indicates whether the activity is permissible under the legislation and includes explanation where necessary.

Some legislation does not apply to land reserved under the NPW Act; however, it is DPIE policy that the **objectives** and **principles** of these Acts and SEPPs are applied to the assessment of on-park activities. Section 1.10 and Appendix 1 of the Guidelines for Preparing a Review of Environmental Factors provide guidance on permissibility.

2.1 Commonwealth legislation

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The Commonwealth EPBC Act protects Matters of National Environmental Significance (MNES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others).

Any actions that will, or are likely to, have a significant impact on MNES require referral and approval from the Australian Government's Environment Minister as a 'Controlled Action'. Significant impacts are defined by the Commonwealth guidelines and policies (DoEE, 2018) for MNES. Evaluating the significance of the impacts associated with the proposed activity has been considered by determining how extensive the impacts are, how adverse the impacts are on environmentally sensitive areas and how acceptable the impacts are, in accordance with the guidelines for preparing a REF (OEH, 2016). Potential impacts to MNES have been assessed through the preparation of this REF and are summarised in Table 2-1.

Table 2-1: EPBC factors for consideration and likely impact

Factor	Likely impact
a. *Any impact on a World Heritage property?* The proposal is not on a World Heritage property	Nil
b. *Any impact on a National Heritage place?* The proposal will not impact any National Heritage place (**Section 5.7: Historic Heritage**).	Nil
c. *Any impact on a wetland of international importance?* The directory of Important Wetlands was searched on 16/10/2019 and found no listing for Toorale. The proposal will not impact any wetland of international importance.	Nil
d. *Any impact on a listed threatened species or communities?* Flora and Fauna assessments undertaken to support this REF indicate that the proposal is unlikely to significantly impact on EPBC listed threatened species and communities (**Sections 5.25.3 & 5.4; Appendix G**)	Unlikely
e. *Any impacts on listed migratory species?* The proposal would not significantly impact any Commonwealth-listed migratory species (Appendix H)	Nil

Factor	Likely impact
f. *Any impact on a Commonwealth marine area?* The proposal will not impact any Commonwealth marine area	Nil
g. *Does the proposal involve a nuclear action (including uranium mining)?* The proposal does not involve a nuclear action	Nil
h. *Additionally, any impact (direct or indirect) on Commonwealth land?* No Commonwealth land will be impacted by the proposal	Nil

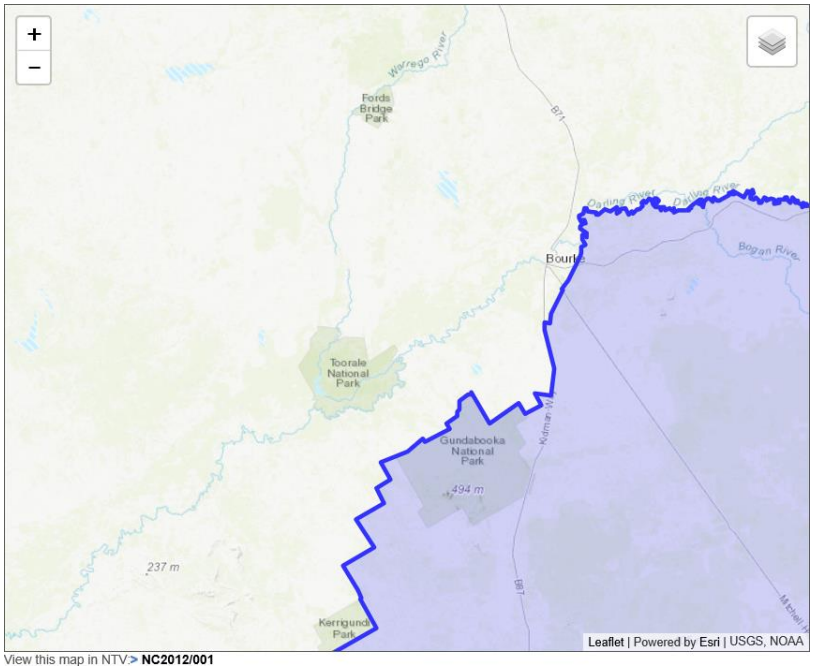
It is concluded that a significant impact is not likely to result and therefore a referral to the Australian Government Department of Environment and Energy is not required. Consultation undertaken with the Australian Government Department of Environment and Energy is documented in Section 4.2.

2.1.2 Native Title Act 1993

The Commonwealth *Native Title Act 1993* (Native Title Act) was introduced following the High Court Mabo judgment and significantly amended following the High Court's Wik decision. The Native Title Act does four major things of relevance to the proposed development:

- recognises native title rights exist in Australia where those rights have not been extinguished (e.g. by the grant of a freehold title)
- validates certain past actions carried out by governments
- includes a 'future act regime' that allows for governments to continue undertaking certain activities on the Crown estate where native title has not been extinguished
- states that compensation may be owing to native title holders for certain past and future acts.

There have been no native title claims over the subject site. The nearest Native Title claim submitted in the vicinity of the proposed works, NC 2012/001, is located generally east of the Toorale National Park and includes parts of Bourke, Nyngan and Cobar. NC 2012/001 was submitted to the Australian Commonwealth Government in 2012 by the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan groups (National Native Title Tribunal, 2018).



View this map in NTV> **NC2012/001**

2.2 State legislation and policies

2.2.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

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

Justification: The activity may be undertaken without development consent as it is **on reserved land** and is for a purpose authorised under the NPW Act. Clause 65 of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) provides that development for any purpose may be undertaken without consent on land reserved under the NPW Act. This removes the need for development consent under Part 4 of the EP&A Act (e.g. council approval), meaning that most activities within DPIE land are assessed under Part 5 of the EP&A Act. Further detail regarding the ISEPP is given in Section 2.2.3. The proponent of the project is the NSW Government acting through the DPIE. Under section 5.1 of the EP&A Act, certain government entities are deemed to be a determining authority.

However, DPIE proponents should still confirm that the ISEPP is applicable to their particular proposal and provide consideration of other environmental planning instruments that would otherwise apply to the proposal if it were not occurring on DPIE land. Notwithstanding this, under section 5.5 of the EP&A Act, a determining authority has the duty to fully consider the environmental impact of an activity and is required to "take into account to the fullest extent possible all matters affecting, or likely to affect the environment" arising from the proposal. Section 5.5 assists in attaining the objects of the EP&A Act relating to the protection and enhancement of the environment. This is facilitated through the current REF, the purpose of which is to identify, assess and determine the significance of potential environmental impacts, as well as mitigating actions and responsibilities to minimise potential impacts.

Section 1.7 of the EP&A Act states that the Act has effect subject to the provisions of Part 7 of *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act). The proponent is required to consider the significance of potential impacts on biota listed under the BC Act

through assessments of significance (5-part tests). Section 221ZV of the FM Act applies to environmental assessment under Part 5 of the EP&A Act and sets out the 'Assessment of significance' for species, populations or ecological communities listed under the Act.

Under section 2.7 of the REF Guidelines, an Environmental Impact Statement (EIS), rather than a REF, is **not** required due to the following:

- Assessments of significance conclude that there will be no significant impact on the environment or any threatened species, population or ecological community, or their habitat, listed under the BC Act or FM Act (Appendix G and Appendix I) and therefore a Species Impact Statement (SIS) will not be required.
- the activity will **not** adversely affect the heritage significance of the site, nor will it unacceptably impact cultural heritage items, and the works are **not** likely to have any high or major impact on the fabric, setting or community values.
- The activity is also **not:**
    - on land that contains coastal wetlands, littoral rainforest or koala habitat and the relevant aims, objectives, principles and provisions of the relevant SEPPs (namely SEPP 14, SEPP 26 or SEPP 44) have therefore **not** been considered in preparation of the REF.
    - of a similar kind to those described in the State and Regional Development SEPP, but doesn't satisfy the exact criteria to be State Significant Development of Infrastructure under that SEPP.
    - of a similar kind described in Schedule 3 of the EP&A Regulation. (This schedule relates to designated development under Part 4 of the EP&A Act but gives DPIE a good indication that the activity is one that is likely to significantly affect the environment).

Pursuant to section 5.5 of the EP&A Act, a determining authority shall also consider the effect of an activity on any wilderness area (within in meaning of the *Wilderness Act 1987*) in the locality in which the activity is intended to be carried on. The proposed works are not located in a wilderness area and will not influence any wildness areas outside of the project area.

2.2.2 Environmental Planning and Assessment Regulation 2000 (EP&A Reg)

There are no specific guidelines in force under clause 228(1) of the EP&A Reg for the proposed modification of the dams. As such, the factors that need to be taken into account when considering the environmental impact of an activity are identified under clause 228(2) of the EP&A Reg and the section of the REF where these items have been assessed -- Table 8-1 summarises the compliance of the proposed project under the requirements of clause 228 of the EP&A Reg.

2.2.3 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The aim of this Policy is to facilitate the effective delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development. Whilst the proposed activity is in accordance with the Toorale PoM, the PoM is currently in draft form. In the absence of a PoM adopted by the Minister, clause 8 of the ISEPP provides that, in the event of an inconsistency between it and any other environmental planning instrument, including a Local Environment Plan (LEP), the ISEPP will prevail.

Clause 65 of the ISEPP provides that development for any purpose may be undertaken without consent on land reserved under the NPW Act. This removes the need for development consent under Part 4 of the EP&A Act (e.g. council approval), meaning that most activities within DPIE land are assessed under Part 5. However, below consideration of ISEPP clauses and other environmental planning instruments that would otherwise apply to the proposal if it were not occurring on DPIE land are provided below.

Pursuant to clause 127(m) of the ISEPP, development in connection with a water supply system for the purpose of "*maintenance or replacement of components of water supply systems that does not increase capacity (or increases capacity only to a minimal extent)*" may be carried out by, or on behalf of, a public authority as exempt development. Under the Standard Instrument definitions, water storage facilities and water reticulation systems are types of water supply system. Water storage facilities are defined as "*a dam, weir or reservoir used for the collection and storage of water, and includes associated monitoring or gauging equipment*". Water reticulation systems are defined as "*a building or place used for the transport of water, including pipes, tunnels, canals, pumping stations, related electricity infrastructure and dosing facilities*", but also includes water supply reservoirs under clause 124 of the ISEPP.

Therefore, the proposed modifications to Boera, Booka and Homestead Dams are considered to be maintenance and/or replacement of existing water storage facilities and water supply reservoirs, permissible as exempt development under clause 127(m) of the ISEPP. However, to retain the classification as exempt development, the development must comply with clause 20 (general requirements for exempt development) of the ISEPP, and involve no greater soil and vegetation disturbance than necessary and no increase in stormwater drainage and run-off from the site. Clause 20 is as below:

20 General requirements for exempt development

(2) To be exempt development, the development:

(a) must meet the relevant deemed-to-satisfy provisions of the *Building Code of Australia*, or if there are no such relevant provisions, must be structurally adequate, and

(b) must not, if it relates to an existing building:

(i) cause the building to contravene the *Building Code of Australia*, or

(ii) compromise the fire safety of the building or affect access to any fire exit, and

(c) must be carried out in accordance with all relevant requirements of the Blue Book, and

(e) if it is likely to affect a State or local heritage item or a heritage conservation area, must involve no more than minimal impact on the heritage significance of the item or area, and

(e1) must not involve the demolition of a building or work that is, or is part of, a State or local heritage item, and

(e2) if it involves the demolition of a building, must be carried out in accordance with Australian Standard AS 2601—2001*, The demolition of structures*, and

(f) must be installed in accordance with the manufacturer's specifications, if applicable, and

(g) must not involve the removal or pruning of a tree or other vegetation that requires a permit or development consent for removal or pruning, unless that removal or pruning is undertaken in accordance with a permit under an LEP or development consent under LLS Act, and

(h) must not involve the removal of asbestos, unless that removal is undertaken in accordance with *Working with Asbestos: Guide 2008 (*ISBN 0 7310 5159 9*)* published by the WorkCover Authority.

Additionally, works on Boera, Booka and Homestead Dams are permissible under clause 129(1) of the ISEPP, whereby development for the purpose of waterway management activities may be carried out by or on behalf of a public authority without consent. Clause 129(2) clarifies that development includes construction works, routine maintenance works, emergency works, including works required as a result of flooding, storms or erosion, and environmental management works in connection with waterway management activities. Because works are within the main Warrego River channel, definitions of waterway management activities under clause 128 that are relevant to the proposed works include:

(a) riparian corridor and bank management, including erosion control, bank stabilisation, resnagging, weed management, revegetation and the creation of foreshore access ways, and

(b) instream management or dredging to rehabilitate aquatic habitat or to maintain or restore environmental flows for ecological purposes, and
(f) installation or upgrade of waterway gauging stations for water accounting purposes.

The ISEPP does not switch off the requirement for approvals under the FM Act for works affecting Key Fish Habitat (KFH). As such, DPIE is required to obtain approval under section 199 of Part 7 of the FM Act to undertake dredging and reclamation works if open trenching is used in waterways classified as KFH (Section 2.2.9).

2.2.4 National Parks and Wildlife Act 1974 (NPW Act)

The *National Parks and Wildlife Act 1974* (NPW Act) is administered by the Director-General of the NPWS, who is responsible for the control and management of all National Parks, historic sites, nature reserves, and Aboriginal areas (among others).

Justification:

Objects of the Act (section 2A):

The objects (section 2A) of the NPW Act include the conservation of nature and the cultural heritage of NSW, and fostering the public's appreciation, understanding and enjoyment of these. The objects of this Act are also to be achieved by applying the principles of ecologically sustainable development (ESD) as assessed in Section 7.

On balance, the proposed modifications to Boera, Booka and Homestead Dams and associated operational strategies are viewed as consistent with the objects of the NPW Act as the project considers, through the assessment process, and avoids as far as practicable, any negative impacts to nature (including habitat, ecosystems, ecosystem processes, biodiversity, and landforms, landscapes and natural features of significance), objects, places or features of cultural value. The project will not decrease access to the National Park and State Conservation area – on the contrary it may enhance access and visitation, as minor repairs to the road will need to be undertaken as part of the works. As such it will continue to be publicly appreciated, understood and enjoyed by the public and conserved. The works will also have positive impacts on nature and wider ecosystem, through the installation of fishways which will enable better dispersal and migration of native fish within and between the Warrego and Darling Rivers, the improvement and ability for NPWS and the CEWHCEWH to manage water for environmental and community benefit, and through the maintenance of and repairs to historically and culturally significant embankments.

The proposal to modify Boera Dam is expected to reduce water flow into the Western Floodplain is expected to further reduce water flow into the Ross Billabong as a cumulative impact to the east of the decommissioned Peebles Dam. This may have some adverse impact on the current ecological values of the Western Floodplain and Ross Billabong. It is important to note that in higher flows in the Darling River, Ross Billabong can be inundated from the Darling River (as naturally occurred in the past and under the current hydrology). The exact degree and nature of the impacts resulting from the likely changed flow regime to Ross Billabong is uncertain, although improvements to the ecosystem elsewhere in the rivers is expected to at least partially offset any impacts.

Ross Billabong also played an important role in the former operation of the Toorale Woolshed and wool scour precinct. The draft Conservation Management Plan for the heritage precincts on Toorale recommends that 'sufficient' water be 'maintained' as a body of water in Ross Billabong to maintain the setting, support the local vegetation as the setting for the Shearer's Quarters and the historic Woolshed and make sense of the Woolshed's location. As a result of the proposed works, the presence of water in Ross Billabong is expected to occur at a lower frequency and duration than under current conditions.

Whilst this is not the preferred outcome as envisaged in the draft CMP, in terms of the objects of the NPW Act this does not compromise the conservation of a place of historic significance nor significantly impact on the fostering of public appreciation, understanding or enjoyment of cultural heritage

Installation of a fishway at each of Boera, Booka and Homestead Dams will allow for improved fish passage, which will benefit fish species in the Warrego River and improve connection with the Darling River. In terms of the objects of the NP&W Act, this is an important action in the conservation of ecosystem processes and biological diversity within Toorale.

Reserve management principles (s.30E–30K):

The proposed activity is not inconsistent with the purpose of a National Park or State Conservation Area. Whilst there will be some adverse impacts associated with the activity, there will also be ecological benefits and outcomes for the community. On balance, and through supporting the section 2A objects as described above, the activity will still promote the management of the Park in accordance with the management principles (Division 2) for National Parks (section 30E) and State Conservation Areas (section 30G) under the NPW Act which are as follows:

- the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes,
- the conservation of places, objects, features and landscapes of cultural value,
- the promotion of public appreciation and understanding of the NP/SCA's natural and cultural values,
- provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the NP/SCA's natural and cultural values (SCA only: and with uses permitted under other provisions of this Act in such areas),
- provision for the sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to the conservation of the NP/SCA's natural and cultural values (SCA only: and with uses permitted under other provisions of this Act in such areas),
- (NP only) the protection of the ecological integrity of one or more ecosystems for present and future generations,
- (SCA only) provision for the undertaking of uses permitted under other provisions of this Act in such areas (including uses permitted under section 47J) having regard to the conservation of the natural and cultural values of the state conservation area.

Despite the potential impacts of the dam modifications on the ecology of the Western Floodplain, the project aims to balance these with the provision of ecological benefits from improved fish passage and the management of instream environmental flows Furthermore, the proposed operating strategy has been designed to meet the minimum environmental water requirements of the water-dependant vegetation types in the western floodplain. The Project aims to minimise impacts from physical disturbance and future water management operations on historic and cultural heritage.

Boera Dam, Booka Dam, the Western Floodplain and Ross Billabong are not within the main visitor precincts and visitation to those sites is uncommon. While Homestead Dam Precinct is more frequently accessed by tourists, most do not venture across the dam. Phase 2 modifications will improve access via the bridge construction and will improve the local visual amenity of the broader precinct by allowing for a larger waterbody to be retained and remediation of the breached area is expected that remediating the breach area will reduce erosion of the bank and river in this area.

The proposal also demonstrates sustainable use and adaptive reuse by incorporating existing features into the proposed modifications and reusing spoil where practicable. Efforts will be made to source materials as locally as possible to the site to reduce travel costs and associated emissions.

The proposed works do not compromise the purpose of the Park to protect and conserve outstanding or representative ecosystems, natural and cultural features and landscapes, nor the provision of opportunities for the Park to be appreciated, understood and enjoyed by the public. Phase 2 of this project involves modification of dams rather than the decommissioning or removal of these features, which lessens the degree of change and impact.

Relevant sections of plan of management or statement of management intent:

Section 81 of the NPW Act provides for operations under a plan of management (PoM). The Toorale PoM is a statutory document required under the NPW Act. Once the Minister has adopted a plan, the plan must be carried out and only operations in accordance with the plan may be undertaken in relation to the lands. Whilst the proposed activity is in accordance with the Toorale PoM, the PoM is currently in draft form. In the absence of a PoM adopted by the Minister, clause 8 of the ISEPP provides that, in the event of an inconsistency between it and any other environmental planning instrument, including a LEP, the ISEPP will prevail.

The *Toorale National Park and Toorale State Conservation Area Statement of Management Intent* (SMI) currently applies to the management of Toorale. In summary, the SMI identifies the following values associated with Toorale:

- the dreaming stories and cultural practices of the Kurnu-Baakandjii People (and ongoing Connections to Country) associated with the area west of the Warrego and Darling Rivers.
- The ongoing role of the Kurnu-Baakandjii People in the management and use of Country including management and use of plants of cultural significance.
- The representation of the natural values of the Darling Riverine Plains and Mulga Lands bioregions in the reserve system.
- Coolibah Black Box Woodland Endangered Ecological Community (accounting for approximately 20% or over 18,000ha of the vegetation on Toorale).
- The Warrego River and its wetlands, including the western floodplain and influenced by water management structures, containing high conservation value biodiversity. One endangered plant (*Dentella minutissima*) and one ‘rare’ plant (*Synostemon trachyspermus*).
- 15 vulnerable fauna species known to occur.
- An additional 17 fauna species of conservation concern.
- Migratory species that are part of international agreements.
- The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River, including the Toorale reach of the Warrego River (EEC under the *Fisheries Management Act 1994*).
- Historic significance at the local state and national level.
- Two megafauna fossil sites adjoining the Park which are likely to extend below exposed ground surfaces into the Park.
- Nature and heritage-based recreation.

Overall, the proposed activity aims to meet State and Commonwealth water flow delivery requirements and objectives whilst protecting and maintaining the environmental, heritage and cultural values present within Toorale which aligns to the SMI.

Some of the values listed in the SMI may be disadvantaged by the proposed works, including the vegetation within the immediate disturbance footprint and future potential changes to the ecosystems of the Western Floodplain and Ross Billabong, including flora and fauna habitat and the Coolibah Black Box EEC. However, direct impacts are localised in the context of the entire Toorale NP and SCA and much of the impact area (if not all except for access tracks) will be regenerated actively and/or passively over time so that Coolibah black box EEC returns to those areas, and adapative approach to flow management is proposed to avoid unavoidable impacts to western floodplain communities. Therefore, the ecological values specifically identified in the current SMI will remain represented across large areas of the Toorale NP and SCA. The proposed works will also provide for future benefits to biodiversity both within the Toorale NP and downstream, from improved fish passage and downstream environmental flows. Overall the proposal is likely to have a positive impact on the Darling River aquatic ecological community EEC.

Whilst the proposed activity will impact on Aboriginal cultural heritage, the works are generally supported by the Toorale Joint Management Committee. The SMI also notes the historic significance of Toorale at the local, state and national level. Whilst the proposal will have some impacts on areas of historic value, these impacts are not considered to be significant at the scale of the National Park or at the scale of the locality.

Is it consistent or compatible with park management and maintenance actions?

The proposed activities will not impede park management practices apart from during construction activities, and will enable more effective conservation practices for improved environmental outcomes. The reinstatement of the crossing at Homestead Dam will facilitate access across the embankment which was formerly utilised by NPWS staff prior to its collapse. Reinstatement of access across Homestead Dam is a priority for the local NPWS. Automation of the gates at Boera Dam, will reduce time and resources needed to pass inflows, and avoid issues with accessing this and sites to operate infrastructure when conditions do not allow. The proposed spill and fill arrangements at Booka and Homestead Dam will remove the need for staff to access and operate gates at these sites to pass inflows. However, all three structures will require ongoing maintenance to optimise their performance.

The draft Conservation Management Plan specifies that '*management of water flows through historic dams and tanks is to be preferred over decommissioning of historic dam infrastructure. It is appropriate to sympathetically modify existing historic dams for example with the addition of a weir to manage water flows. Partial decommissioning of historic water infrastructure where necessary will where possible be carried out in a sensitive manner so that the majority of the dam or tank remains to identify its location, size and shape and evidence the construction techniques used. As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials'.*

In alignment to this, Phase 2 seeks to modify the existing historic dam infrastructure within the Boera Floodwaters Scheme. The activities are consistent with the intentions of the Plan which clearly prefer modification or adaptation of the existing three dams and crossings to achieve desired environmental outcomes, as opposed to total demolition or decommissioning. The proposal to construct new automated vertical regulator gates at Boera Dam will assist NPWS staff to manage environmental flows within the river. New spillways or 'fill & spill' systems at Booka and Homestead Dams will also assist staff to manage flows within the river in order to maintain or improve the Parks' natural and cultural values. The proposed works will also facilitate more effective management practices for NPWS staff and amenity for visitors, including provision of water supply for management purposes and amenities. The proposal also helps to achieve desired outcomes, as identified in the Draft POM, which seek to protect significant cultural places from flooding (where possible) and improve fish passage within the river. In essence the proposed activities are compatible with park management and maintenance actions and are consistent with the

relevant aims and objectives of the *Conservation Management Plan*, *Draft Plan of Management* and Toorale SMI.

Management powers and responsibilities of OEH (s.8 and s.12):

Management powers and responsibilities of OEH (DPIE) (section 8, miscellaneous functions of Chief Executive, and section 12, powers and functions of Service, of the NPW Act).

Under section 12 (a-g), the Service is to carry out such works and activities as the Minister may direct, either generally or in a particular case, in relation to the conservation and protection of threatened species, populations and ecological communities, the identification, conservation and protection of, and prevention of damage to, Aboriginal objects and Aboriginal places, the identification and protection of buildings, places and objects of non-Aboriginal cultural values and provision of facilities and opportunities for sustainable visitor or tourist use and enjoyment on land reserved under the Act. The proposal will act to protect identified natural and cultural values and to provide appropriately upgraded and maintained water management infrastructure.

Aboriginal Cultural Heritage:

The NPW Act also affords protection for Aboriginal cultural heritage in NSW. Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to destroy, deface, damage, or move them from the land, irrespective of their level of significance or issues of land tenure. Pursuant to sections 89 and 90 it is an offence to disturb an Aboriginal object or knowingly destroy or damage, or cause the destruction or damage to, an Aboriginal object or Aboriginal place, except in accordance with a permit or consent under sections 87 and 90 of the NPW Act. The DPIE must be notified on the discovery of Aboriginal objects under section 89A of the NPW Act. DPIE has and continues to follow the correct legislated processes and procedures to assess and minimise harm to Aboriginal Objects. Designs have taken into consideration the occurrence of significant Aboriginal Objects and have avoided these areas where possible, for example areas east of Boera. Where impacts can't be minimised, AHIPs have been secured and will be complied with, including salvaging Aboriginal Objects with the community to preserve them.

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010b) as adopted by the *National Parks and Wildlife Regulation 2009* (NPW Reg) made under the NPW Act, provides guidance to individuals and organisations to exercise due diligence when carrying out activities that may harm Aboriginal objects. This Code also determines whether proponents should apply for consent in the form of an AHIP under section 90 of the Act. The NPW Act provides that a person who exercises due diligence in determining that their actions will not harm Aboriginal objects has a defence against prosecution if they later unknowingly harm an object without an AHIP. However, if an Aboriginal object is encountered in the course of an activity work must cease and an application should be made for an AHIP. Two AHIPs have been approved for the proposed works under permit numbers C0003079 and C0004300. AHIP C0003079 covers the survey, geotechnical investigations and construction works at Boera, Booka, Homestead, Dick's and Peebles Dams. A second AHIP (C0004300) covers the modified project works area at Boera, Booka, Homestead and Peebles Dams and includes permission to harm all Aboriginal objects located within the AHIP boundary. DPIE is will seek a third AHIP to ensure the project complies with the modified impact areas as a consequence of improvements to the infrastructure designs, and will be consulting the Registered Aboriginal Parties in early 2020.

In addition to the Due Diligence Code of Practice, *Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010b) was developed to support the process of investigating and assessing Aboriginal cultural heritage. It specifies the minimum standards for archaeological investigation undertaken in NSW under the NPW Act.

An Aboriginal cultural heritage assessment provided in Appendix J and summarised further in Section 5.6, indicates that potential impacts resulting from the proposed works shall be managed through the application for an Aboriginal Heritage Impact Permit (AHIP) to be prepared in accordance with conditions provided in (Biosis, 2019).

The Toorale Joint Management Committee has been consulted throughout all stages of the Project.

Compliance with NPWS Conservation Agreement, Conservation Plan, or another plan

A draft Conservation Management Plan (CMP) for the Toorale NP and SCA has been prepared (Jill Shepherd Heritage Consultants, 2013). Whilst this CMP is available on the Department's website the NPWS Bourke Area Manager has confirmed that this document remains draft only. NPWS have identified errors within the current version (Melissa Hams *pers.comm*. 31 May 2019).

The CMP states that *'Management of water flows through historic dams and tanks is to be preferred over decommissioning of historic dam and tank infrastructure. It is appropriate to sympathetically modify existing historic dams for example with the addition of a weir to manage water flows. Partial decommissioning of historic water infrastructure where necessary will where possible be carried out in a sensitive manner so that the majority of the dam or tank remains to identify its location, size and shape and evidence the construction techniques used. As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials'.*

The proposed activity appears partially consistent with this draft CMP recommendation However, the Statement of Heritage Impact (SHI) provided with the REF concludes that removal of part of the embankment will not have a materially detrimental effect on the heritage significance of the Boera Dam and Floodwaters Scheme.

The CMP also states that the modified Ross Billabong is recognised as a critical component of the setting of the historic Toorale Woolshed. The CMP includes the recommendation: *'Ensure that the Ross Billabong in the vicinity of the Toorale Woolshed (BS001) is maintained as a body of water, sufficient to support the local vegetation as the setting for the Shearers Quarters and the Woolshed'.*

Page 126 of the CMP states: '*The Ross Billabong in the vicinity of the Toorale Woolshed (BS001) is also recognised as an important factor in the story and success of the Woolshed operations. NPWS will aim to maintain sufficient water in the Billabong near the Woolshed to maintain the setting and make sense of the historic Woolshed's location'.*

Following the implementation of the proposed activity the presence of water in Ross Billabong is expected to occur at a lower frequency and duration compared with current conditions. In simple terms, low to moderate flows in the Warrego River will no longer be diverted into and held in Ross Billabong. However, when larger flows do inundate the billabong, they will not be pumped out to the old irrigation area as they used to be prior to the purchase of Toorale by the State government – so in that respect those flows will be 'maintained' in the billabong until their natural recession.

The SHI does not specifically note the recommendations of the CMP regarding Ross Billabong, nor discuss what level or frequency of inundation would be considered 'sufficient' to maintain the setting and make sense of the Woolshed's location. However, it does acknowledge that the removal of part of the Peebles embankment will result in altered flooding regimes in the lowest reaches of the Warrego River, and concludes that these will be more representative of the natural flow regimes than those associated with the full development of the historic Boera Dam and Floodwaters Scheme and likely more similar to conditions associated with the historic context of the Old Toorale Woolshed Precinct.

Nevertheless, NW BCD concludes that the proposed activity may not be entirely consistent with the recommendation of the draft CMP related to Ross Billabong and the historic setting of the Woolshed precinct. This is discussed further below.

The NPWS Historic Heritage, Historic and World Heritage Team (Partnerships, Planning and Heritage Branch) have not objected to the proposed activity.

2.2.5 Heritage Act 1977

Under section 140 of the *Heritage Act 1977* (Heritage Act) a person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damage or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. A relic is any deposit, artefact, object or material that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and is of State or local heritage significance.

Section 140 does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Order.

Justification (*indicate all the following that are relevant*) (*for activities likely to affect items or places listed on the State Heritage Register or of historic cultural heritage value*):

The activity is on land that contains:

- ☐ an item listed on the State Heritage Register (SHR)
- ☒ an item not listed on the SHR but identified by DPIE as being of state significance
- ☒ an item listed on the DPIE Heritage and Conservation Register (contained in the Historic Heritage Information Management System)
- ☐ a place, building landscape feature or moveable heritage item older than 25 years

The Park retains a significant amount of built infrastructure and built heritage relating to its former agricultural use, including the main homestead, woolshed, shearers quarters and other rural buildings. Since its purchase by the NSW Government in 2008, emergency restoration and repair works have been undertaken to the homestead and woolshed.

The Conservation Management Plan identifies the Boera Dam and Floodwaters Scheme as having state heritage significance with potential national heritage significance. Furthermore, the whole of the Park (or the homestead or woolshed individually) may also meet the National Heritage List thresholds, thereby making it eligible for the National Heritage List, subject to future consideration. Notwithstanding the important heritage values of Toorale, the precincts and property as a whole are not the subject of an interim heritage order, nor has it been added to the State Heritage Register in accordance with the *Heritage Act 1977*.

ELA has undertaken a Historic Heritage Assessment to determine any potential impacts of the proposed works on historic heritage (Section 5.7). Where impacts were identified, these are addressed in a Statement of Heritage Impact (SoHI Appendix K) prepared in accordance with *NPWS templates for Heritage Assessments and Heritage Impact Statements*.

2.2.6 Native Title Act 1994

This Act (enabling the Commonwealth Native Title Act) provides for the recognition of traditional Aboriginal ownership of land in NSW. The enabling of the Act has seen the rise of native claimant groups across the site who aim to prove traditional land ownership through historic connection. Native title

claimant groups are routinely consulted on matters of Aboriginal cultural heritage, which relate to locations of which they have traditional knowledge or association - irrespective of whether their native title claims have been determined by the judicial system. Consultation regarding matters relating to Aboriginal cultural heritage has been conducted through the excavation works conducted and completed by Biosis on behalf of DPIE in April 2018 (Biosis, 2018a) and for Boera Dam only in November 2019 (Biosis, 2019).

2.2.7 Biodiversity Conservation Act 2016 (BC Act)

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

The BC Act contains provision relating to threatened species and ecological communities' listings and assessment, section 1.7 of the EP&A Act and repealing the *Threatened Species Conservation Act 1995*. The BC Act lists and protects threatened species, populations and ecological communities that are under threat of extinction in NSW. The BC Act also provides for a biodiversity offsets scheme, a single biodiversity assessment methodology (BAM), calculation and retirement of biodiversity credits and biodiversity assessment and approvals. The BC Act also contains measures for flora and fauna protection, repealing parts of the NPW Act. The *Biodiversity Conservation Regulation 2017* supports the BC Act.

Justification: *Is the activity consistent with the biodiversity conservation objectives of the Act?*

The proposal is consistent with the objectives of the BC Act in that it aims to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development.

Potential impacts to threatened species and endangered ecological communities listed under the BC Act are addressed in **Section 5.4** and in **Appendix G** of this report. Assessments of significance for the impact to threatened species and endangered ecological communities in accordance with section 7.3 of the Act have been undertaken for the proposed works and are addressed in **Appendix G** of this report. No significant impacts are likely to result, and therefore a BDAR or a SIS is not required to be prepared.

2.2.8 Rural Fires Act 1997

The *Rural Fires Act 1997* (Rural Fires Act) provides for the preparation, mitigation and suppression of bush and other fires in local government areas and to provide protection of infrastructure and environment, economic, cultural, agricultural and community assets from damage arising from fire.

The site contains Bushfire Prone Land as mapped on the Bourke Shire Bushfire Prone Land Map. However, the proposed development is not a subdivision for residential or rural residential purposes nor is it for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required.

Justification: *Is the activity consistent with the objectives of protecting life and property and protection of the environment? Is it consistent with bush fire management plans?*

The proposed activities would have no impact to bushfire risk within the Park and would not increase occurrence of bushfires or threat to life in an emergency bushfire event. All construction materials for the proposed works are non-combustible – and similarly to Phase 1, a CEMP will be created outlining how any flammable consumables (such as fuel) will need to be stored and used during works to minimise risks of fire or contamination.

In terms of bushfire hazard, the proposed activities will not result in any changes to the bushfire prone land mapping nor will they increase bushfire risk to visitors or staff within the Park. All works will be undertaken in accordance with the operational guidelines under the *Toorale National Park Fire Management Strategy* which includes provisions pertaining to operation of earthmoving equipment and visitor management. The proposed activity is not contrary to the objectives of the Bushfire Management Plan which seek to protect life and property and protection of the environment. Bushfire risk and hazards is discussed further in Section 5.5.2.

2.2.9 Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) is the principal piece of legislation protecting aquatic habitat in NSW. The act aims to conserve fish stocks, key fish habitat, aquatic vegetation, and threatened species, populations and communities. Threatened aquatic species, populations and Endangered Ecological Communities (EECs) are listed under Schedules 4, 4A and 5 of the FM Act, while key threatening processes are listed under Schedule 6. Depending on the location and type of activity, developments undertaken by public authorities, or contractors on their behalf, may be required to apply for a permit under Part 7 of the FM Act.

Justification: *Will the activity affect fish, fish habitat or marine vegetation, including threatened species? Is approval required under the Act?*

For areas mapped as Key Fish Habitat (KFH), permits are required for activities that have direct or indirect impact on marine vegetation, require dredging or excavation of bed or bank, obstruct fish passage, or involve land reclamation. The Warrego River is mapped as KFH.

Division 3 of Part 7 of the FM Act outlines the provisions for the management of dredging and reclamation work, consistent with the objectives of ecologically sustainable development. For the purposes of this proposal, water land is defined as land submerged by water, whether permanently or intermittently. The works will involve excavation of the creek bank and as such does involve dredging or reclamation works as defined under Division 3 of the FM Act at these waterway crossings. Pursuant to section 199 of the FM Act, a public authority must not carryout dredging or reclamation work except under the authority of a permit issued by the Minister.

Under section 218 of the FM Act, fishways are required during the construction, alteration, or modification of a dam. A public authority that wishes to modify a dam on a waterway must notify the Minister of the proposal and, if requested by the Minister, include a suitable fishway as part of the works.

Boera and Booka Dams already constitute considerable barriers to fish passage, whereas the proposed works at Homestead Dam will reintroduce an obstruction to unimpeded passage of fish relative to the breached condition. During the construction process, fish passage will need to be maintained as per conditions set out in the Part 7 Fisheries Act Permit. Upgrades at all dams include fishways to facilitate fish passage along the Warrego River between Boera Dam and the confluence with the Darling River.

Under the proposed operational regime, when there are no inflows into Boera Dam, the fishway will need to be closed off. During these events, a section 219 permit will be required to block fish passage. The permit would most likely be issued for a number of years with conditions relating to an agreed operating protocol. A separate permit would not be required every time the fishway is closed, rather a notification form would be required to be filled out and sent to the relevant DPI Fisheries contact.

DPIE have consulted with DPI-Fisheries throughout the planning and design process to ensure that fish habitat is properly assessed and fishway designs are fit for purpose over the longer term.

2.2.10 Water Management Act 2000 (WM Act)

The *Water Management Act 2000* (WM Act) aims to provide for the sustainable and integrated management of water sources for NSW. The Act requires developments on waterfront land to be ecologically sustainable, and recognises the benefits of aquatic ecosystems to agriculture, fisheries, and recreation. Waterfront land is defined as the bed of any river, together with any land lying between the bed of the river and a line parallel to, and the prescribed distance (being 40 m) inland of, the highest bank of the river.

Section 91E (1) of the WM Act identifies that it is an offence to carry out a controlled activity in, on or under waterfront land without gaining a controlled activity approval. Controlled activities are defined in section 33 of the WM Act. However, under clause 41 of the *Water Management (General) Regulation 2018* (WM Reg) public authorities are exempt from section 91E (1) of the WM Act, and therefore do not require any approvals for controlled activities on waterfront land. Therefore, DPIE does not need to apply for controlled activity approval under the WM Act. Despite this, the objectives of protecting water sources will be managed through the CEMP for the works.

Structures for the storage and diversion of water are registered under Works Approvals, and access to water is administered under an entitlement of Water Access Licences (WALs) and tradable allocation system of classes of access security, based on the reliability of the entitlement and availability of the water resource. Water can only be extracted at a site holding a valid Works Approval. Rules for access of water and determining the maximum entitlement or sustainable yield for water sources are set out in regional Water Sharing Plans (WSPs).

The four main WALs for Toorale under the NSW WM Act are held by the CEWH. Works Approvals remain held by the Director General of the NPWS for administration of the structures.

NSW can override normal water sharing arrangements by temporary embargoes under section 324 of the WM Act if there are critical human water needs downstream in the Darling. This occurred in October and November 2019 when the Commonwealth and other license holders in the intersecting streams were unable to take water because of critical human water needs.

Any modification to site structures covered by Works Approvals may require amended work approval applications. This is assessed based on the significance of change, and whether it requires advertised consultation. Initial consultation with DPIE-Water and NRAR has been conducted regarding likely changes.

Management of any inflows to the storages during construction will be undertaken in accordance with an approved Construction Environmental Management Plan.

2.2.11 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) repealed the *Noxious Weeds Act 1993* and provides a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

Part 3 of the Biosecurity Act applies a general biosecurity duty for any person who deals with biosecurity matter or a carrier to prevent, eliminate or minimise any biosecurity risk they may pose. Under section 23 of the Act, a person who fails to discharge a biosecurity duty is guilty of an offence.

Whilst the Act provides for all biosecurity risks, implementation of the Act for weeds is supported by Regional Strategic Weed Management Plans (RSWMP) developed for each region in NSW. Appendix 1

of each RSWMP identifies the priority weeds for control at a regional scale. However, landowners and managers must take appropriate actions to reduce the impact of problem weed species regardless of whether they are listed in Appendix 1 of the RSWMP or not as the general biosecurity duty applies to these species.

Several weeds were identified within the proposed development footprint and are detailed in Section 5.4. One listed priority weed was recorded within the study areas for Boera Dam and Homestead Dam (*Lycium ferocissimum*) (Western LLS, 2017).

2.2.12 Contaminated Land Management Act 1997 and Protection of the Environment Operations Act 1997

A review of the NSW Environment Protection Authority (EPA) Contaminated Land Record, under section 58 of the *Contaminated Land Management Act 1997* (CLM Act), and the List of NSW contaminated sites notified to the NSW EPA, under section 60 of CLM Act, did not reveal any registered contaminated land sites within or surrounding the subject sites.

A review of premises currently regulated by an Environmental Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997* (POEO Act) and premises that are no longer required to be licensed under the POEO Act did not reveal any premises within or surrounding the proposed site.

Pursuant to clause 7 of the *State Environmental Planning Policy No 55 – Remediation of Land* there is no apparent reason to consider that land to be impacted by the proposal would be contaminated.

A review of the Toorale draft PoM revealed that contaminants and dangerous substances exist at some sites within Toorale as a relic of former use, such as asbestos, petrochemical residue or chemicals from activities such as sheep dipping. The Plan acknowledges the requirements to avoid harm to the environment and human health. The most recent geotechnical report completed by A.S. James Pty Ltd (2018) does not indicate such contaminated soils in the impact areas. The PoM does not identify where these potentially contaminated locations are situated in regard to the proposed works. It can be accepted that these areas would be located in human altered landscapes and buildings, rather than the dam structures within the Warrego.

2.2.13 Bourke Local Environment Plan 2012

The subject land is zoned ‘E1 National Parks and Nature Reserves’ under the provisions of the Bourke LEP. The objectives of the E1 Zone are:

- To enable the management and appropriate use of land that is reserved under the NPW Act or that is acquired under Part 11 of that Act;
- To enable uses authorised under the NPW Act; and
- To identify land that is to be reserved under the NPW Act and to protect the environmental significance of that land.

Under the provisions of the E1 Zone, specific land uses authorised under the NPW Act are permissible without consent. However, in the absence of a PoM adopted by the Minister, clause 8 of the ISEPP provides that, in the event of an inconsistency between it and any other environmental planning instrument, including an LEP, the ISEPP will prevail (Section 2.2.3).

The site is listed as a Local Heritage Item (I28 Toorale Homestead and outbuildings) under schedule 5 of the Bourke LEP 2012. Pursuant to clause 5.10 Council consent is not required if-

a) The applicant has notified the consent authority (Council) of the proposed development and the consent authority has advised the applicant in writing before any work is carried out that it is satisfied that the proposed development-
   i. Is of a minor nature or is for the maintenance of the heritage item, Aboriginal object, Aboriginal place of heritage significance or archaeological site or a building, work, relic, tree or place within the conservation area, and
   ii. Would not adversely affect the heritage significance of the heritage item, Aboriginal object, Aboriginal place, archaeological site or heritage conservation area.

Development consent from Council is not required, however written notice to the Council is required to carry out any modifications or works within locally heritage listed sites. To comply with this, DPIE shall provide a copy of the REF and any specific Conservation Management Plan, heritage assessment or impact assessment to the Bourke Shire Council.

2.3 Summary of Licences and Approvals Required

A summary of approvals and licences required are outlined below:

- Internal DPIE authorisation under EP&A Act.
- Two Aboriginal Heritage Impact Permits (AHIP) have already been obtained as required by the NPW Act. DPIE is currently applying for an AHIP variation to consider the modified impact areas as a consequence of amendments to the proposed project footprint.
- Approvals under the *NSW Water Management Act* to modify and operate the proposed new structures, and interim arrangements during construction
- Approval from NSW DPI Fisheries is required under the FM Act for the fishway designs
- A FM Act Section 219 permit will be required to block fish passage. Under the proposed operational regime, when there are no inflows into Boera Dam, the fishway will need to be closed off.

2.3.1 Consistency with DPIE policy

DPIE policies which are relevant to the proposal are identified, with details provided, below.

Policy name	How proposal is consistent
1. Cultural Heritage Community Consultation Policy	Consultation for the Aboriginal cultural heritage assessment component of the Project has been undertaken in line with the *Aboriginal cultural heritage consultation requirements for proponents 2010,* which is understood to supersede this policy.
2. Cultural Heritage Conservation Policy	The Project has actively engaged with representatives of the indigenous community through the Toorale Joint Management Committee (JMC, advisory committee representing the Kurnu-Baakandji people) since commencement. This engagement is outlined in the REF. All Aboriginal cultural heritage assessment and consultation has been undertaken in accordance with current DPIE guidelines. The impacts of the activity on cultural heritage have been considered in the REF and in the Statement of Heritage Impacts. AHIPs have been issued and/or will be sought for Aboriginal cultural heritage that will be harmed or potentially harmed during the Project. See Section 5.6.3 for further details of mitigations actions proposed to be applied to the Project.

Policy name	How proposal is consistent
3. Environmental Integrity Policy	Sediment control and vehicle hygiene measures will be applied during the works period. The impact areas will be monitored following construction for the introduction of any new exotic species. Existing access tracks and borrow pits will be used reducing disturbance to more intact parts of the project area. See also Section 6 of the REF for further details of mitigation actions proposed to be applied during and following works. The proposal is consistent with maintaining the environmental integrity of the reserve. Improved fish passage opportunities and connectivity of flow with the Darling will improve the environmental integrity of aquatic ecosystems
4. Fire/Fire Management Manual	All work will be undertaken in accordance with NPWS Fire Management Manual requirements. Project personnel will maintain close contact with local NPWS staff in planning and undertaking on-ground works and practical actions to reduce fire risks during construction will be included in the CEMP.
5. Landscape/Scenic Quality Statement	The modification of the existing structures, including fishways, will be result in changes to the scenic quality of these sites. *Boera Dam* The area of the proposed Boera Dam works will have new concrete structures that will have a visual impact. The concrete may be stained to make its colour more sympathetic to the surrounding sediments. It is anticipated that the visual impact of the structure will "soften" over time as the concrete weathers and is covered by natural sediments. The current storage levels will be maintained and so the scenic and landscape quality of the dam itself are expected to be unaffected. There will be an impact to the landscape and scenic quality in the vicinity of the works site due to disturbance by vehicles and machinery. This impact will be temporary until vegetation regrows in these places. The structure will be in an area of the Park infrequently visited by most people. *Booka Dam* The area of the proposed Booka Dam works will have new concrete and steel structures that will have a visual impact. The fishway ridges have been designed to mimic the shape of rocks to lessen the visual impact. The surface of each ridge will also be "roughened", and the ridges will be coloured to a suitable colour to enhance this effect. It is anticipated that the visual impact of the structure will "soften" over time as the concrete weathers and is covered by natural sediments. There will be an impact to the landscape and scenic quality in the vicinity of the works site due to disturbance by vehicles and machinery. This impact will be temporary until vegetation regrows in these places. The storage level will be lowered from the current level, which is expected will have an impact on scenic quality. Fringing vegetation may also be impacted that will add to this impact.

Policy name	How proposal is consistent
	The structure will be in an area of the Park infrequently visited by most people. However, Park neighbours on Booka will be impacted by reduced scenic amenity. *Homestead Dam* The area of the proposed Homestead Dam works will have new concrete and steel structures, including a bridge, that will have a visual impact. The fishway ridges have been designed to mimic the shape of rocks to lessen the visual impact based on feedback provided by the JMC. The surface of each ridge will also be "roughened", and the ridges will be coloured to a suitable colour to enhance this effect. It is anticipated that the visual impact of the structure will "soften" over time as the concrete weathers and is covered by natural sediments. There will be an impact to the landscape and scenic quality in the vicinity of the works site due to disturbance by vehicles and machinery. This impact will be temporary until vegetation regrows in these places. Although it will be at lower levels than historically, the reinstatement of Homestead Dam will change the landscape and scenic quality. The storage will return to a condition whereby it has more water stored more frequently. Given the location of this storage in the primacy visitor precinct as well as its historic context, this is considered to be a positive change. *Warrego and Darling Rivers* The scenic and landscape qualities of the Warrego and Darling Rivers may change as a result of more frequent flows, particularly during low-moderate flow events. This is expected to contribute to more resilient aquatic and riparian vegetation communities which will improve the scenic quality of those areas. *Western Floodplain* While the changes that will occur to the Western Floodplain are not fully known, the reduced watering of this area may see some changes to the scenic qualities in some areas.
6. Noise Policy Statement	Noise impacts associated with the activity will be short term, during daylight hours and away from visitor precincts. In this regard the activity is consistent with policy.
7. River and catchment management policy	Phase 2 of the Project will enhance the natural functioning and processes of the river and contribute to catchment outcomes by improving connectivity with the Darling River. In this regard it is consistent with this policy. See also Section 6 of the REF in relation to mitigation measures proposed to be applied to the Project.
8. Roads Policy/ Vehicle access policy	https://www.environment.nsw.gov.au/topics/parks-reserves-and-protected-areas/park-policies/vehicle-access No new roads are proposed for this activity. Access will primarily be by existing tracks. Works will not be undertaken during wet weather when the site will not be accessible, minimising the potential damage to tracks. Tracks will be graded if required following removal of the dam wall. The proposal is consistent with this policy.

Policy name	How proposal is consistent
9. Water Quality	Phase 2 work will be undertaken within the bed and banks of a river. Mitigation measures will be put in place to avoid downstream sedimentation impacts (including sediment fencing and coffer dams). There will be no long-term water quality impacts from the structures. Increased flows through the river as part of the broader project are likely to contribute to water quality improvements both in the lower Warrego River and the Darling River. In this regard, the proposal is consistent with policy.
10. Weeds	Potential to import or cause new infestations of weeds will be managed by hygiene practices and monitoring of sites. The CEMP will include measures to mitigate and control weeds during construction. Any new infestations introduced will be controlled as required.
11. Managing Parks Prior to a Plan of Management Policy	https://www.environment.nsw.gov.au/topics/parks-reserves-and-protected-areas/park-policies/managing-parks-prior-to-a-plan-of-management The *National Parks and Wildlife Act 1974* (NPW Act) requires that a **plan of management** (PoM) be prepared for a park as soon as practicable after the park is reserved. A PoM indicates how a park will be conserved, used, developed and managed. This policy provides guidelines for the management of a reserve that does not yet have a plan of management. If a park does not yet have a PoM, a **statement of management intent** (SMI) may be prepared to guide its management. Parks without an adopted PoM will be managed consistent with the NPW Act and other relevant legislation, existing park management policies (including this policy), and other relevant manuals, procedures and guidelines. The Phase 2 Proposal is consistent with the following management directions outlined in the Toorale Statement of Management Intent (2016): • NPWS will continue to work with the Toorale Joint Management Committee (JMC) to support the Kurnu-Baakandji People to sustainably use resources for cultural purposes on Country in accordance with policy and legislation. • The JMC, other relevant Aboriginal community organisations, and families will be consulted and involved in the management of their Country, including management of Aboriginal sites, places and cultural and natural values. The Kurnu-Baakandji and other Aboriginal people will be actively involved in conservation management and interpretation of Toorale's shared historic heritage. • Water infrastructure will be operated in accordance with licence conditions and CEWH instructions where required. • Environmental assessments will be conducted for any development activities, including any proposed modifications to Toorale's water infrastructure, with the potential to impact on the flora and fauna and other natural and cultural values. In particular, any changes in the watering frequency of the western floodplain or modifications to in-stream storages must consider the effect on habitat availability for wetland dependent fauna, in-stream refugia and other habitat values, especially

Policy name	How proposal is consistent
	endangered ecological communities, threatened plants and animals and the maintenance of populations of culturally significant plants. • Visitor experiences at Toorale will be developed in accordance with the Toorale and Gundabooka Nature Tourism Action Plan.

3 The Proposed Phase 2 Activity

There are two elements to the Phase 2 Activity:

1. Modification to the existing structures at Boera, Booka and Homestead Dams
2. Modified management of flows on and through Toorale

The structures have been designed to meet the project objectives (see Section 3.1). They will allow for flexible flow management and therefore will support an adaptive approach to the delivery of water in space and over time.

The proposed project designs and flow management arrangements described in this section are the result of extensive consultation with the community and government agencies. The proposal has evolved over the life of the project in response to community input.

For the purposes of assessment, the proposed works described in this section will represent the maximum level of impact likely to occur. The actual physical footprint of construction impacts is likely to be smaller than that identified.

3.1 Project Objectives

A key outcome of the Toorale Water Infrastructure Project is to increase the capacity to deliver more flow to the lower Warrego River and Darling River whilst not compromising the values of Toorale. Within this overarching aim is a subset of objectives that guide the development of the Project (Table 3-1).

Table 3-1: Design objectives

Element	Objecitve
Hydrology	Meet the intent of the existing works approval conditions Provide for discharge of up to 1, 650 ML/d in Warrego River for release to the Darling River. Retain capacity to divert flows from Boera Dam to the Western Floodplain.
Ecological values	Retain the refuge habitat values of the existing storages. Protect intact and established values as required under relevant legislation. Maintain the ecological values of the Western Floodplain.
Fish passage	Provide fish habitat and passage through Warrego River for small to large bodied native fish. Meet the fish passage criteria determined for the project and regulatory requirements for fish passage in any modification to existing structures and in particular to satisfy section 218 of the *Fisheries Management Act 1994* (NSW).
Cultural heritage values	Avoid and minimise site and functional level heritage impacts. Manage cultural values in accordance with heritage values, legislation and policy. Have regard to values and concerns of Aboriginal community as represented by Toorale JMC.
Local stakeholder and council interests	Consider social and stakeholder values in the development of options, including stock and domestic water supply. Maintain water supply opportunities for adjoining properties. Not adversely impact on public road access.
National Park operation and maintenance	Not increase the maintenance and operation liabilities at the site. Reduce the potential for failure of embankments and associated risks to public safety and repair costs. Consider Park recreational and aesthetic values. Limit adverse impact on Park access.
Budget and timeframe	Works to be completed in line with budget and timeline restrictions.

3.2 Description of the Proposed Structural Modifications and Associated Activities

The proposed Phase 2 works seek to modify Boera Dam, Booka Dam and Homestead Dam to increase passing flow capacity and improve fish passage through these structures. The proposed modifications are summarised in Table 3-2**Error! Reference source not found.** and described in more detail below. Further information on the proposed designs is provided in Appendix A.

Table 3-2: Summary of proposed modifications at each site

Dam	Proposed Modifications
Boera Dam	Embankment modified at the Warrego River site of existing pipes: • Automated regulator gates constructed to control discharge (and allow targeted watering of the Western Floodplain) with capacity to pass up to 1,650 ML/day at full supply level. • The existing pipes to be removed and disposed. • Existing full supply level of Boera Dam (104.85 m AHD) to be retained. Vertical slot fishway to be constructed at the embankment to provide fish passage independent of the regulator gates.
Booka Dam	Spillway constructed at the site of existing regulator pipes: • Spillway crest at 100.90 m AHD • Capacity to pass 900 ML/d prior to engagement of dam bywashes • Existing pipes to be retained for maintenance purposes only • New full supply level of Booka Dam to be 100.90 m AHD Rock ramp fishway to be constructed at the spillway Causeway constructed for dry-weather access only.
Homestead Dam	Dam embankment to be rebuilt and spillway constructed at the existing embankment site: • Spillway crest 98.50 m AHD. Crest width of 6 m to allow single vehicle access over the dam. • Capacity to pass 900 ML/d prior to engagement of dam bywashes • Existing pipes to be retained for maintenance purposes only • New full supply level of Homestead Dam to be 98.50 m AHD Rock ramp fishway to be constructed at the spillway Bridge access across the Warrego River at spillway site to be constructed.

Final designs for the fishways have not been completed. Concept designs have been completed and have been used for the purpose of the REF. These describe the required functionality, fishway type and layout, but a number of design refinements have been identified for adoption during detailed design. It is considered that the concept designs likely overstate the actual physical footprint of final structures at Homestead and Booka Dams.

3.2.1 Boera Dam Structural Modifications

Modifications to Boera Dam have been developed to enable a more flexible approach to delivering water to either the Western Floodplain and/or the Warrego River/Darling Rivers. The earthen embankment will be modified at the location of the existing regulator pipes by installing gates to increase capacity to deliver from the current 600 ML/d up to 1,650 ML/d at full supply level (104.85 m AHD).

The regulator will be a 3-bay structure with lay flat gates, each approximately 2.2 m wide, to enable operation over a wide range of flows (0 to 1,650 ML/d).

Stop boards will be installed on the upstream side of the gates to provide a failsafe limit on the potential drawdown of the storage to be used to isolate a gate for repair and/or removal.

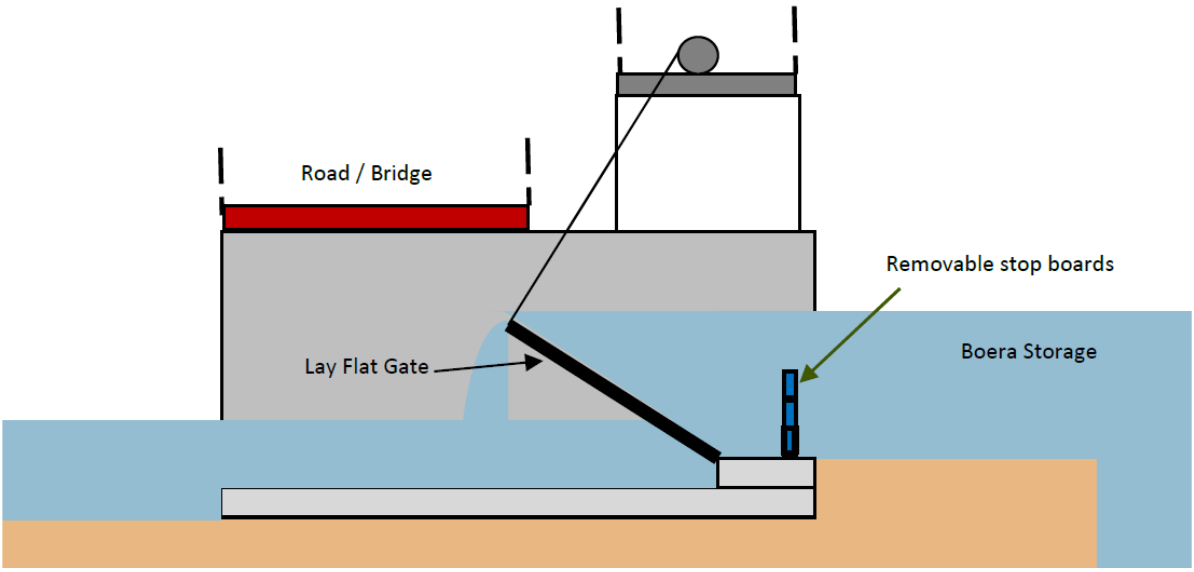


Figure 3-1: Arrangement for the proposed lay flat gate at Boera Dam

A vertical slot fishway will be constructed at the embankment to provide fish passage independent of the regulator gates. Fish passage downstream can also be over the gates where a minimum depth plunge pool will be provided on the downstream side. The fishway will have 21 cells, each 2.5 m long x 2 m wide. The six lowest cells will be 3 m wide to reduce turbulence.

The effective slope of the fishway is 1:31. Precast baffles will be installed with keyholes slots for fish passage. The entrance to the fishway will be located near the discharge point from the gate infrastructure, at the upstream limit for fish to swim when the gates are operating. The preferred location and arrangement of the entrance was tested and finalised using a physical model to replicate the hydraulics of the site with the proposed works in place.

The following criteria have been adopted for the fishway design:

- Maximum pool head loss 100 mm
- Maximum velocity:
  - Small fish burst speed: 0.8 m/s (distances <20mm)
  - Small fish sustained speed: 0.3 m/s (distances < 100mm)
  - Medium -large fish burst speed: 1.8 m/s
- Maximum average pool turbulence 35 W/m3
- Minimum length between ridges of 2.2 m in order to provide resting areas for larger fish.
- Key shaped slots to cater for large and small fish
- Minimum flow depth (medium – large fish) 0.7 m, small fish 0.5 m.

The key fishway criteria for the entrance are:

- The entrance must be accessible under all flows within the design range.
- The entrance must be at the 'limit of upstream migration' i.e. at a point where fish cannot move further upstream without entering the fishway.
- Fish attracted to the spillway/regulator gates can enter the fishway without having to swim back downstream.
- Attraction flows are appropriate for all size classes of fish.

To achieve this, the design is based on achieving a minimum head loss at the entrance of 50 mm.

3.2.2 Booka Dam Structural Modifications

The two 1200 mm outlet pipes will be decommissioned, and the full supply level will be lowered by 0.5 m to 100.9 m AHD by providing a spillway in the embankment at the southwest end of the dam. The spillway will discharge into the Warrego River at this point via a rock ramp fishway.

The existing embankment will be cut down for a new spillway at the lower end of the storage in the embankment at the southwest corner of the dam (see Figure 3.3). Approximately 0.5 m of compacted fill will then be placed to build the crest back up the to the spillway level of 100.9 AHD. The spillway will discharge into the Warrego River at this point via a rock ramp fishway installed in the lowered section of embankment. The full supply level in the storage will be reduced by 0.5 m to 100.9 m AHD.

The rock ramp fishway will be provided on the downstream side of the concrete spillway on top of the compacted fill. The fishway will be a maximum of 0.9 m high up to 35 m wide 75 m long and at a grade of 1(V):30(H). The fishway is designed to fit within the width of the existing channel.

The ridges in the fishway will be an innovative, bespoke design to reduce aesthetic and cultural heritage impacts. The ridges will be pre-cast concrete designed to mimic rocks in their shape, texture and colour. Natural rocks were discounted as an option due to hydraulic inefficiencies, construction and maintenance costs, and the limited feasibility of sourcing suitable rocks. The concept for the design was developed with input from both the Toorale JMC and NSW Fisheries.

The existing pipes will remain for maintenance purposes, if required, but will not be used to regulate flows through the storage.

3.2.3 Homestead Dam Structural Modifications

The dam embankment will be reinstated at the existing breach at Homestead Dam, however the new spillway will be at a lower level than the previous, pre-breach level. The lower level will facilitate more efficient flow delivery through the Warrego River, whilst retaining the ecological, cultural and social benefits associated with the water body. A structure with a crest width of 6 m is proposed and will be constructed of either local material or imported material from the Peebles Dam site. The proposed 6 m wide spillway crest of the reinstated embankment is at a level of 98.5 m AHD, compared to the 99.5 m prior to breaching. The dam will operate as a fill and spill arrangement. The existing pipes will no longer be operated to deliver flows through the dam to the Warrego River, but will be retained for future maintenance purposes, if required.

The downstream face will be a full width rock ramp fishway with a grade of 1(V):30(H). The structure is designed to pass the design flow of 900 ML/d within the available head of 1 m before the eastern bywash channels are engaged at 99.5 m AHD and within acceptable velocities. The fishway will be a maximum of 35 m wide although design refinements to be considered during detailed design are likely to reduce this width significantly

The ridges in the fishway will be an innovative, bespoke design to reduce aesthetic and cultural heritage impacts. The ridges will be pre-cast concrete designed to mimic rocks in their shape, texture and colour. Natural rocks were not an option due to hydraulic inefficiencies, construction and maintenance costs, and the limited feasibility of sourcing suitable rocks. The concept for the design was developed with input from both the Toorale JMC and NSW Fisheries.

The dam and spillway will be earthen fill with a clay core. The fishway will comprise graded rock fill across the width of the channel, containing a central low flow channel, and a series of higher ridges across the rock ramp at regular spacings, forming pools that provide resting locations for fish as they move upstream

The spillway will be earthen fill with a clay core. The fishway will comprise graded rock fill across the width of the channel, containing a central low flow channel, and a series of higher ridges across the rock ramp at regular spacings, forming pools that provide resting locations for fish as they move upstream

Access across the spillway will be achieved by a bridge that meets relevant safety standards and a design has been developed based on a maximum 40 m span after the embankments are trimmed and widened. Two supports, with a 13.7 m central span and two 13.7 m approach spans complete the bridge. The bridge deck width will be 4.8 m, allowing for single lane access and no vehicle passing. Maximum vehicle load will be 15 tonnes and a standard guard rail provided.

DPIE is continuing to refine the fishway design at both the Homestead and Booka Dam sites. While the functionality and concept of the rock ramp fishway design will not change, DPIE is investigating ways to reduce the size, and therefore the potential impacts, of these structures. The design described above has been included for the purposes of this REF and represents the maximum potential impact that the proposed activity will have at these sites.

3.2.4 Proposed Operating Arrangements

The proposed works will enable more flexible management of water at Toorale (both held and planned environmental water), and particularly provide much greater capacity to deliver water to the Darling River when required. Inherent in the project proposal is the intention to utilise this enhanced functionality to improve the balance of outcomes from management of water at Toorale, and the potential outcomes from changes to the operation require consideration in this REF.

Future operations at Toorale will follow much the same process as current operations, with decisions around water use governed and guided by several elements:

1. Prevailing climatic conditions and the specific characteristics of Warrego flow events;
2. Legislative requirements, works approval conditions, water allocations and water accounting requirements;
3. Balancing the multiple environmental, social and cultural objectives, particularly the balance between:
    - Contributing to downstream (Darling River) objectives, particularly during dry times in the Darling River; and
    - Toorale objectives, noting the environmental values for which the property was purchased and which must be maintained, and
4. Stakeholder consultation.

To understand the potential outcomes of the proposed infrastructure and revised operations DPIE, with support from Alluvium Consulting, has undertaken initial modelling of potential operating strategies. This modelling has been undertaken to explore options and inform this REF, but does not ‘lock-in’ a particular operating strategy. Future operations may be informed by the modelling but will remain adaptive so that operations can best adjust to the prevailing conditions and take into account new information (eg onground monitoring or observations of conditions in both the Darling River and at Toorale). Further modelling may be undertaken to test different operating strategies, including consideration of feedback from this REF and other stakeholder consultation.

Operating Strategy Modelling

The Toorale water balance model used to represent the operating strategy covers the following areas and components:

- The Warrego River between the Fords Bridge gauges and the Darling River, including the Warrego River channel, Western Floodplain and the storage and operations of the structures on Toorale
- The Darling River between Bourke and Louth.

The model operates for the period 1972 to 2016, and enables the impact of Boera operating decisions on the flows at various points in the system (eg flows from the Warrego River to the Darling River, or flows to the Western Floodplain) to be evaluated. The modelling assumes that planned and held environmental water is coordinated and directed to the same watering priorities.

The modelled operating strategy seeks to achieve four main watering outcomes:

- Providing enhanced downstream flows for the **Warrego and Darling Rivers** at times of low flow. Enhancing flows to the Warrego and Darling Rivers is a key objective for this project and the modelling represents this.
- Watering the **Western Floodplain**. Historically Boera Dam has been operated such that the largest proportion of flows have been diverted to the Western Floodplain. Ensuring the values of the Western Floodplain are maintained is another key objective for the project.
- Enabling **fish passage** through the Warrego River. The project will provide fish passage in each of the structures to be modified, and flows may be managed to enhance fish passage through the structures and support other fish objectives such as spawning.
- Maintaining the Full Supply Level (FSL) of Boera Dam at 104.85 m AHD to support stock and domestic supply and provision of drought refuge habitat.

Determining Relative Watering Priorities

DPIE is in the process of finalising Long-Term Water Plans (LTWPs) across the NSW Murray-Darling Basin. The plans set out ecological objectives, environmental water requirements and strategies to guide the management of environmental water over the long term. The environmental water requirements from the draft Intersecting Streams and Barwon Darling Rivers LTWPs have been used to determine relative watering priorities within the modelling, and direct flows to meet those priorities according to a set of principles.

The approach adopted in the modelling is described in the text below and summarised in **Error! R eference source not found.**.

<u>Demand Priority 1 - Darling and Warrego Rivers</u>

The operation of the Boera regulator to maximise flows to the Darling River is considered a priority (above all other priorities) when conditions in the Darling River are particularly dry, as indicated by the

exceedance (or near exceedance[1]) of one or more environmental water requirements from the Barwon Darling LTWP:

1. When cease to flow conditions have occurred for more than 110 days, or
2. There has been more than 135 days of flow less than 450 ML/d, or
3. It has been more than one year since a small fresh of at least 1,500ML/d occurred for at least 10 days as measure at the Louth gauge.

The modelling uses environmental water requirements for Louth, but in reality, decision making will be able to consider a range of inputs including environmental water requirements further downstream (eg Wilcannia) as well as water quality and other data.

Demand by the Darling River is deemed to have been met when a flow rate of 1,250 ML/d is reached at the Bourke gauge. This rate is the flow at which B class licenses can activate under the current Water Sharing Plan.

Demand Priority 2 – Western Floodplain

The operation of the Boera regulator to target the watering of the Western Floodplain can only occur when the delivery to the Darling River is not the priority (as defined above).

Delivery of flows from Boera Dam to the Western Floodplain is considered a priority when the Western Floodplain is particularly dry, as indicated by the exceedance (or near exceedance[1]) of one or more environmental water requirements from the Intersecting Streams LTWP:

1. It has been more than 2 years since a small watering event of 7GL/month flowed to the floodplain; or
2. It has been more than 3 years since a small watering event of 16GL/month flowed to the floodplain; or
3. It has been more than 6 years since a medium watering event of 33GL/month flowed to the floodplain

Demand by the Western Floodplain is deemed to have been met when it has received 75GL of flow. This represents a medium sized watering event typically occurring about once every 5 years. Analysis of imagery suggests that such an event would flow to Uteara Lake (adjoining Toorale) and connect through to the Darling River. It is likely that in events of this magnitude, flow would also be returning to the Warrego River, although this has not been quantified.

Normal Operating Conditions

When none of the environmental water requirements triggers to prioritise water to either the Darling River or the Western Floodplain are met, inflows to Toorale will be shared (Table 3-3).

[1] The durations quoted (e.g. 110 days for cease-to-flows at Louth) are the maximum interflow periods, beyond which a significant decline in the condition, survival or viability of a particular population is likely to occur. The desire is not to exceed these durations, whilst noting that achieving these flows in an unregulated system requires river flows in response to rainfall and there may be limited opportunities to avoid these thresholds being exceeded during dry conditions. To date, modelling of the operating strategy has adopted triggers of 80% of these values, noting that this an interim approach and may be refined.

Operating Strategy to Deliver Inflows to Watering Priorities

As with the current arrangements, when inflows arrive at Toorale the new structure at Boera will be operated to satisfy the existing approval conditions at a minimum. That is, at least 600ML/d will be released through the structure through the Warrego River until the gauge at Louth reaches 330ML/d. In practice, the release rate is likely to be greater than this figure (up to 1650 ML/d).

Once that flow condition has been realised, the first priority for flows is the Darling River if demand conditions, as defined above, are triggered. When the Darling River is a high priority, up to 1,650 ML/d will be passed through the gates at Boera.

If demand in the Darling River is not deemed to be a priority when an event arrives, and demand in the Western Floodplain is triggered, then the gates will be closed (once approval conditions are satisfied) so that the storage can surcharge and spill to the western floodplain. This operating mode will continue until floodplain watering finishing triggers are met.

Based on modelling results, a flow arriving at Toorale will be operated under the “normal operating conditions” mode for most events. Under this mode, a minimum 14 day event is first passed down the Warrego River (up to 900 ML/d to enable fish passage) and the gates will then be closed to promote watering of the Western Floodplain until the finishing triggers are met, after which the gates will be reopened to share the remaining flows.

In line with the existing conditions, the gates at Boera Dam will be closed when inflows cease to maintain the storage at the proposed full supply level.

Table 3-3: Proposed Operating Strategy for the management of environmental water within Toorale

Operating Mode	Objective	Operating approach[1]	Operating Mode Triggers[2]
Priority 1 (Darling)	Maximise flows to the Darling River when there have been extended dry conditions in the Darling River.	• Open Boera regulator to pass flows up to 1650 ML/d • Continue unless a significant flow event occurs in the Darling River (taken as more than 1250 ML/d at Bourke – B class pumping threshold). • If so, then review priorities below and adjust operations accordingly.	If one or more of the following are met (or close to being met[3]) • Cease to flow – greater than 110 days of no flow at Louth • Baseflows – more than 135 days of flow less than 450 ML/d at Louth • Small freshes – more than 1 year since 1500 ML/d for 10 days at Louth
Priority 2 (Western Floodplain)	Maximise flows to the Western Floodplain when there have been extended dry conditions on the Western Floodplain.	• Open Boera regulator to pass flows up to 900 ML/d until works approval conditions are met • Gradually close Boera regulator and water the Western Floodplain (retain a base flow of 50 ML/d through Boera to enable fish passage) • If Western Floodplain EWRs are met (taken as EWR WL4 from LTWP - 75 GL over 30 days), reopen Boera regulator and share remaining flows 50:50.	If one or more of the following are met (or close to being met[3]) • More than 2 years since 7GL/month flow to Western Floodplain (WL1) • More than 3 years since 16 GL/month flow to Western Floodplain (WL2) • More than 6 years since 33 GL/month flow to Western Floodplain (WL3)
Normal operations	Share delivery of water between the Warrego/Darling and Western Floodplain.	• Open Boera regulator to pass flows up to 900 ML/d for at least 14 days to encourage fish movement and spawning • Gradually close Boera regulator and water Western Floodplain (retain a base flow of 50 ML/d through Boera to enable fish passage) • If Western Floodplain requirements are met (taken as EWR WS4 from LTWP - 75 GL over 30 days), reopen Boera regulator to share remaining flows 50:50.	• All other times – when none of the above triggers are met

Notes:

1. Under all operating modes, the first requirement is to meet the Boera works approval conditions of achieving a visible flow from the Warrego River to the Darling River, and greater than 330 ML/d in the Darling River at Louth.
2. These triggers are sourced from the respective Long Term Water Plans, for the Barwon Darling and Intersecting Streams.
3. The durations quoted (e.g. 110 days for cease-to-flows at Louth) are the maximum interflow periods, beyond which a significant decline in the condition, survival or viability of a particular population is likely to occur. The desire is not to exceed these durations, whilst noting that achieving these flows in an unregulated system requires river flows in response to rainfall and there may be limited opportunities to avoid these thresholds being exceeded during dry conditions. To date, modelling of the operating strategy has adopted triggers of 80% of these values, noting that this an interim approach and may be refined.

3.3 Activities Associated with Proposed Works Stages

This section discusses the works methodology, timing, materials and materials management (collection and storage), machinery, equipment, hours of operation and working hours, as well as access and ancillary works (for example signage or bushfire hazard reduction) that are relevant to each stage of the proposed project. For further information, see the *Detailed Design Drawings* and *Technical Specifications* by Alluvium (Appendix A).

3.3.1 Pre-construction

Pre-construction activities aimed at avoiding and minimising impacts have included field and desktop investigations, analysis of multiple alternatives (Section 3.4.2) and consultation (Section 4).

Access to the work sites will be via existing roads and management trails within Toorale. No new access tracks are proposed. A vehicle movement plan is to be prepared and approved prior to works commencing and is recommended to form part of the Construction Environment Management Plan (CEMP).

Site preparation:

Site facilities and temporary laydown areas have been included in the project design and construction disturbance footprints/impact areas. They will be surveyed and established (only where necessary) through scraping, grading, placement of suitable fill material and compacting.

Vegetation currently growing on the sections of embankments to be modified at the dams will be removed by local NPWS staff and relocated for use as habitat, firewood or access barriers.

Potential use of Peebles Dam spoil as a source of select general fill material:

Peebles Dam was decommissioned in Phase 1 (October 2019) by removing a large portion of the embankment at the main Warrego River location to the existing waterway bed level. Approximately 22,000 m^3 of material was removed from Peebles Dam during the Phase 1 works and deposited in existing borrow pits, from which the material was originally sourced and compacted to ensure there were no dust or erosion issues. If found to be suitable for general fill from quality testing by the earthwork's contactor, a portion of this spoil may be transported for reuse for the construction of the coffer dams, Homestead Dam embankment and/or infilling and reshaping of the scour pool at Boera Dam. The material would be transported in tipper trucks traveling on Toorale Road. The haulage route is to be shown in the construction traffic management plan (Vehicle Movement Plan) developed by the construction contractor for pre works approval before taking possession of the site (will be a subplan of the CEMP). The borrow source, once exhausted, is to be rehabilitated to be free draining and revegetated with endemic plant species, oversown with sterile quick growing natural groundcover crop to offer short term surface stability if needed.

3.3.2 Construction

General

Construction is expected to begin during April/June 2020 and be completed by May/June 2021. Works will be dependent on weather conditions and flows in the Warrego River at the time. If flows are passing through when works are expected to commence, then works will likely be rescheduled to reduce the environmental impacts on the Park and the Warrego River, and to ensure safe working conditions.

Construction work will occur during hours of light, when it is safe to do so. The site is remote, with no neighbours nearby and noise will not be a factor for work hours.

Construction equipment that will be used for the proposed works shall likely include tipper trucks for transporting embankment material, excavators and Moxies to remove, place and shape embankments, dozers for stockpile management and cutting and filling of dam wall pad foot rollers and or compactors for consolidating general fill material, as placed to specification, and graders for trimming the final dam wall shape to final design level.

This plant and other relevant equipment shall be stored within the demarcated designated project disturbance footprint at each site for the duration of the works. During construction, additional auxiliary infrastructure may be established within the approved footprint including site offices and amenities, vehicle parking and turning areas, equipment laydown and storage areas, safety fencing, and temporary power. Potential power sources during construction include the use of generators. Any hazardous material (e.g. hydrocarbons) shall be stored in a bunded areas. Diesel fuel will be stored in self-bunded containers. This infrastructure will be removed at completion of commissioning and disturbed ground made good through re-topsoiling, re-profiling and establishing a groundcover.

Where possible, infrastructure (pipes, gates and operating platform) will be reused or recycled by NPWS in the Bourke area. However, an exact future purpose has not yet been determined and infrastructure will be stored at Toorale. Wastage of materials will be minimised wherever possible (e.g. through re-use for alternative purposes) through the adoption and implementation of the project Waste Reduction Management Plan (WRMP) - a sub plan of the project's CEMP.

Access to the work sites will be via existing roads and management trails. No new access tracks are proposed. The works will increase the traffic load on the Toorale Road to a minimal degree during the hours of 7am and 6pm, for a period of 7 working days.

A coffer dam will be installed in each storage to isolate the works from the water. Due to cultural heritage constraints at the site, excavation of material locally is limited and material from offsite may be imported for this purpose. The potential for use of Peebles Dam spoil is discussed in Section 3.3.1.

There potential, that during high flows, the coffer dam will be overtopped, or fail resulting in flooding of the works site. However, due to the location of the works, there will be several days warning of a large flow event and the contractor will:

- Protect the constructed works as much as possible
- Reinforce the coffer dam if deemed necessary
- Move machinery and equipment to high ground.

The coffer dams will be removed post-construction and a suitable location for the disposal of this material will be arranged in consultation with the construction principal and NPWS.

Spoil from the modification of the embankments will be placed in existing borrow pits close to the site. The Alluvium (2019) detailed design drawings for the Dam works show that whilst the existing borrow pits will indeed be filled with the spoil, this material will also be spread beyond the borrow pits to gradually slope up to the remaining embankment running along the top of the pits (Appendix A).

Boera Dam

Site access to the Boera Dam site will be via the existing access track on the embankment, from either the western or eastern sides. However, access via the eastern side is preferable as it is the shorter route for equipment and materials coming from Bourke via Pumpkin Bore Trail through "Nulty". This route is subject to a landholder agreement. The alternative route to Boera Dam is via the Western Floodplain.

Access to the lower end of fishway downstream area of the works site will require a track to be constructed by the contractor. As the exact locale of this track is unknown at time of report writing, this track may from part of post approval early works approval requiring a consistency review in accordance with this REF and the Construction Environmental Management Plan. It is a recommendation that the track be formed to avoid need for removal of any substantive vegetation (i.e. trees and shrubs).

Hydrometric equipment owned and operated by WaterNSW is located within the construction footprint for the proposed works at Boera Dam. It will be necessary to temporarily decommission this gauging equipment prior to works commencing at the site and store it at an appropriate location to be later reinstalled at the site upon the completion of all demolition and construction activities. Consultation with WaterNSW confirms the equipment will be removed upon notification to the Authority of approximate date for works commencing.

Earthworks and site clearing could theoretically impact just over 11 ha (the elected maximum construction disturbance footprint for Boera Dam); however, the actual extent of vegetation to be removed and area to undergo earthworks will be much less.

Flows can be diverted from the proposed coffer dam at Boera Dam onto the Western Floodplain, which commences to flow at a water level of RL 104.85 m AHD. The coffer dam will control the upstream weir pool up to 105.7 m AHD (the 3% exceedance level).

The fishway design is based on custom made precast units manufactured and transported to site for installation by mechanical equipment (crane or excavator). This approach would consist of cell blocks with in situ casting of joints in between the blocks. Alternatively, concrete for construction of the fishway can be poured in-situ into formwork installed at the site. The approach for pre-caste and in situ concrete will be further explored in the detailed design phase. Some, or all of the Boera fishway will be constructed on fill material and it may therefore be necessary to install concrete piling to support the fishway where it is installed over fill material.

Fishway baffles will be precast concrete, installed into the channel using a crane or similar. Sloes will use fibre-reinforced plastic or aluminium plates that can be adjusted to allow fine tuning of the opening sizes.

Booka Dam

Site access to the Booka Dam site will be via the existing access track on the embankment, from either the western or eastern sides. However, access via the eastern side is preferable as it is the shorter route for equipment and materials coming from Bourke via a track through Booka Station. This route is subject to a landholder agreement.

Access to Booka Dam from the west is via an undefined track which may not not currently be adequate to service the required construction vehicles and equipment and may therefore require upgrading to be constructed by the contractor if adopted. This track may from part of post approval early works approval requiring a consistency review in accordance with this REF and the Construction Environmental Management Plan. Any upgrade will avoid removal of any substantive vegetation (i.e. trees and shrubs) as far as possible.

Earthworks and site clearing could theoretically impact just over 12 ha (the nominated maximum construction disturbance footprint for Booka Dam, plus western access), however, the actual extent of vegetation to be removed and area to undergo earthworks will be much less.

At Booka Dam, the water level in the dam can be lowered via the existing discharge pipes, to facilitate the works. Nevertheless, a small coffer dam arrangement may be required to protect against localised runoff.

Homestead Dam

Access to Homestead Dam will be via existing roads and management trails within Toorale. No additional access tracks are proposed.

The gravel sheeting with imported ridge gravel/selected material used for the bridge access across the spillway may be sourced by the construction contractor from Council approved quarries/borrows. The sourcing and use of this material are to be approved prior to construction by the Principle pursuant to the projects CEMP.

Earthworks and site clearing could theoretically impact just over 6.5 ha (the elected maximum construction disturbance footprint for Homestead Dam, plus western access); however, the actual extent of vegetation to be removed and area to undergo earthworks will be much less.

At Homestead Dam, the wall has been breached so there is little storage in the dam at present, although there may be when it comes time to do works. A coffer dam will be required to facilitate the installation of the new earthen weir at the site of the breach and divert flows downstream through the existing discharge pipes.

3.3.1 Operation and Maintenance

The Toorale Operating Strategy, when finalised with expert and community input, will detail all operational and maintenance activities (including methodology, timing, materials and materials management [collection and storage], machinery, equipment, hours of operation and working hours) concerning:

- Pipes and gates;
    - Once reconstructed, operation of Homestead Dam will return to that undertaken prior to the breach, i.e. operating pipes in accordance with the licence conditions and CEWHCEWH watering requirements. This will require periodic site visits to manually set and/or reset the gates
- Licences and Works approvals that will be updated to reflect the new strategy;
- Embankment/ new dam crests;
- Fishways;
- Flow gauging equipment;
- Access arrangements (at project completion, all access tracks shall be reinstated to the condition that existed prior to the works); and,
- Ancillary works (e.g. signage or bushfire hazard reduction) relevant to this stage

To ensure the strategy is achieving the desired objectives, monitoring will be essential of the Warrego River, neighbouring land, the western floodplain and downstream water discharge.

3.3.2 Future Works

The Toorale Water Infrastructure Project relates to the works that are funded by the Australian Government and includes the removal of Peebles Dam (Phase 1) – and modifications to Boera, Booka and Homestead Dams (Phase 2). However, there are other related projects identified in the Project Business Case that may be pursued in the future to facilitate improved management of environmental flows on Toorale:

- **Western Floodplain training embankment** (between Boera Dam and the Western Floodplain)**:** Installation of a l structure in the existing levee to manage return of floodwater flows to the Warrego River if and when needed
- **Ross Billabong**: Removal of some existing embankments at this location to improve the connection between Ross Billabong and the Darling River.
- **Other irrigation infrastructure**: Placement of breaches in other irrigation infrastructure and levees across the Darling River floodplain

If these projects proceed, they will all be subject to separate environmental impact assessments including assessment of cumulative impacts.

3.3.3 Spatial Scope of Assessment

Item 5.3 of Part B (Statement of requirements) of the Request for Tender document for Tender_1402 (Toorale Infrastructure Project – Environmental Assessment) sets out the spatial scope of this assessment as follows:

"*The REF is to consider all direct and indirect impacts that will occur, or will potentially occur, as a result of the Project. The extent of consideration of impacts is to be limited to:*

- *The area within Toorale National Park and State Conservation Area*
- *The public road where it passes through Toorale NP and SCA*
- *Adjoining landholders*
- *The Darling River between Toorale and weir 20A*

unless a potentially significant impact outside of this area is identified. If this happens, the OEH (DPIE) *Project Manager is to be contacted for advice*."

Spatial descriptions used in this report are defined in Table 3-4 below.

Table 3-4: Spatial Definitions

Term	Definition
Study Area	The spatial scope of the assessment as described above
Survey Areas	These are the areas originally surveyed during field studies for impacts to ecological communities.
Investigation Areas	These are the broad areas, in a list form, that will be investigated to take the project from a series of ideas, through to implementation. - what and how it was investigated, limitations and parameters.
Construction Disturbance Area	Means the spatial area surrounding a proposed development site that will be affected by development construction.
Inundation regime change impact area	Means the area which is potentially affected by the construction, modification, or operation of a site and related facilities. Means the land that approved operations directly or indirectly affect through changes to the inundation regime.
Direct Impact	Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component.
Indirect Impact	Indirect impacts on the environment are those which are not a direct result of the project, often produced away from or as a result of a complex impact pathway. The indirect impacts are also known as secondary or even third level impacts.

3.3.4 Construction works extent and construction disturbance footprint

The final extent of construction works at Boera Dam, Booka Dam and Homestead Dam and the spatial extent of assessed construction disturbance footprints of these works have been defined using the parameters described in Table 3-5. The final extent of works and construction disturbance footprints for Boera Dam, Booka Dam and Homestead Dam are shown on Figure 3-2, Figure 3-3 and Figure 3-4 respectively.

These areas represent the maximum area potentially impacted by construction-related activities. This approach has been taken because the specific movements of vehicles and equipment cannot be precisely described at this point in time, nor is the location for spoil deposition resolved. The disturbance footprints also include existing access tracks that are routinely used and maintained for park management. The actual area to be disturbed is likely to be less that that shown but the maximum possible area has been assessed.

Table 3-5: Definition of construction disturbance footprint extents at each Dam

Disturbance type	Description	Maximum Impact Area (ha)	Source
Boera Dam works area	Immediate area of embankment overflow Fishway construction area Clearing and earthworks Suitable setdown area for spoil and parkup for machinery 10 m construction buffer around all works and setdown areas to allow for incidental impacts beyond the planned works.	11.11 ha	Engineering plans provided by Alluvium Consulting Australia Pty Ltd (2019) Appendix A Aerial imagery interpretation and Spatial analysis by DPIE
Booka Dam works area	Immediate area of embankment overflow Fishway construction area Suitable setdown area for spoil and parkup for machinery 10 m construction buffer around all works and setdown areas to allow for incidental impacts beyond the planned works.	5.78 ha	Engineering plans provided by Alluvium Consulting Australia Pty Ltd (2019) Appendix A Aerial imagery interpretation and Spatial analysis by DPIE
Booka Dam western access area	Area for upgrading western access to service construction vehicles Includes crossing of the western bywash, turning bays and suitable setdown area for spoil and parkup for machinery	6.43 ha	Aerial imagery interpretation and Spatial analysis by DPIE
Homestead Dam works area	Immediate area of embankment overflow Fishway construction area Suitable setdown area for spoil and parkup for machinery 10 m construction buffer construction buffer around all works and setdown areas	11.29 ha	Engineering plans provided by Alluvium Consulting Australia Pty Ltd (2019) Appendix A Aerial imagery interpretation and Spatial analysis by DPIE

	to allow for incidental impacts beyond the planned works.		
Total Construction Disturbance Footprint	The outer extent of the sum of all works, setdown, and construction areas, plus the construction buffer for incidental impacts.	34.62 ha	Spatial analysis by DPIE

The maximum area that will potentially be impacted by construction related activities equates to approximately 35ha, representing a very small part of the total area (85,600ha) of the Park.

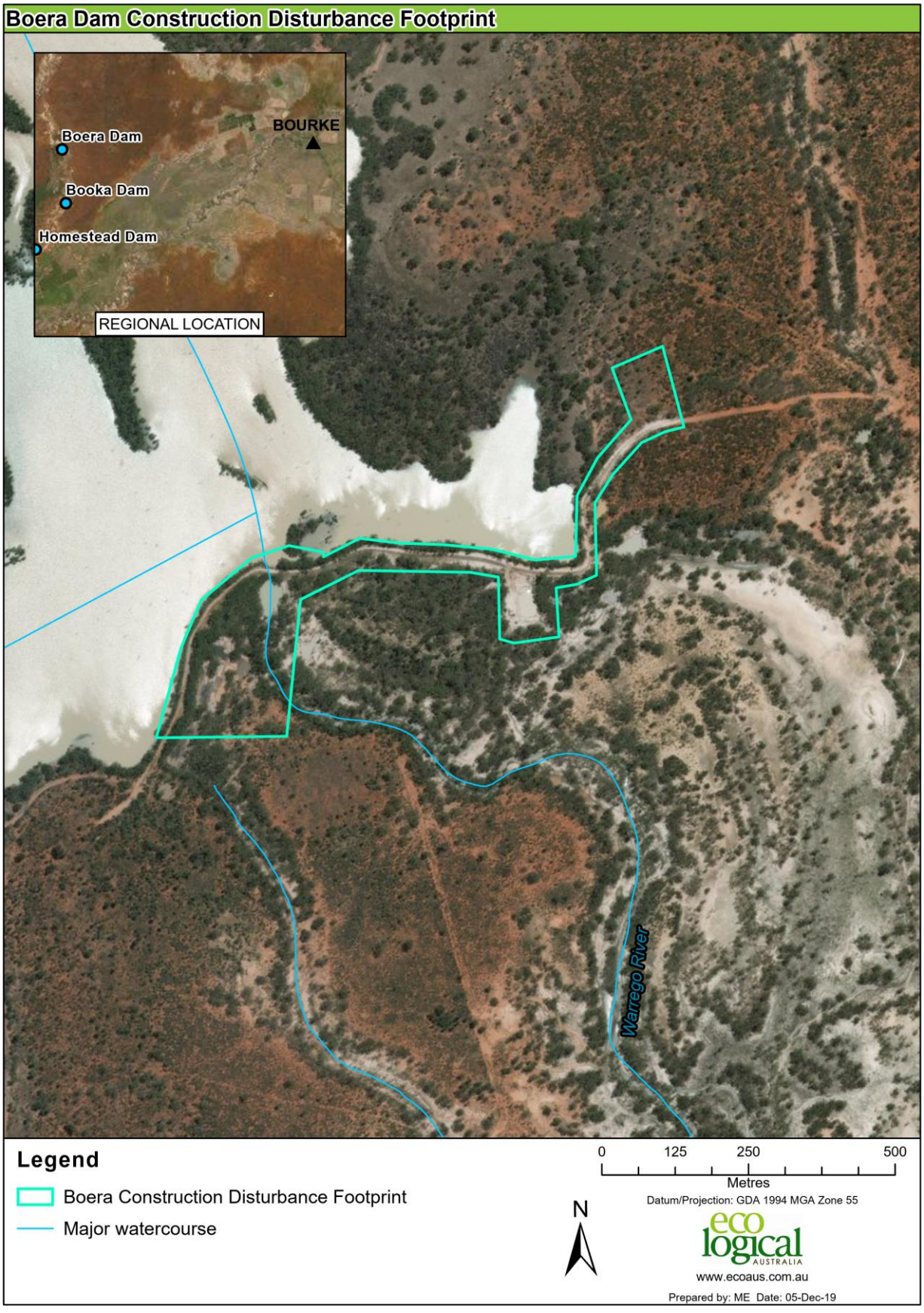


Figure 3-2: Boera Dam construction disturbance footprint

Figure 3-3: Booka Dam construction disturbance footprint

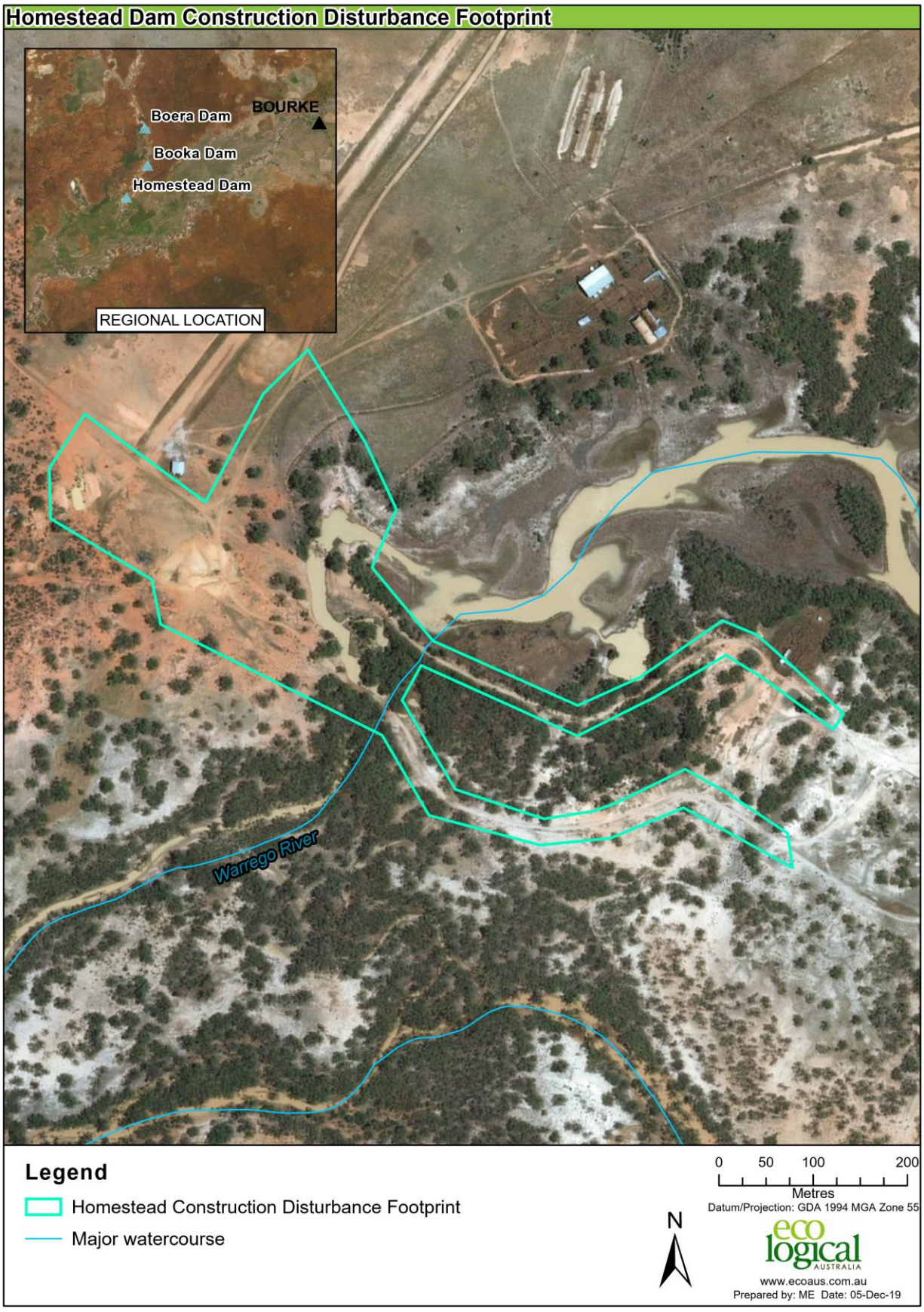


Figure 3-4: Homestead Dam construction disturbance footprint

3.4 Reasons for the Activity and Consideration of Alternatives with Justification

3.4.1 Reasons for the activity

An agreement between the State and Australian Governments at the time of Toorale's purchase requires the NSW Government to demolish, modify, remove or decommission the water infrastructure on Toorale to improve water flows for environmental purposes. The (then) NSW Office of Environment and Heritage commenced the Toorale Water Infrastructure Project in 2016 to enable greater quantities of flows to be passed through the Warrego River to the Darling River, and to improve conditions so that fish can more easily move through this reach.

The CEWH purchased the water entitlements attached to Toorale to improve the benefits from the delivery of these flows to environmental assets on-park and within the Darling River downstream. However, the existing water infrastructure has been established to maximise water retention and use for irrigation and agricultural purposes on Toorale and constrains CEWH's ability to manage its entitlements to generate desired improvements in both the Warrego and Darling Rivers.

The proposal is consistent with the draft Plan of Management (PoM) prepared for Toorale (OEH, 2018a) which includes a summary of the issues that have been considered during planning and design of the proposed activity. Those that are specifically relevant to the proposed activity are:

- Improvement of flows downstream of Toorale needs to be balanced with the maintenance of key natural and cultural values present at Toorale. The design and operation of in-stream structures must ensure:
  - the maintenance of vegetation, and wetland condition on the Western Floodplain to conserve habitat and food availability for both terrestrial and aquatic species;
  - the health and viability of important wetland communities and the species they support, including vulnerable Blue-Billed Ducks (*Oxyura australis*) and Brolgas (*Grus rubicunda*) and migratory species such as Eastern Great Egrets (*Ardea modesta*), Glossy Ibis (*Plegadis falcinellus*) and Oriental Pratincoles (*Glareola maldivarum*). This includes in-stream refugia and other habitat values;
  - the heritage values of the Boera Dam and Toorale Floodwaters Scheme and the Toorale Homestead Precinct are conserved;
  - access is available for visitor opportunities and the maintenance and protection of cultural and heritage values.
- Ongoing maintenance and operation of in-stream regulating structures retained for the delivery of Commonwealth water or the maintenance of Park values;
- The need for intervention to prevent the continual erosion of the Homestead Dam bank during periods of high flow;
- That existing in-stream and floodplain structures are barriers to fish passage during low flows and some medium flows; and,
- That there is an ongoing requirement for water to be supplied to the Park through stock and domestic entitlements.

The proposed works seek to ensure that the following desired outcomes in the draft PoM are met, or make significant contributions to achieving these outcomes:

- Water in the Park is managed to maintain or improve the Park's natural and cultural values (in particular, water-dependent ecosystems), and facilitate effective land management operations and amenity for visitors.
- Fish passage is improved.

- Development, modifications and other works associated with in-stream structures have a net environmental benefit for natural and cultural values. Environmental and cultural impact assessments are conducted prior to any works or modifications.
- Water supply to the Park for management purposes, including visitor facilities, is maintained.
- Cooperative relationships are maintained with water management authorities, neighbours and stakeholders.
- The importance of flooding and drying events to maintain key ecological processes is communicated to stakeholders, including authorities, neighbours and the community.
- The impacts of riverbank subsidence and sedimentation are minimised.
- Where possible, significant cultural values are protected from flooding.

3.4.2 Alternatives Considered

In 2016, the then OEH (now DPIE) contracted Alluvium Consulting Pty Ltd (Alluvium) to undertake a business case to investigate options for the Toorale Water Infrastructure Project. The business case identified and assessed options to modify the existing water infrastructure at Toorale with the objective to protect and maintain its environmental values, while enabling greater capacity to divert flow through the Warrego River to the Darling River (Alluvium, 2016).

The business case included:

- Technical investigations, field studies and stakeholder consultation;
- Identification of ecological, social and cultural values, fish passage requirements, and water delivery requirements to be protected and/or enhanced through the project;
- Identification and evaluation of infrastructure modification options to support the integrated delivery of environmental water to achieve desired objectives, improved fish passage and the passing of water through the site (including conceptual designs); and
- An estimate of the costs necessary to implement the project, including for regulatory planning assessment and approval, detailed design, construction, operation and maintenance, including an appropriate contingency.

The business case recommended a preferred arrangement of works for the water infrastructure on Toorale. The Toorale Project Steering Committee subsequently endorsed a preferred package of works to be undertaken at Boera, Booka, Homestead and Peebles Dams.

Several modifications to the proposal have been made since completion of the business case based on further consultation with stakeholders and additional information gained from associated studies. These changes mostly relate to works proposed for Boera Dam, and the fishways proposed at Booka and Homestead Dams. Key points regarding these changes are as follows:

- The proposed flow capacity of 1500 ML/d set out in the Business Case was reduced to900 ML/d for Boera Dam. Through the design process it was agreed that fish passage is required for flows up to 900 ML/d. Flows above 900 ML/d typically only occur for short periods during events and provision of fish passage at flows below 900 ML/d will meet fish passage objectives whilst managing project costs.
- Delivery of flows above 900 ML/d (and potentially up to the design capacity of 1500 ML/d as proposed in the Business Case) is recognised as being important during times of low or no flow in the Darling River. Accordingly, the proposed design provide flexibility in the delivery of flow within this range.
- The business case proposed a fill and spill arrangement with rock ramp fishway at all 3 sites. The structure at Boera was initially to be located at an alternative site to the east of the currently proposed location.

- As a result of the potential for impacts to significant Aboriginal cultural heritage, the Boera structure was relocated to the currently proposed site (site of existing pipes). In addition, a fill and spill did not sufficiently meet project objectives (providing for flexibility in flow delivery and unacceptable social and ecological impacts within the storage and to the western floodplain)), and further survey of the channel indicated that a rock ramp design fishway was not an option. It was concluded that a gated regulator and vertical slot fishway would be required to effectively meet the project objectives, particularly those relating to flexibility in flow delivery and effective fish passage.
- A framework to guide the operation of the proposed structure at Boera Dam has been developed in parallel with the works designs since the concept plan for this site was resolved. The operating guidelines have been guided by the Project objectives, the conditions of the existing works approvals and water access licences, and by consultation with government and community stakeholders.
- Concept designs for the 3 new structures proposed for each site were resolved during 2019. These are as described in this REF and include a 3-bay regulator in the Boera Dam structure. This was designed to achieve the passing flow rate objective of up to 900 ML/d to the Warrego River.
- Changes to the design of the rock ramp fishways proposed for Booka and Homestead Dams have been made in response to stakeholder concerns regarding aesthetic and heritage impacts, as well as potential maintenance and hydraulic efficiency concerns
- Delivery of flows above 900 ML/d, (and potentially up to the design capacity of 1,650 ML/d), is recognised as being important during times of low or no flow in the Darling River. Accordingly, the proposed design provides flexibility in the delivery of flow within this range.
- Increasing of the maximum passing flow objective from 900 ML/d to up to a potential 1,650 ML/d (maximum rate to be confirmed) in response to community calls for more water to be delivered to the Darling River more quickly during extended dry periods, and to better align with Basin Plan processes that have progressed since the project commenced. While the Boera Dam structure has been designed to pass 900ML/d, in practice it can be operated to pass significantly more. No modifications are therefore needed to the proposed structure at Boera Dam, apart from some additional armouring of the toe of the structure to protect it from the impacts of larger flow discharges
- During further consultation undertaken in 2019, some community members expressed a view that a 4-bay structure should to be constructed so that an accurate measure of where flows are delivered can be made. This follows from the current constraint of the 3 by structure to only accurately measure flows of up to 1000ML/d. This has been considered and a decision made to proceed with a 3-bay arrangement since the increased capacity to measure is thought to not provide be sufficiently accurate, and measurements will be able to be made using up and downstream gauges. However, this matter will be discussed further with the Natural Resources Access Regulator (NRAR)
- In 2018, a temporary replacement bank at Homestead Dam was proposed as an interim measure, concurrent with the removal of Peebles Dam, for later installation of the fill-and-spill crested weir and rock-ramp fishway. The rationale of this approach was to avoid double-handling of spoil. However, the Toorale JMC did not support the interim option and indicated a preference to hold off until the full project could be implemented. NSW Fisheries did not support the interim reinstatement of Homestead Dam on the grounds that it reinstated a barrier to fish movement in the Warrego River. As a result, no temporary work at Homestead Dam has been undertaken.

The current status quo of the water management infrastructure at Toorale (the “do-nothing approach”), does not address the issues or achieve the desired Project objectives that were agreed to between the State and Australian Governments, and the community. The following impacts are identified as being likely to occur, or continue to occur as a result of the “do-nothing approach”:

- Inability to improve passage of flows through Toorale to the Darling River
- No effective fish passage through the dams on Warrego River channel on Toorale which restrict fish dispersal and migration
- Continued limitation on Park access associated with Homestead Dam and further erosion of the breached area at the dam
- Maintenance liability and risk of failure of existing infrastructure which could also compromise NPWS and the CEWHCEWH's ability to fulfil their water licence and works approval conditions
- Failure to meet community expectations that more flow will be delivered to the Darling River
- Traditional owners unable to fulfil aspirations for cultural heritage management

3.4.3 Justification for preferred option

The preferred option, as described in Section 3, has been agreed following extensive consultation, investigations and planning since 2016. This option has been revised and refined over that time to maximise potential benefits and to avoid and/or minimise negative impacts to the environment and stakeholders. The preferred option has taken into consideration the requirements for management within the draft PoM and concerns indicated by stakeholders, and addressed these to the fullest extent possible in the time and budget available. It has also been developed taking into account uncertainty about historic watering practices and the potential future impacts of climate change on the region.

The proposed activity has been selected for implementation since it will:

- meet flow delivery requirements and objectives
- be consistent with existing Water Management Act approvals
- Meet fish passage objectives, including provision of improvements to fish passage (fishways) across the required flow range for a significant proportion of both large and small bodied fish.
- protect and maintain environmental, heritage and cultural values
- improve amenity for Park visitors
- facilitate improved NPWS access to the western side of the Park during period of high flows
- provide regulating capacity to deliver flows of up to 1,650 ML/d to the Darling River during times of high need while minimising impacts to Warrego River users to the extent possible
- maintain capacity to divert flows to the western floodplain
- result in least impact to Aboriginal cultural heritage of all options considered, and has the agreement of the Toorale Joint Management Committee

If the proposed activity is not approved:

- flow management at Toorale would continue to not meet the Project water management objectives and community expectations.
- NSW will fail to deliver on an agreement with the Commonwealth government to undertake the works, and on commitments made to local communities and other stakeholders
- Funding to implement the project is at risk
- The "do nothing" scenario continues which is not a long-term solution

Selection of the preferred option should be justified in terms of:

- *Ability to satisfy the objectives of the proposal:*

Element	Criteria	Ability to satisfy the objectives of the proposal
Hydrology	Meet the intent of the existing works approval conditions.	No reduction in flows passed downstream (actually results in an increase). Capacity to regulate structure at Boera to pass flows and maintain storage levels consistent with existing approval.

Element	Criteria	Ability to satisfy the objectives of the proposal
		Some change to capacity of Homestead and Booka Dam. Stock and domestic function maintained. Allows use of Commonwealth-held water in line with their objectives
	Provide agreed discharge in Warrego River for release to the Darling River.	New structures and operating strategy provide for release of agreed flows.
	Retain capacity to divert flows from Boera Dam to the Western Floodplain.	Capacity to divert flows to the western floodplain retained.
Ecological values	Maintain the ecological values of the Western Floodplain.	Structure and operating strategy provide for flexible management of inflows to maintain ecological values of western floodplain. Operating strategy can be adaptive and respond to changed conditions if required
	Minimise impacts on existing in-stream ecological values.	Instream habitat of Boera maintained Some loss of habitat extent in Booka somewhat offset by increased frequency of flows Improvement of in-stream values at Homestead Dam from current breached state, but reduced from pre-breach state. Somewhat offset by increased frequency of flow Impact in Warrego River ecological values anticipated to be positive
	Protect intact and established values as required under relevant legislation.	No significant impacts identified for threatened species and/or ecological communities under the BC Act, FM Act or EPBC Act.
Fish passage	Provide fish habitat and passage through Warrego River for small to large bodied native fish.	Fish passage provided for a range of fish species and sizes through both structure modifications and proposed flow management arrangements
	Meet the fish passage criteria determined for the project and regulatory requirements for fish passage in any modification to existing structures and to satisfy section 218 of the *Fisheries Management Act 1994* (NSW).	Compliance with NSW fish passage guidelines
Cultural heritage values	Avoid and minimise site and functional level heritage impacts.	Impacts to ACH avoided and minimised to the fullest extent possible during planning, design and construction phases
	Manage cultural values in accordance with heritage values, legislation and policy.	Compliance with all legislation, policies and guidelines.

Element	Criteria	Ability to satisfy the objectives of the proposal
		AHIPs obtained/to be obtained for all areas to be disturbed during the project
	Have regard to values and concerns of Aboriginal community as represented by Toorale JMC.	Toorale JMC regularly consulted throughout all stages of the project has indicated its broad acceptance of the project as proposed All values and matters of concern expressed by JMC considered and addressed by preferred option
Local stakeholder and council interests	Consider social and stakeholder values in the development of options, including stock and domestic water supply.	Extensive stakeholder consultation undertaken throughout the project. All issues and values considered and addressed by preferred option.
	Maintain water supply opportunities for adjoining properties.	Water supply opportunities maintained with some changes
	Not adversely impact on public road access.	Public access will not be significantly impacted
National Park operation and maintenance	Limit adverse impact on Park access.	Access across Warrego River provided as requested
	Not increase the maintenance and operation liabilities at the site.	Maintenance and operation liabilities reduced under the proposed option
	Reduce the potential for failure of embankments and associated risks to public safety and repair costs.	Potential risks and costs reduced with preferred option
	Consider Park recreational and aesthetic values.	Recreational and aesthetic values have been considered. Reinstatement of storage at Homestead will enhance visitor experience

- *Relative environmental and other costs of each alternative:*

There is an unavoidable cost to the ecosystems of the western floodplain if more water is to be delivered through the Warrego River to the Darling River. However, this is anticipated to result in environmental improvements and improved ecosystem health in the Warrego and Darling Rivers.

Similarly, neighbouring landholders will be impacted by the proposed changes that will bring benefits to downstream communities.

The proposed activity will impact on Aboriginal cultural heritage, particularly in those sites that will be directly disturbed. However, sites of high significance have been avoided. The reinstatement and design elements of Homestead Dam as well as the maintenance of the western floodplain as requested by the JMC provides some compensation for these impacts.

The project value has increased substantially since commencement as a result of making it as environmentally, socially and culturally acceptable as possible.

- *Acceptability of environmental impacts and contribution to identified environmental objectives:*

See above

- *Acceptability of any environmental risks or uncertainties:*

The limited understanding of flow management prior through the regulators prior to purchase of Toorale creates some risk and uncertainty with the proposal, particularly in relation to potential impacts to ecosystems on the western floodplain.

This uncertainty has been managed in the selection of the preferred option by:

1. Reference to research on the flood history of Toorale and the watering requirements of those ecosystems that occur on Toorale
2. Consultation with community members with an awareness of historic management practices
3. Interpretation of how flows would have been required to be managed under the licence conditions
4. Modelling of flows under various management scenarios
5. Designing structures and an operating strategy which can be adapted in response to future information inputs and that are consistent with broader Basin environmental flow triggers

- *Reliability of proposed environmental impact mitigation measures*

All environmental mitigation measures proposed are based on standard best practice measures relevant to similar construction projects. Mitigation measures have been developed in a consultative manner by appropriately qualified ecologists, archaeologists and environmental scientists.

- *Efficient use (including maximising reuse) of land, raw materials, energy and other resources.*

Designs and construction techniques have been developed in a consultative manner to ensure the efficient use of land, raw material, energy and other resources.

4 Consultation

4.1 Consultation During Project Planning and Design

Consultation with relevant stakeholders regarding the proposed works has been undertaken over the duration of the Toorale Water Infrastructure Project to ensure that social, environmental and cultural impacts have been appropriately assessed and managed. Consultation activities have been undertaken in accordance with the requirements outlined under Division 1 of Part 2 of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) for development carried out by, or on behalf of, a public authority.

In 2016, the DPIE contracted Alluvium Australia to undertake a business case to investigate options to deliver the project objectives and requirements (Alluvium, 2016). Stakeholders were consulted several times during preparation of the business case to provide input on the values of Toorale and the environment that are important to them, and what they wished to be addressed in refining the preferred business case option to achieve the project requirements. The stakeholders consulted during this process included:

- National Parks and Wildlife Service,
- Bourke Shire Council,
- NSW Fisheries,
- Department of Industry – Water,
- Commonwealth Environmental Water Holder,
- Toorale Joint Management Committee,
- Park neighbours,
- Australian Government Department of Infrastructure, Transport, Cities and Regional Development, and
- Downstream landholders and communities.

DPIE has continued to consult with these stakeholders as the project has progressed, and the final designs have been substantially modified in response to their input. The outcome of this consultative approach has been the development of a proposal that is generally supported and endorsed by each of the above groups. Efforts have been made to adapt and modify the design of infrastructure to suit as many stakeholder's needs as possible.

NSW National Parks and Wildlife Service

NPWS Bourke Area manages both Toorale NP and SCA. NPWS has been closely involved with all aspects of the planning, design, consultation and impact-mitigation of the project since its inception. The Project Manager has also liaised with the NPWS Planning and Assessment Team to ensure consistency with the aims and objectives of the draft Toorale Plan of Management. DPIE will continue to liaise with NPWS as the project progresses.

NPWS has noted/indicated there are no significant concerns with the proposed works at Boera, Booka and Homestead Dams within the Park. Mitigation works as outlined in Section 6.3 will seek to avoid or minimise adverse impacts to the environmental, historic and cultural values of the Park.

Australian Government Department of Infrastructure, Transport, Cities and Regional Development

The Australian Government are a key stakeholder and primary source of funding of the Toorale Water Infrastructure Project. The Department of Infrastructure, Transport, Cities and Regional Development (previously Department of Agriculture and Water Resources) has provided ongoing support and feedback on design decisions since the project's inception and have worked with DPIE to ensure high standards of Indigenous engagement throughout its development.

Bourke Shire Council

Bourke Shire Council was consulted during preparation of the business case and provided with subsequent updates on project progress. Council was also consulted on the potential inundation of the Dick's Dam crossing as a result of increased flows in the Warrego River and access issues for residents along Dick's Dam Road during a flood event.

During discussions, Council raised issues regarding road maintenance and access, especially along Dick's Dam Road. Impacts to neighbouring properties was also raised as potential areas of concern.

NSW Fisheries

NSW Fisheries has been closely involved with the Project during preparation of the business case and through the design stages, particularly regarding the plans and future operation of the fishways to ensure designs are feasible and enable fish dispersal and migration as per the requirements.

Engagement with NSW Fisheries has also taken place regarding the future legal obligations under section 219 of the Fisheries Management Act as a permit will be required to periodically close the proposed fishway at Boera Dam.

Department of Planning, Industry and Environment - Water (DPIE-W)

DPIE-Water was consulted during preparation of the business case and again early in the concept design stage.

DPIE-Water has advised that options proposed for the Toorale Water Infrastructure Project should not result in a reduction in delivery of water to the Darling River from that currently provided for under existing water access licences and approvals.

WaterNSW

WaterNSW has been engaged regarding removal of hydrometric equipment (gauging station) at Boera Dam which is located within the construction footprint for the proposed works. There is also a gauging station located further downstream at Dicks Dam that is not within the construction footprint however may be impacted by changing water levels. Negotiations are underway to determine the best process of removal, storage and reinstatement of the hydrometric equipment at the conclusion of the construction phase at Boera Dam. WaterNSW have confirmed that the equipment at Boera Dam will be removed by the authority by notification from DPIE prior to works commencing.

Commonwealth Environmental Water Holder

The CEWH has been closely engaged in project planning and design since its inception. CEWH have been involved in developing the draft Toorale Operating Strategy and in reviewing the components of this REF that relate to their business.

Aboriginal Cultural Heritage consultation

The land is not subject to an Indigenous Land Use Agreement, nor has there been a determination of Native Title and the land is not subject to any pending native title claim (National Native Title Tribunal,

2018). Native title has not been extinguished and the activity does not have a high risk of adversely affecting native title. Therefore, no further consultation regarding native title is required.

Consultation with the Aboriginal community has primarily been through the Toorale Joint Management Committee, which includes representatives of the Kurnu-Baakandji traditional owners.

During 2017 and 2018, comprehensive assessment of Aboriginal cultural heritage in the area to be impacted by the project was undertaken by Biosis Pty Ltd. This assessment included consultation with the Toorale Joint Management Committee (JMC). Consultation with Registered Aboriginal Parties was also undertaken in support of two Aboriginal Heritage Impact Permit (AHIP) Applications (C0003079 and C0004300). Records of consultation undertaken during the development of the AHIP applications are provided in Biosis (2017, 2018b).

The Toorale JMC has been actively engaged in the planning of the project, which has been modified several times in response to concerns expressed and suggestions the committee has made (see Appendix B for a log of consultation with the JMC). Specific JMC requirements that have been incorporated into the project planning and design that are of particular relevance to this REF include:

- Reinstatement of the storage at Homestead Dam;
- Commencement of work at Homestead Dam as a priority;
- Avoid and minimise harm to Aboriginal Cultural Heritage unless absolutely necessary;
- Maintain flows to protect the Western Floodplain; and,
- Provide training and employment opportunities for Aboriginal people.

At its October 2018 meeting, the JMC indicated that it was satisfied with the project as presented at that point in time. However, the JMC did not support commencement of works at Peebles and Homestead prior to implementation of the full project, i.e. works proposed at all four dam sites.

In August 2019, DPIE met again with the JMC to provide a project update and engage about the specifics of the Aboriginal Cultural Heritage Management Plan, with Biosis. JMC members were also invited to participate in the salvage of Aboriginal Artefacts and Objects as part of the AHIP process. Two JMC members were employed as part of this process.

Adjoining Landholders

Adjoining landholders were contacted and invited to provide input into the business case (Alluvium, 2016), and have since been updated on the project by letter or email. Both NPWS and the Project Manager have had ongoing discussions with park neighbours in the intervening time. More formal communications have also been received in which neighbours have indicated their concerns.

Issues raised by neighbours include:

- Loss of water supply reliability
- Livestock management issues
- Loss of productivity as a result of less watering of floodplain areas
- Impact to a proposed eco-tourism venture adjoining Booka Dam
- Desilting of storages should be considered
- Impact to amenity and recreation opportunities

Wider community and downstream water users

DPIE has engaged with the wider community, including water users and communities on the Darling River. Recent engagements include community meetings at Dubbo on 1st August 2019 and Menindee

on 5th September 2019 (47 people present). Adjoining landholders were also invited to attend each of these information and discussion sessions.

Issues raised by downstream communities and landholders primarily relate to maximising the rates and volumes of Warrego River inflow that are passed to the Darling River, particularly during critically dry periods.

4.2 Consultation on Environmental Assessment Requirements

While no formal consultation has been undertaken, the following agencies were contacted for their environmental assessment requirements for the proposed works.

Office of Environment and Heritage/ Department of Planning, Industry and Environment

The Regional Operations North West Branch of the then OEH, now part of the DPIE cluster, provided guidance on the matters to be considered in the environmental impact assessment and the NPWS REF template to be used for the report. All feedback and advice from the Phase 1 documentation has been incorporated into this Phase 2 REF where possible to ensure the environmental impacts are adequately assessed and to demonstrate consistencies with the NPWS REF template.

National Parks and Wildlife Service

The Park Programs Branch provided advice on the requirements for assessment of non-Aboriginal heritage and referred the Project Manager to the relevant guidelines NPWS Guidelines for historic heritage approvals. How to seek approvals for activities and work at historic heritage places within national parks and other reserves.

The Partnerships, Planning and Heritage Branch provided written advice on public exhibition requirements under the OEH Guidelines for determining a Review of Environmental Factors and referred the assessment to the OEH/NPWS Construction Assessment Procedures.

Department of Planning, Industry and Environment – Water

In May 2018, the Water Regulation Group advised the Project Manager of assessment requirements for new or modified works approvals. No new works or modifications are proposed that are inconsistent with the existing approvals.

Department of Primary Industries - NSW Fisheries

NSW Fisheries has been consulted on the legislative requirements under s219 of the Fisheries Management Act 1994 to close the proposed gate on the fishway exit and hence close fish passage at Boera Dam. NSW Fisheries advises that an overall permit can be issued to close the fishway under certain conditions and to maintain levels in Boera Dam, and a notification form submitted to the Department each time such closure occurs.

Specific requirements for the operating strategy and guidelines

In addition to the above criteria, there will be specific rules that will need to be included in the operating strategy and guidelines. This includes the operation of the manual gate on the fishway exit. The purpose of the gate is to maintain the level of Boera Dam when there are no inflows into the system. The gate can be closed once inflows are <50 ML/day at Fords Bridge and can be reopened any time after the Boera Dam water level drops below the fishway invert. The gate must be reopened again prior to when inflows into Boera are greater than 50 ML/day at Fords Bridge and the water level is at or above 104.85 m AHD in the storage. As noted above, a FM Act section.219 permit will be required whenever the exit gate is placed in the fishway (Alluvium, 2019).

Environmental Protection Authority

EPA Central West Operations advised its assessment requirements in December 2017 (Appendix C).

Bourke Shire Council

Councils assessment requirements were sought in March 2017. Bourke Shire Council did not respond with any requirements.

Australian Government Department of Environment and Energy

Consultation with the Australian Department of the Environment and Energy is not warranted as the proposed activities do not impact or concern any Matters of National Environmental Significance as defined under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Early contact was made in December 2015 in broad terms about the project and approvals process. Documentation related to the above consultation can be provided on request.

Natural Resource Access Regulator

The NRAR is within the Department of Planning, Industry and Environment (DPIE). The NRAR administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

Controlled activities on waterfront land are described as activities carried out in, on, or under waterfront land are regulated by the Water Management Act 2000 (WM Act). Works described in this REF are to comply with the guidelines for controlled activities on waterfront lands – riparian corridors.).

5 Environmental Assessment

Assessment Methodology

The **Environmental Assessment** (Section 5) has been undertaken to assess potential environmental impacts for a range of specific issues identified through consultation and site investigations. These are:

Issues	Section
Land Use, Landscape, Topography, Geology and Soils	5.1
Groundwater	5.2
Surface Water and Aquatic Ecology	5.3
Terrestrial Ecology	5.4
Community Impacts	5.5
Aboriginal Cultural Heritage	5.6
Historic Heritage	5.7
Waste and resource use	5.8

A description of ***existing conditions*** is provided for each issue, considering existing levels of development, as well as antecedent conditions as relevant. This includes all areas potentially impacted by the works, including the direct impact footprint and all areas potentially affected by changed flow regimes. This provides an opportunity to consider both environmental state and function in the absence of the Proposal.

In accordance with the principles of environmental assessment, all ***potential impacts*** associated with the Proposal are considered across the entire lifespan of the development, considering construction, operational and decommissioning phases. Potential impacts are considered in addition to existing environmental conditions, representing potential cumulative impacts. Furthermore, where known future development is proposed, consideration is given to potential cumulative impacts as relevant.

Mitigation measures are proposed to effectively manage all potential environmental impacts. These may include design considerations, monitoring strategies, construction safeguards, consultation, training and awareness programs, modified work practices, management plans or other relevant management strategies. A full list of mitigation and environmental management strategies and commitments is provided in **Environmental Management** (Section 6).

Potential **residual environmental risks** (Section 6) following mitigation are investigated using likelihood/consequence analysis to describe the potential magnitude of residual impacts. Where the mitigated impact remains high or extreme, further justification is provided to contextualise project risks going forward.

The **Project Justification** (Sections 2, 3.4 and 7) provides triple-bottom-line (environmental/social/economic) evaluation of the Proposal in order to fully describe potential benefits and impacts to the environment and the local, regional and NSW community. Justification against high level social and economic expectations is then considered against the principles of **Ecologically**

Sustainable Development (Section 7), and more specifically, considering the particular **socio-economic** attributes associated with the Proposal.

The **Conclusion** (Section 8) integrates the **Permissibility and Statutory Justification** (Section 2) and commitments made through the **Consultation** process (Section 4) with the findings of the **Environmental Assessment** to provide a concise statement regarding the suitability of the Proposal and outlines any key points for consideration as part of the development approval process.

5.1 Landscape, Topography, Geology and Soils

5.1.1 Existing environment

Toorale is located at the confluence of the Warrego and Darling rivers. The Gundabooka National Park and State Conservation Area are located southeast of Toorale, across the Darling River. The Park straddles three of the most poorly reserved bioregions in NSW. It protects significant areas of the Darling Riverine Plains Bioregion (49,119 ha) and Mulga Lands Bioregion (35,355 ha), as well as a portion of the Cobar Peneplain Bioregion (67 ha) (OEH, 2018a).

Overall, the landscape at Toorale is flat with river channels and floodplain features dominant. There are only a few large rises in the study area however low rises of cretaceous sandstones and red soil terraces are more common. Between Bourke and Wilcannia, the Darling River has a simple landscape of channels, floodplains, billabongs and slightly higher red soil terraces (OEH, 2018a).

Toorale also contains an unusually high diversity of Mitchell landscapes, one of which was not previously protected within the NSW park system and five others that are now significantly better represented following Toorale's reservation. Boera, Booka and Homestead Dams are located within the Paroo-Warrego Channels and Floodouts landscape which includes parts of seven land systems including the Walkdens and Warrego land systems (Mitchell, 2002; Figure 5-1). The Paroo-Darling Channels and Floodouts landscape is characterised by channels, floodplains and dune field islands of Quaternary alluvium and aeolian sand, with occasional salinas and extensive scalds along the Warrego River. Relief is low (to 5 m) and channel and floodplain soil, such as which Homestead Dam is located in, are grey cracking, crab-holey clay (Mitchell, 2002).

Toorale's high landscape and ecosystem diversity is reflected in the presence of 12 different land systems (Walker, 1991) including old erosional surfaces of undulating downs, sand plains, dunefields and alluvial floodplains. Ten of these 12 land systems were not represented in the NSW park system prior to Toorale's reservation. Homestead Dam is located entirely within the Walkdens land system, which is characterised by backplains of the Darling and Warrego River and channels and depressions of Quaternary alluviums (Walker, 1991; Figure 5-1). Relief in the Walkdens land system is usually less than 1 m (Walker, 1991). Boera and Booka Dams are located within the Warrego land system which incorporates the Warrego River, tributaries and distributaries and floodplains, and is characterized by sinuous perennial stream, incised distributaries and extensive floodplains of Quaternary alluvium, and small elevated areas of red and yellow Quaternary aeolian sands (Walker, 1991; Figure 5-1).

Geology

The sites are underlain by Quaternary floodplain, outwash and drainage flat deposits comprising of clayey silt and sand (NSW Geological Survey 1: 250,000). At depth the Quaternary deposits are underlain by Cretaceous deposits of sandstone, siltstone and claystone, known as the Rolling Downs Group (A.S. James Pty Ltd, 2018).

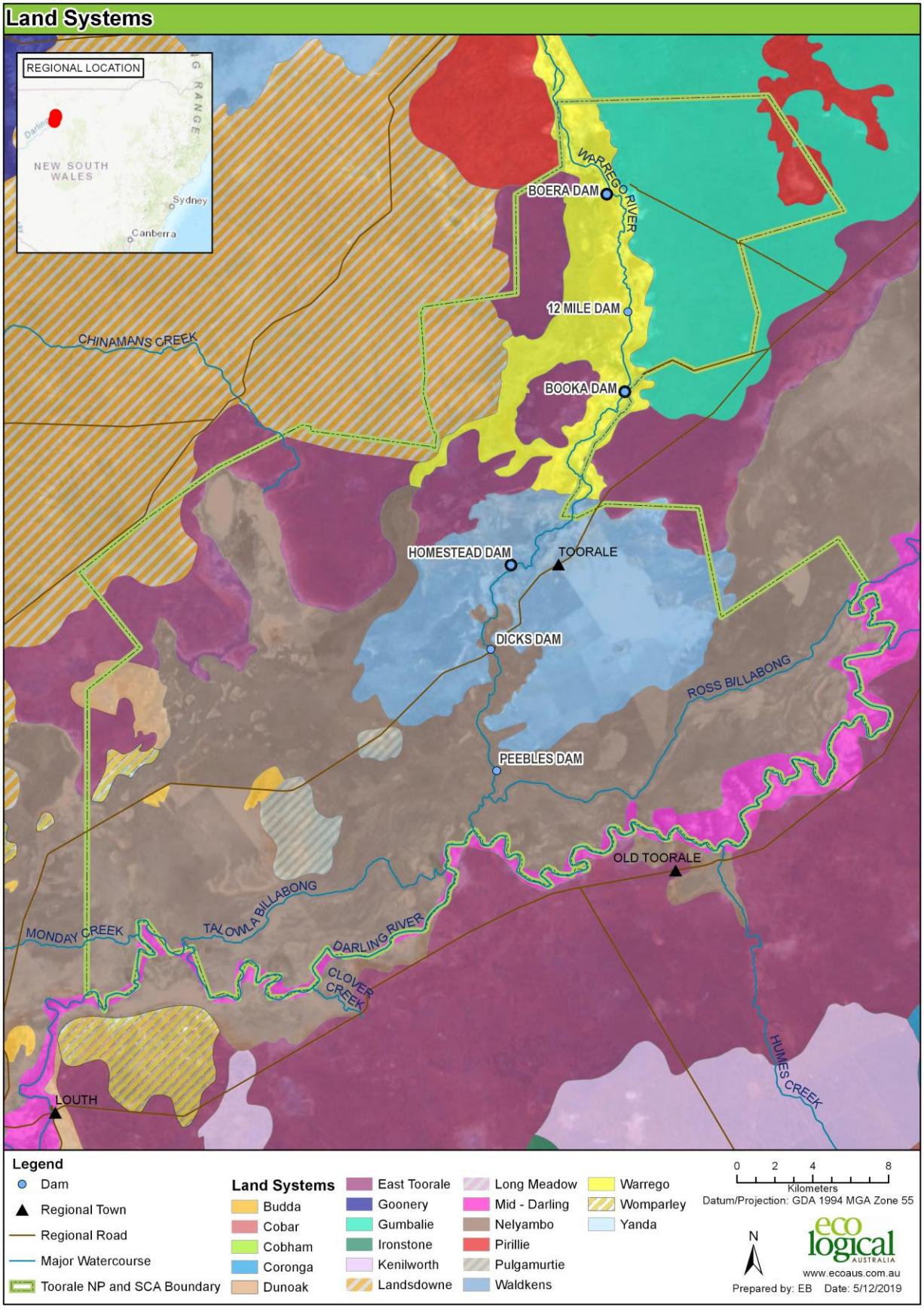


Figure 5-1: Land systems

Climate

According to the Köeppen climate classification system, which uses native vegetation cover as a representation of local climate, Toorale experiences a Grassland (semi-arid) climate (BoM, 2016). Typical conditions are hot summers and cold to mild winters with relatively uniform rainfall across the year, with drier months occurring between August and October (BoM, 2016; Alluvium, 2016).

The closest automatic weather station (AWS) with full climate statistics available is Bourke Airport AWS (station 048245) approximately 60 km north east of Toorale. Bourke has an annual average rainfall of 300 mm, an average maximum temperature of 28.3°C, and an average minimum temperature of 13.4°C (BoM, 2019a). Mean daily evaporation (mm) is not available at Bourke Airport AWS, however data from Cobar Meteorological Office has been included (BoM, 2019b). High summer temperatures, over 40°C, are regularly experienced in the area. Other weather stations that collect rainfall data only indicate that the average annual rainfall for the area is between 339 mm and 310.4 mm (Fords Bridge and Louth) (BoM, 2019c; BoM, 2019d).

Summary climate statistics for Bourke Airport AWS are provided in Table 5-1.

Table 5-1: Summary climate statistics for Bourke Airport AWS (BoM, 2019a; BoM, 2019b)

Month	Mean Temp		Mean Monthly Rainfall (mm)	Mean Number of Days of Rain (>1 mm)	Mean Wind Speed		Mean Daily Evaporation (mm)#
	Min	Max			9 am	3 pm	
January	22.7	37.6	30.3	3.0	19.3	16.4	11.4
February	21.8	35.8	30.0	2.8	18.1	16.5	10
March	18.6	32.8	36.8	3.1	16.6	15.6	8
April	13.4	28.2	22.4	2.0	15.3	14.5	5.3
May	8.4	22.8	24.2	2.5	12.1	13.6	3.1
June	6.1	18.8	32.5	3.9	11.8	14.2	2.1
July	4.1	18.6	12.9	1.9	11.2	14.1	2.3
August	5.0	21.3	13.0	2.0	14	16.3	3.4
September	9.3	25.7	17.7	2.2	17.1	16.2	5.4
October	13.9	29.8	24.4	3.0	17.9	17.4	7.5
November	17.5	32.8	38.4	4.1	18.3	17.3	9.4
December	20.5	35.5	34.8	2.8	18.6	17.1	11.1
Annual	**13.4**	**28.3**	**300.0**	**33.3**	**15.9**	**15.8**	**6.6**

Cobar Meteorological Office

Land Capability

Land capability classes aim to classify land according to its inherent ability and protection from erosion and other forms of land degradation. The classification of any land is based on biophysical features which determine the limitations and hazards of that land. The main hazards and limitations include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and rockiness, and mass movement. The eight-class system recognises four types of land uses with land capability decreasing from Class 1 to Class 8 (OEH, 2012):

- Class 1 – 3: land suitable for cultivation;
- Class 4 – 5: land suitable for grazing and restricted cultivation;
- Class 6: land suitable for grazing; and
- Class 7 – 8: land not suitable for agricultural production.

Boera and Booka Dams are mapped as high capability land (Class 3). Class 3 land has moderate limitations for more intensive use other than grazing and cropping with cultivation, and suitability for a variety of land uses can be maintained if carefully managed to prevent long-term degradation (OEH, 2012). Land and soil capability declines to Class 4 land at Homestead Dam. Class 4 land has moderate to high limitations for high impact land uses and restricts land management options for regular cropping, high-intensity grazing and horticulture (OEH, 2012). Under current management practices, soils at these locations are not cultivated for cropping and grazing, and livestock have now been excluded from Toorale.

Soils, erosion and sedimentation

The project sites include old erosional weathered surfaces of undulating downs, sand plains, dunefields and alluvial floodplains. All dam augmentation sites occur on Vertosol soils as per the Australian Soil Classification (Grey, Brown and Red Clays under the Great Soils Group classification). These are clay soils with shrink-swell properties that exhibit cracking when dry and at depth have slickensides and/or lenticular peds (Isbell, 2016). Gilgai (microrelief) may also be present but may have been smoothed out due to past agricultural practices, however the shrinking and swelling processes that created them are still operating (Isbell, 2016).

The Australian Soil Resource Information System online database indicates that there is a low to high probability of occurrence of potential acid sulfate soils (PASS) at Booka and Homestead Dams, while there is an extremely-low probability of occurrence of PASS at Boera (Fitzpatrick, Powell & Marvanek, 2011). Mapping indicates that PASS would generally occur within the upper 1 m of wet/riparian areas. However, the data confidence level of the mapping is low hence the classification is provisional due to a lack of analytical data available or ground truthing. Furthermore, an extensive study undertaken by the Murray-Darling Basin Authority (MDBA) found that waterways containing acid sulfate soils at levels of concern were located in the southern part of the Murray-Darling Basin, as opposed to in the northern basin around Toorale (MDBA, 2009).

Modelled Exchangeable Sodium Percentage (ESP) at all sites ranges between ≤2 – 4% in soil 0 – 30 cm deep (OEH, 2017a). At the 30 – 100 cm depth, modelled ESP is variable ranges between ≤2 – 6% at all sites (OEH, 2017a). In Australia, soil sodicity is defined as an ESP of 6% (Isbell, 2016). Modelled ESP and presence of Vertosols are characterised by strongly sodic subsoils. Data collected at all dam sites indicate subsoils are potentially sodic, indicating that dispersion is likely if exposed to water from rainfall or runoff. The topsoils are unlikely to be sodic. Generally, the erodibility of the surface soil and subsoil differ; surface erodibility primarily relates to sheet and rill erosion, while subsoil erodibility relates to gully erosion (Walker, 1991). Rill erosion is evident on the dam embankments at Boera and Booka Dams.

Salinity is the accumulation of salt in land and water to a level that damages the natural and built environment. Hydrogeological landscape and salinity hazard mapping are not available for Toorale. Modelled Electrical Conductivity ($EC_{1:5}$) indicates topsoils may be moderately saline at all sites (0.1 – 0.2 dS/m) (OEH, 2017a). Modelled salinity increases with depth, with subsoils salinity at Boera and Booka Dams ranging between 0.3 – 0.75 dS/m and at Homestead Dam modelled salinity is between 0.3 – 0.5 dS/m (OEH, 2017a). Furthermore, evidence of dryland salinity impacts is present at Toorale. Scalding is evident on pale clay soils in areas that have been overgrazed (saline scalds – formed from removal of topsoil natural and exacerbated by removal of vegetation cover in uncontrolled agricultural practices and forming of clay plough pan at B horizon). Ponding structures have been constructed to control scalding in these areas (ponding structures are shallow earth pushup banks formed on contours to aid retention of surface runoff to break up scalded clay sub-layer to promote entrapment of organic matter detritus and reform a topsoil layer that can be revegetated naturally).

Homestead Dam is located in areas mapped as Grey, Brown and Red Clays (Vertosols), which are classified as "D - Very slow infiltration" under the Hydrologic Groups of Soils system (OEH, 2017b). Whilst the confidence level of the Hydrologic Groups of Soils mapping at Toorale is very low, infiltration is initially rapid in Vertosols via the cracks, but are imperfectly drained when wet, or if surface soil is dispersive.

It is noted that AS James (2018) encountered groundwater at 7.7 m depth in sampling bore hole 9 downstream of the existing Homestead dam wall.

Embankments

Geotechnical assessments at Boera, Booka and Homestead Dam were undertaken by A.S. James in 2018. The embankments in the sites were initially constructed in the late 19th century, as such, are likely to consist of locally sourced materials (A.S. James, 2018). A. S. James (2018) note that the embankments are more than likely not constructed to satisfy current Australian Standard Compaction methods. Historical methods of construction of earthen dam walls have included use of a horse drawn scoop and use of a flock of sheep to knead the clay layer (hence modern roller termed as 'sheep's foot' roller).

The Boera Dam embankment consists of bare earth with no grass cover or equivalent protection from weathering processes. At the eastern end, the embankment is comprised of clayey sand sill extending to depths between 2.5 m and 3.4 m. Underlying the clayey sand fill is a natural, stiff sandy clay that persisted to a termination depth of 5 m.

The composition of the embankment at Booka Dam is variable. At borehole 6, the closest borehole to the proposed fishway, fill material (clayey sand and sandy clay) extend to a depth of 4.8 m. The fill Is underlain by a cemented sand layer with a thickness of 0.7 m, and a lightly cemented clayey sand lays underneath which persisted until the termination depth of 8 m. In the adjacent boreholes (5 and 7), sandy fill was encountered at depths 0.8 m and 1.8 m respectively. At borehole 5, fill was underlain by natural sandy clay to a termination depth of 5 m, while at borehole 7 the fill was underlain by a dense clayey sand which graded to a dense silty sand a 4.6 m, persisting until the termination depth of 5 m.

The embankment of Homestead Dam consists of bare earth with no grass cover or equivalent protection from weathering processes. The causeway near the Homestead Dam is underlain by a sandy clay. Adjacent to the Homestead Dam, the surface soil is comprised of a sandy silt, which is underlain by a very stiff clay with calcrete lenses.

Geotechnical surveys at Homestead dam site indicate that the embankments are stable in their current state, however evidence of erosion was observed on site (A.S. James, 2018) in the form of batter rills and minor invert scour along the embankment toe. If this erosion continues, the stability of the embankments

could be compromised. Instability of the embankments has occurred in the past and Homestead Dam embankment is currently breached.

Contaminated Land

A review of the EPA Contaminated Land Record under section 58 of the CLM Act and the List of NSW contaminated sites notified to the NSW EPA under section 60 of CLM Act did not reveal any registered contaminated land sites within or surrounding Toorale.

A review of premises currently regulated by an EPL under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not reveal any identified premises within or surrounding Toorale.

Pursuant to Clause 7 of the *State Environmental Planning Policy No 55 – Remediation of Land* there is no apparent reason to consider that the land proposed to be developed would be contaminated and, as such, no further contamination investigation is required.

Furthermore, whilst no registered contaminated land occurs within Toorale, potential contamination associated with past agricultural activities may exist on-site. These potential contamination sources include sheep dips, imported fill material, demolition of old buildings and stockpiling of wastes. These potential contamination sources are not within proximity to each of the dam sites and, as such, potential for contamination from previous agricultural uses is highly unlikely.

5.1.2 Potential Impacts

Landscape, topography and geology

The landscape, topography and geology of the study area will not be altered by the proposed works. River channel features, at the three (3) dams, will be impacted with the modification of the dam walls and construction of fishway passages. These impacts are further considered in Section 5.2.

Soils

General construction impacts

The proposed works will involve local site disturbance through excavation, removal of topsoil, subsoil, rock and vegetation, vehicle access and other construction activities. These works have the potential to cause soil structural and biophysical changes, erosion (including wind erosion from stockpiles), decreased stability and sedimentation due to localised temporary removal of groundcover and the disturbance of the soil profile. The extent of the impact will vary depending on the area of impact and what activities will occur there (for example: the amount of earthworks at each site, the size and weight of machinery type used for the activity, the extent of vegetation removal, the land capability at each site, the effectiveness of mitigation measures, and the rate of rehabilitation).

Due to the location of the works occurring in the Warrego River channel, there is potential for soil erosion to occur if a flow occurred during construction. Excavation and deposition in the channel may increase erosion hazard, particularly if sodic soils are used and not ameliorated or protected. However, the likelihood of erosion from flows is unlikely as the proposed activity will be scheduled for a no flow period, or water will be redirected away from the construction area.

There is potential for post-construction soil erosion downstream of the embankment location following modifications due to localised increased flow velocity. Mitigative measures are further described in Section 5.1.3

There is the potential for erosion during heavy rainfall events, particularly if there is a decline in soil structure resulting in low infiltration rates and increased run-off. The water erosion hazard of these soils will be greatly reduced by installation and monitoring of sediment and erosion controls during the construction period as described in Section 5.1.3. Water and wind erosion could result in the loss of soil from the landscape and a subsequent movement of soils and associated nutrients into watercourses leading to reductions in water quality at the site and downstream. Mitigative measures are described in Section 5.1.3

Dust particles may be generated as a result of a range of activities associated with the proposed works involving topsoil disturbance including: vegetation clearing; earthworks; stockpiles; loading and unloading of material; and haulage on unsealed roads. Dust caused by the works could cause nuisance, harm or injury to Public Safety, nearby residents and contractor staff.

Fuels and lubricants will be used on site during construction activities and these chemicals may pose a potential contamination risk to soils and waterways in the event of a spill. These chemicals may alter soil properties and can impact negatively on soil health and consequently plant growth or if absorbed by plants/animals could potentially enter the food chain with adverse impacts. Contaminants in the soil can be mobilised during high rainfall events and surface water runoff which may potentially spread such contamination through the soil profile, or into surface or groundwater potentially impacting aquatic habitats.

If suitable, the proposed works at Boera, Booka and Homestead dams may utilise spoil generated by the removal of the Peebles Dam embankment. Such an approach would minimise disturbance of *in-situ* soil resources within the proposed disturbance/impact areas in the form of adjacent borrow pits.

A geotechnical survey of the Peebles Dam embankments has not been undertaken. Therefore, there are uncertainties regarding the stability of the existing soil structure for re-use, particularly given the sodic nature of Vertosol subsoils. If on testing, this material proves unsuitable, alternative external sources will be identified and where necessary additional environmental assessments shall be undertaken to assess and mitigate potential environmental impacts.

Regardless of its source, spoil material, will be transported to the site by tipper trucks, and any stockpiling of material at Boera Dam will be of short duration, therefore, alteration of physical and chemical soil properties, including structure, fertility, permeability and microbial activity are not anticipated.

There is the potential for erosion of stockpiles that may be created in the burrow pits during heavy rainfall events, particularly if there is a decline in soil structure resulting in low infiltration rates and increased run-off. The water erosion hazard of these soils will be greatly reduced by installation and monitoring of sediment and erosion controls during the construction period.

5.1.3 Mitigation measures

An Erosion and Sedimentation Control Plan (ESCP) will be developed and included as part of the Construction Environmental Management Plan (CEMP) that will be developed prior to construction. Erosion and sediment controls are to be detailed on Environmental Control Maps (ECMs) for each area. Mitigation Measures to be included in the ESCP shall include:

- Laydown and stockpile areas are to be placed, secured and managed if flooding or weather conditions suggest the likelihood of high water flows and therefore sedimentation risks.
- The plan should identify areas requiring management control, include inspection and checklist and be reviewed by a suitably qualified professional prior to any works commencing. These controls must be suitably maintained and monitored to ensure the measures and controls in place are effective. Controls can be removed once soils are stabilised.

- Account for weather events during construction:
  - If heavy rainfall is predicted the site should be stabilised and works modified to prevent erosion for the duration of the wet period; and
  - Works methods shall be modified during high wind conditions if excessive dust is generated.
- Visual monitoring for dust will be implemented during the works. Water cart to regularly wet down haul roads and laydown areas, particularly adjacent to the Akuna homestead where water will be sourced.
- Schedule works when there is no/low flow through the Warrego River. If this is not possible, water diversion works shall be implemented to minimise the risk of water erosion whilst construction works are undertaken.
- The area of disturbance should be limited to the smallest practicable footprint possible.
- Limit duration of disturbance – e.g. only excavate immediately prior to scheduled activities.

The CEMP will include measures to mitigate the risk of fuel and hydraulic oil spills/leaks including use of designated refuelling and bunding of maintenance areas. The CEMP will also include a Spill Response Plan to manage potential soil contamination by the implementation of a spill response procedure.

- To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with NSW EPA guidelines. Spent oils and liquids from construction plant and equipment will be disposed of appropriately in a properly licenced facility.
- All hazardous materials will be stored in accordance with existing or agreed NPWS procedures.
- All contractors and staff will be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills.
- Spill response procedures will follow existing or agreed NPWS procedures.
- Onsite refuelling shall occur within the designated areas and located more than 100m from the waterway and within an impervious bund.
- Daily inspections of contractor's machinery will be undertaken to ensure no oil, fuel or fluids are leaking.

If suspected soil contamination is encountered, the suspected materials should be segregated and placed in a designated bunded stockpile covered in plastic sheeting to prevent rainfall infiltration and/or soil migration during windy conditions. Pending disposal at a licenced waste facility, suspected contaminated should be tested to determine waste classification. Records of waste analysis, classification and disposal dockets would be recorded and maintained.

Make contractors aware of erosion and sediment and contamination issues and mitigation measures through project induction. Brief on the erosion and sediment controls in the work area for that day in pre-start briefing each day.

5.2 Groundwater

5.2.1 Existing environment

The groundwater assessment for the proposed works is based on the available hydrogeological data from the WaterNSW real-time data website (WaterNSW, 2019), Bureau of Meteorology Groundwater Explorer database (BoM, 2017a) and water sharing plan background documents that apply to the site. No local hydrogeological studies are known to have been undertaken within the Park.

Homestead Dam is located entirely within the area of the Upper Darling Alluvial groundwater source, while the survey locations for Boera and Booka Dams are located on the Warrego Alluvial groundwater source which overlies the Great Artesian Basin Warrego groundwater source as shown Figure 5-2 and Figure 5-3.

The Upper Darling Alluvium consists of the Cenozic sediments associated with the Lower and Upper Darling River and the Paroo and Warrego Rivers. The valley fill alluvial sediments are comprised of unconsolidated clay, silt, sand and gravel, generally becoming finer closer to the surface, and are typically semi-confined to unconfined (DPI, 2017; NOW, 2012). Alluvial deposits are generally 40 to 50 m thick, with piezometric heads of groundwater generally at 10 to 20 m depth below ground surface (NOW, 2012).

The alluvium of the Upper Darling is typically divided into three main aquifer systems, with the deep and the intermediate aquifer reaching a combined depth of 120 m. These aquifers are naturally saline and are only accessed for salinity management purposes (i.e. to reduce salt discharge downstream). The shallow aquifer, which is typically found at depths up to 25 m, is associated with varied levels of salinity depending on its connection to the river and the underlying geology. Locally, this shallow aquifer is recharged by the river, creating a freshwater lens that can be accessed for use. Yields from the shallow aquifer vary but tend to be generally less than 6 L/s (DPI, 2017). Monitoring groundwater levels near the rivers in the Upper Darling Alluvial groundwater source indicates the Alluvium gains water from the river during flood events and loses water to the Darling River during low flows in some river sections (NOW, 2012). As such, the alluvium and surface waters of the Upper Darling catchment and some of its major unregulated tributaries are periodically connected, however, generally this has low impact to instream flows in the catchment.

The Warrego Alluvium consists of Quaternary aeolian sands and alluvial sediments surrounding small areas of Tertiary silcretes in the northern portion of the alluviums. Small areas of Palaeozoic bedrock are characterised in the central section of the alluviums, whilst in the lower reaches Devonian quartz sandstone is surrounded by Quaternary aeolian sands and alluvial clays (NOW, 2011). In the alluvium of these unregulated rivers, groundwater is largely derived from direct rainfall infiltration and groundwater levels in these areas of alluvium respond readily to climatic conditions. In these unregulated alluvial aquifers, the storage is limited and when the groundwater level falls below the bed of the river due to lack of rain or through abstraction, the river runs dry (NOW, 2011).

A review of the WaterNSW Real Time Data website indicated no groundwater monitoring bores within the REF survey locations. However, a 12 km radius search for surrounding bores revealed eight registered stock and domestic bores which access groundwater from the deeper Great Artesian Basin (GAB) Warrego groundwater source, one monitoring bore penetrating the Lachlan Fold Belt MDB groundwater source and five stock and exploration bores within the Upper Darling Alluvial (Table 5-2 and Figure 5-3). These registered bores are mostly identified for stock and domestic groundwater as well as several monitoring and exploration bores.

Water quality within the Upper Darling and Warrego Alluviums is considered to be comparatively poor with several surrounding bores described as *salty* or *very salty.*

Groundwater from the Upper Darling Alluvium is included under the Water Sharing Plan (WSP) for the Barwon-Darling Unregulated and Alluvial Water Sources. Groundwater resources within the Plan area are primarily used for irrigation, stock and domestic purposes, and also downstream for Wilcannia town water supply. Current management arrangements under the WSP are that access water licenses are required for all purposes, other than stock and domestic use. Stock and domestic licences currently are not required to be metered. Water taken from groundwater sources within the Warrego Alluvium and Upper Darling Alluvium for commercial purposes is regulated and monitored by the DPIE-Water to ensure the sustainability of the water sources in the region.

Alluvial groundwater sources associated with the Warrego River are included in the WSP for the Intersecting Streams Unregulated and Alluvial Water Sources (NOW, 2011). There are 18 bore licences in the Upper Darling alluvium and 16 bore licences in the Warrego alluvium, covering a range of purposes including stock and domestic and town water supply (NOW, 2011).

The Warrego water source is located within the Mulga Lands bioregion and the two alluvial aquifer systems relevant to the Warrego River are the Upper Darling alluvial groundwater source and the Warrego alluvial groundwater source. Groundwater resources in and surrounding Toorale and the Warrego River are shown in Figure 5-2.

A review of the driller's logs for all the bores indicated that the shallowest water bearing zones were overlaid by clays or hard rock (WaterNSW, 2019). Whilst these layers may be saturated, useable yield is low due to poor porosity and/or permeability.

Based on the available information it is concluded that surrounding groundwater levels across the three aquifers is variable. Within the GAB Warrego groundwater source, the water bearing zone ranged from 8.5 metres below ground level (mbgl) to 84.7 mbgl indicating groundwater is moderately deep. Depth the water bearing zone within the Upper Darling Alluvium and the Lachlan Fold Belt MDB groundwater sources are shallower, but still indicate moderately deep groundwater (range: 12.8 to 42 mbgl).

The available data describes water quality from the alluvial aquifer as "Very salty" to 'Fresh" with two reporting salinity levels of over 14,000 ppm (WaterNSW, 2019). Groundwater yield records suggest the surrounding alluvial aquifer has low productivity, with all three registered bores that contain yield data (Table 5-2) reporting groundwater yields of < 5.4 L/s from the shallowest water bearing zones.

It was noted in a recent geotechnical study of the dams (AS James, 2018) that groundwater was encountered in the sampling bore hole 9 downstream of the existing Homestead Dam wall at 7.7 m depth. All other bores taken to refusal (2-5m) were dry. This groundwater was linked with lateral flows to and from the ephemeral river and pondages to the shallow aquifer. A total of eleven (11) shallow boreholes (three (3) boreholes at Boera dam, five (5) boreholes at Booka dam, and three (3) boreholes at Homestead dam) were augered across the subject site.

Given the longevity of the current dry period over the review period it is likely the shallow groundwater levels adjacent to the works would have lowered from these levels, as very little recharge from rain or floods/overland flow has occurred.

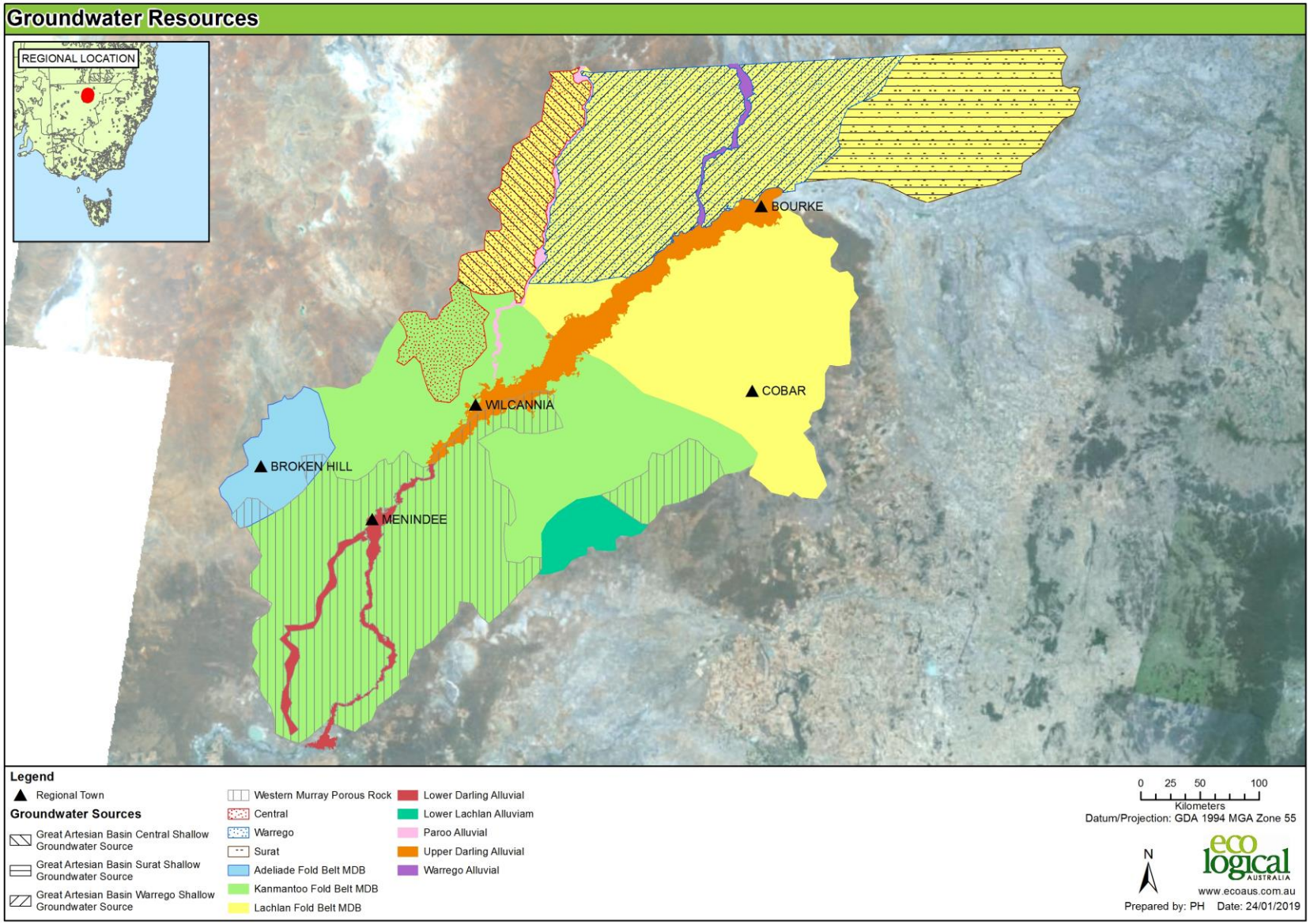


Figure 5-2: Regional groundwater sources in the vicinity of Toorale

Table 5-2: Registered bore details near the Site

Groundwater Source	Bore ID	Easting	Northing	Purpose	Total depth (m)	Water Bearing Zones		SWL* (mbgl)	Salinity	Yield (L/s)
						Depth range	Type			
Warrego	GW003817	347628	6680982	Stock	265.2	76.2 – 76.2	Unknown	76.2	501 – 1,000 ppm	0.01
	GW004530	352999	6674127	Stock	326.7	54 – 54	Unknown	-	0 – 500 ppm	-
	GW004583	355079	6666734	Stock	246.9	32 – 36.3	Unconsolidated	10.4	“Fresh”	0.51
	GW006532	355079	6664063	Stock	79.2	24.4 – 24.4	Unknown	8.8	-	2.27
	GW006785	355079	6669929	Stock	87.2	84.7 – 84.7	Fractured	9.1	“Fresh”	0.63
	GW006943	342366	6659137	Stock	79.2	8.5 – 8.5	Unknown	4.3	"Fresh"	0.04
	GW012255	355079	6657513	Stock	107	20.1 – 20.7	Unknown	15.2	Over 14,000 ppm	0.08
	GW012269	351587	6655787	Stock	182.3	43.9 – 43.9	Unknown	-	Over 14,000 ppm	-
Upper Darling Alluvial	GW006837	339871	6639547	Unknown	105.2	12.8 – 12.8	Unconsolidated	3	"Salty"	0.63
	GW007331	353050	6652358	Stock	202.7	38.1 – 38.1	Unknown	16.5	"Salty"	0.63
	GW010815	334558	6641284	Stock	109.7	15.2 – 19.8	Unconsolidated	-	"Very salty"	-
	GW036796	348253	6635941	Exploration	17.3	14 – 17	Unconsolidated	8.7	-	2.2
	GW800752	339765	6634834	Test bore (filled)	49.5	42 – 49.5	Unknown	12.2	“Salty”	5.4
Lachlan Fold Belt MDB	GW039472	344598	6632434	Monitoring bore, stock	35.5	9 – 15.5	Unknown	-	602 mg/L	-

*SWL = standing water level (within the bore).

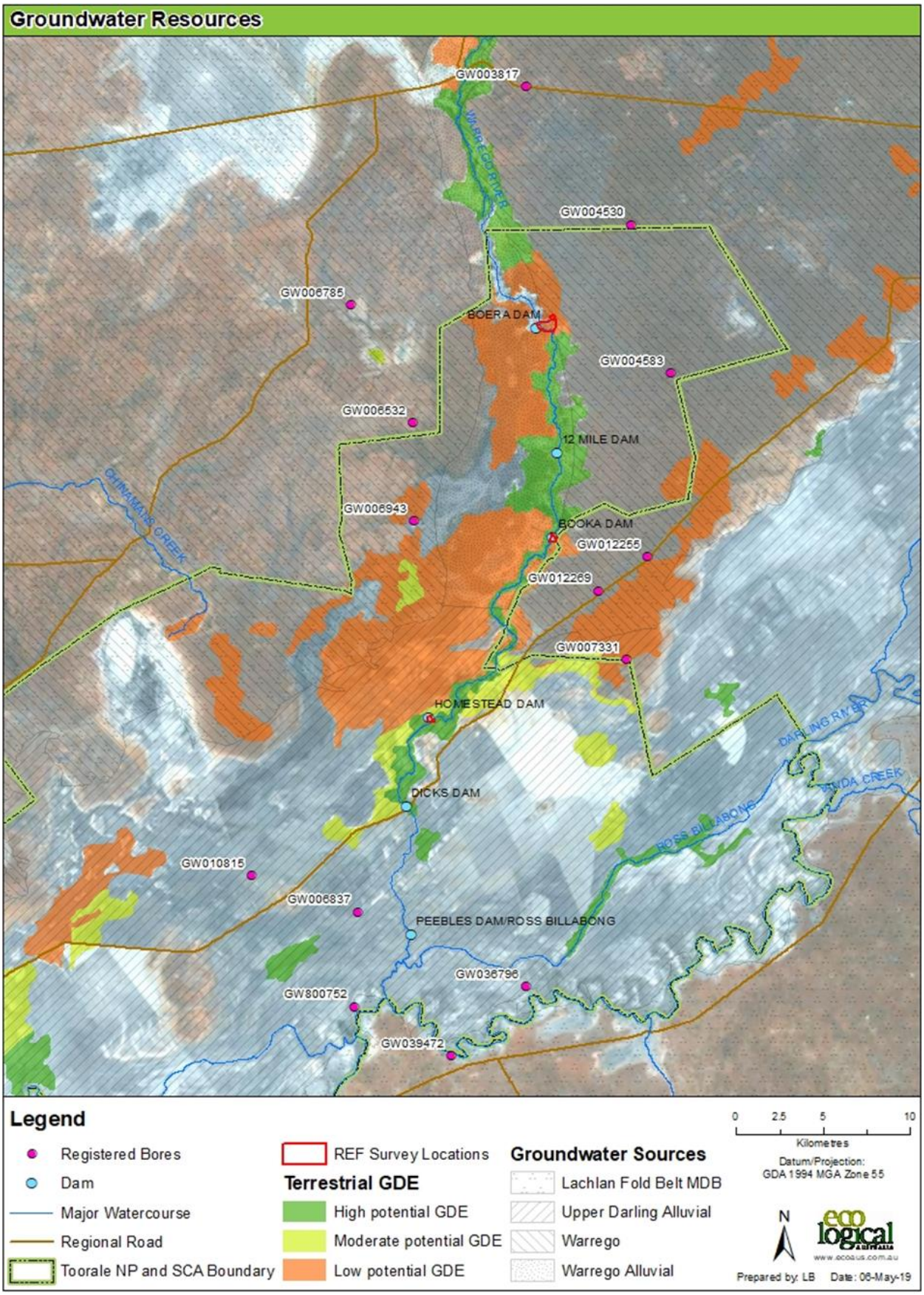


Figure 5-3: Groundwater source regions and groundwater dependent ecosystems (WaterNSW, 2019; BoM, 2017c).

Groundwater Dependent Ecosystems (GDEs)

DPIE Water protects the environmental values in the alluvial groundwater sources by reserving the total storage volume and a proportion of recharge to the sources as planned environmental water. Only a portion of the recharge from rainfall has been made available for extraction and recharge from any other sources is included as planned environmental water. Critically, environmental water is reserved for the preservation of any high priority groundwater-dependent ecosystems (GDEs).

Currently, no high priority GDEs have been identified in the Warrego Alluvium, and there is no current evidence of GDEs that rely on the Warrego Alluvium (NOW, 2011), although the BoM Groundwater Dependent Ecosystems Atlas (BOM, 2017b) maps areas around Homestead Dam and Booka Dam as high potential terrestrial GDE, and low potential terrestrial GDE (Figure 5-3).

The Darling Alluvium groundwater source, however, is known to support significant GDEs of ecological value including wetlands, vegetation and baseflow ecosystems (DPI, 2017). The Darling Alluvium is dominated by the vegetation GDE communities of River Red Gum woodland wetlands, Lignum wetlands, freshwater wetlands, Black Box woodlands, Canegrass swamps, Coolabah-River Coobah-Lignum woodland wetlands and chenopod shrublands. Generally, the GDE communities with high ecological value had large vegetation patches, were high connected (such as riparian corridors) and had a moderate number of threatened species present, especially in the wetland areas (DPI, 2017).

5.2.2 Potential impacts

The potential for impact upon water quality, specifically groundwater, at each dam site is greatest during the construction phase. During this period the soils will be subject to disturbance associated with site preparation and infrastructure installation/removal. Construction works for the proposed dam structures include removal of minor areas of potentially, partially groundwater-dependent vegetation and soil during site preparation and excavation for the proposed fishways as well as demolition and reinstatement of dam infrastructure. The upper layer of soil will be subject to temporary disturbance which may lead to erosion and potential sedimentation within the river system. This could also result in turbidity and sedimentation affecting the Warrego River, especially if periods of high rainfall occur.

Groundwater in the vicinity of the proposed work area is relatively deep and of low productivity and use. Surface water-groundwater interactions is also not apparent within the surveyed work areas. These factors, coupled with the proposed works being undertaken above ground, suggest that it is unlikely that there will be any direct or indirect impacts on regional or local groundwater sources. Matters pertaining to surface water and hydrology are addressed further in Section 5.3.

The proposed works are not likely to influence groundwater systems directly or indirectly, nor would an aquifer interference approval as per the *NSW Aquifer Interference Policy* be required in this instance.

The proposed works are not within a coastal area and are therefore would have no impact to coastal processes or coastal hazards. Regarding projected climate change, current trends indicate there is potential for increased climate variability which would effectively alter the frequency and intensity of rainfall within the catchment area. The proposed scenario reflects a small increase in the availability of water in the Warrego and Darling systems, thereby mitigating the effects of climate change. Water use in the area and availability to water has always been subject to extreme climate variability however the proposed works will restore the river system to a more natural regime.

In terms of the use, storage or transportation of hazardous substances or the generation of chemicals which may build up in the environment, during the construction period a variety of dispersible liquid

materials will be used which pose a potential pollutant threat to local water quality, which could result in groundwater contamination. These liquids include diesel, petrol, machinery oils, lubricants and chemicals. The nature of these liquids and their ability to disperse away from the site means that they could have a negative impact on groundwater on or adjacent to the site, especially during or after periods of high rainfall where occurrence of interaction with the Alluvium is highest. The use of fuels, lubricants, herbicides and other chemicals during construction may pose a risk to water quality in the event of a spill or discharge, however the potential for groundwater interaction or contamination is very small and appropriate mitigation measures, detailed below, will be implemented to ensure there is no risk of contamination.

Environmental impacts to groundwater during the construction and operational phases are considered very unlikely due to the recorded depth of groundwater at the site and limited potential for groundwater interaction during the proposed demolition and construction works.

5.2.3 Mitigation measures

A CEMP, including site specific Erosion and Sediment Control Plans and a Spill Response Plan, is to be prepared prior to works commencing to guide the implementation of environmental impact mitigation measures as proposed in Section 5.1.3.

5.3 Surface Water and Aquatic Ecology

5.3.1 Existing environment

The Warrego and Darling Rivers meet in the south-west of Toorale which is upstream of the town of Louth. The Warrego catchment comprises 7% of the total area of the Murray-Darling Basin but contributes less than 1% of the catchment flows. By contrast, the Darling River catchment above Toorale comprises around 36% of the total area of the Murray-Darling Basin, taking in the Condamine –Balonne, Moonie, Border Rivers, Gwydir, Namoi, Macquarie-Castlereagh and Barwon-Darling subcatchments. In total these subcatchments contribute around 30% of the total catchment flow to the basin (MDBA, 2016).

The Darling River flows for approximately 2,750 kilometres, making it the longest river in Australia. The catchment begins in the Great Diving Range around Armidale and flows generally in a south western direction towards its junction with the Murray River in south-west NSW. The Warrego Rivers' headwaters are south of Ka Mundi in the Carnarvon Ranges near Tambo in south-west Queensland. It flows in a southerly direction for approximately 800 km, where it joins the Darling River at Toorale. The Warrego River is an intermittent stream, with flow varying with season and rainfall. The long-term flows in the Darling and Warrego Rivers do show some seasonality, with higher flows usually occurring during the summer and autumn months from December to April.

The Warrego River flows through Toorale in a southerly direction from the most northern part of Toorale, upstream of Boera Dam (Figure 1-3). Toorale includes multiple water structures, made up of dam embankments, flow diversion works, levee banks, training embankments, pumps, pipes and irrigation channels. Many of these water structures were established before the 1860s by Toorale Station owner Samuel McCaughey. However, the dams have been subject to numerous modifications, failures, rebuilds and upgrades through time (Alluvium, 2018).

These structures have significantly altered the flow of this part of the Warrego for over 100 years and any modifications to the dams or how they operate may change the duration, extent or spread of flooding events on Toorale as well as flows in the Warrego River (OEH, 2018a). For example, in the lower Warrego River, before the construction of the dams, it is reported that there were no natural waterholes along this stretch of the river, therefore, the availability of aquatic refugia has increased post development (Holz *et al,* 2008). Historically the Western Floodplain was thought to be inundated every 20 years on average, which increased to one in two years with the development on Toorale in the late 1800s (Aurecon, 2009). This increase in flooding frequency has influenced the floodplain vegetation composition and biodiversity on the floodplain.

While inflows to Toorale down the Warrego River have been measured via the two flow gauging stations at Fords Bridge (NSW423001, NSW423002) since 1921, measurement of flow within Toorale has only occurred since 2012, though the gauging stations at Boera Dam (NSW423008) and Dicks Dam (NSW423007). In addition, while the dam height at which water flows from Boera Dam to the Western Floodplain is known, no on ground monitoring of flows to the Western Floodplain has been undertaken. Instead, flows to the Western Floodplain have been modelled via flow models developed by Alluvium through the Toorale Business Case (Alluvium, 2018). Therefore, there is some uncertainty surrounding historical flow volumes to the Western Floodplain. Cox *et al*. (2012) provides the best long-term assessment of inundation to the Western Floodplain, through their analysis of 12 flooding events over the 1988 – 2010 period. This work suggests that up to 40,000 ha of the Western Floodplain was inundated during this period, with the largest events occurring in 1990 and 1998. However, this report does not consider the operational strategy employed in line with the licence requirements on Toorale to produce this inundation.

Current water management

As outlined in Section 1.5, water is currently managed in Toorale by the CEWHCEWH in consultation with NPWS in line with a 5-year environmental watering strategy. This strategy takes into consideration both environmental and social requirements within Toorale and downstream in the Darling River and is delivered within the licence conditions and works approvals associated with each licence (see Section 1.5).

As part of the Toorale water licence conditions, flows entering Toorale down the Warrego River, must be let through the system to provide connection with the Darling River before licence conditions are met and the CEWH can manage the water.

The dams on the Warrego River within Toorale were retrospectively licenced in the 1960s under the provision of the NSW *Water Act 1912*. The water entitlements include:

- A number of Warrego River unregulated river access licenses, totalling 8.1 gigalitres (GL) long term average annual yield (LTAAY);
- A Warrego River special additional high flow license with a volume of 9.7 GL (LTAAY); and
- A number of Darling River unregulated river access licenses totalling 7.6 GL (LTAAY).

These licences are owned and managed by the Commonwealth Government and are managed by the CEWH. Conditions placed on these licences determine how the licenses may be managed. This is especially true for the licences specified at Boera Dam. Before these licences can be accessed, downstream conditions must be met. That is, water must first be let through the regulator pipes on Boera Dam and all downstream dams on the Warrego until there is flow from the Warrego to the Darling and flows in the Darling River at Louth have reached 330 ML/d. Once this has been achieved, the CEWHCEWH can choose whether to continue to release water down the lower Warrego channel, therefore activating their Warrego River unregulated river access licences, or close the regulator gates, and hold water in Boera Dam to divert water to the Western Floodplain. If flows in the Darling exceed 97 ML/d at Louth, the CEWH may also access the special additional high flow licence to divert water to the Western Floodplain.

When the regulating gates are closed at Boera Dam, and if dam inflows are sufficient, water will flow through the ‘western bywash’ and onto the Western Floodplain (Figure 5-4). This occurs when water levels reach 2.26 m on the Boera Dam Gauge (NSW423008, estimated at 104.85 m AHD). Due to embankments placed on the eastern margins of the floodplain, water that flows onto the Western Floodplain. Water is retained on the western floodplain, although periodically breaches of the training embankment allow some flow to return to the Warrego River, as occurred during a flow event in April-May 2019 (Figure 5-5). While the breech remains open at the time of writing, NPWS will reinstate the embankment as a matter of priority in 2019/20. In large flood events, the flows can extend the length of the western floodplain and connect with the Darling River via that pathway. If Boera Dam levels reach a gauge height of 2.91 m (105.5 m AHD), water will begin to flow through the ‘eastern bywash’ (Figure 5-4). This channel bypasses the Boera Dam wall to the east and returns flow to the Warrego River downstream.

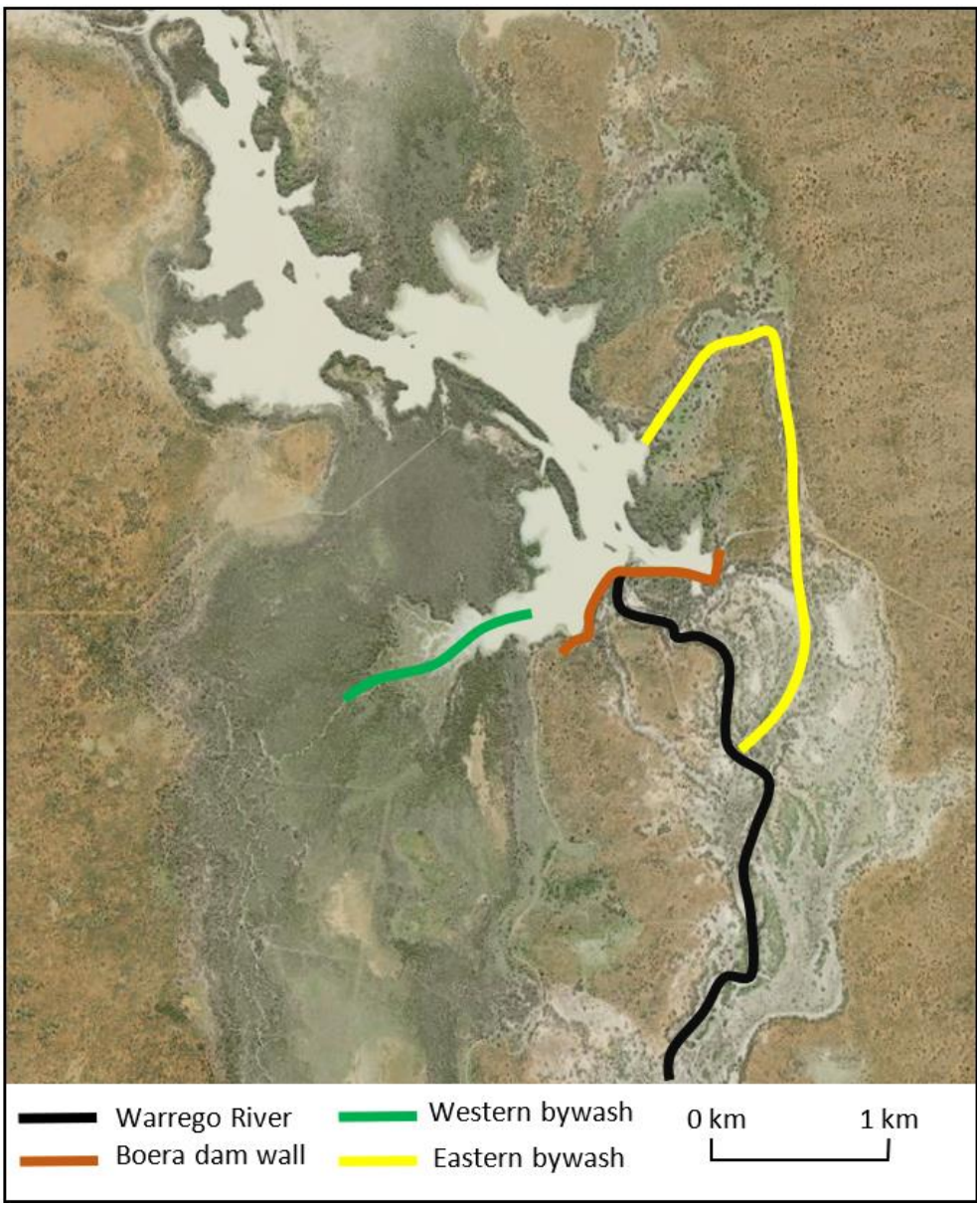


Figure 5-4: Boera Dam western and eastern bywashes

Figure 5-5: Breach in the eastern embankment allowing floodplain water to return to the Warrego River. Date: 15 May 2019

Flows through Toorale down the Warrego River have been sporadic over the last 4 years, but management in accordance with the 5-year Water Use Strategy for Toorale has provided additional water to both the Western Floodplain and the Warrego and Darling Rivers at different times. Figure 5-6 shows water levels in Boera Dam and Dicks Dam (where regular stage heights are recorded) relative to the operation of the Boera Dam regulating gates over the past four years.

In response to inflows, the regulating gates at Boera Dam were opened several times in 2015-16, with flows refilling waterholes and providing a connection to the Darling River. No environmental water was accounted for in the Warrego River or Western Floodplain during 2015-16. In contrast, during 2016-17, larger Warrego River inflows resulted in 9,770 ML of environmental water flowing onto the Western Floodplain, and 7,770 ML of environmental water flowing down the Warrego River through Toorale between June 2016 and February 2017 (Commonwealth of Australia, 2019).

Flows in the Warrego River during the 2017-18 water year were very low, with water entering Toorale during four small flow events in October 2017, December 2017, March-April 2018 and June 2018. Water levels in Boera Dam remained below the Western Floodplain connection level for most of the year with only one brief period of connection to the floodplain observed in December 2017

During the March to April 2018 flow event, the Boera Dam regulating gates were partially opened for 16 days, though flows were restricted to 300 ML/d or less in response to Boera Dam inflows. This event reconnected the waterholes in the lower Warrego and provided connection through to the Darling River.

No flows were experienced through the lower Warrego River system during the majority of 2018-19, with levels receding in both Boera and Dicks Dams (Figure 5-6). Widespread rainfall from a tropical depression in the upper Warrego catchment produced a flow event down the Warrego that entered Toorale in April 2019. The gates at Boera Dam were opened on the 22 April 2019 and remained open for 40 days until the flow pulse had moved through the system. During this time 8,106 ML of environmental water was accounted against the Toorale Warrego River licence, which comprised 40% of the total flow. This water helped to reinstate flow in the Darling River downstream of the Warrego River

confluence, with flows progressing through the system to below Wilcannia (Commonwealth of Australia, 2019).

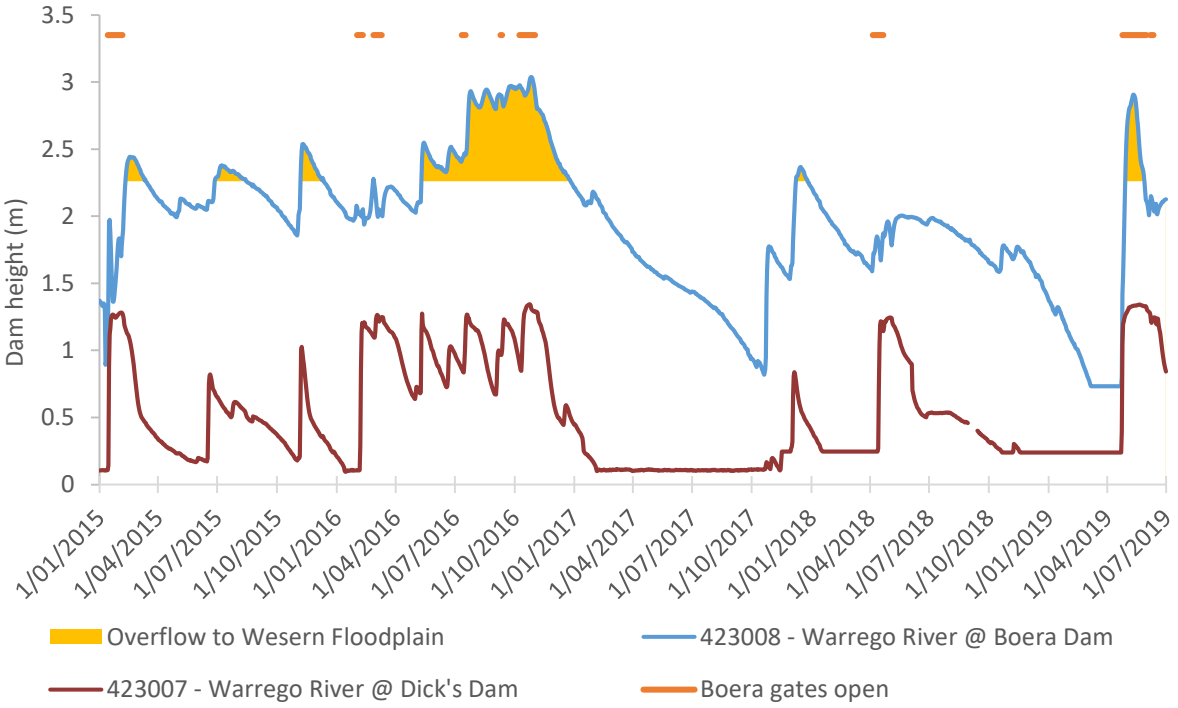


Figure 5-6: Water levels in Boera and Dicks Dams compared to the operation of Boera regulating gates.

Water which flows from the Warrego River also influences flows in the Darling River downstream of their confluence. In most years, Warrego inflows make up less than 10% of downstream Darling flows (Figure 5-7), with Warrego flows making up less than 2% of Darling River flows every second year. Thus, it is only on rare occasions when the Warrego inflows make a substantial proportional contribution to Darling River flows downstream of the confluence (Eco Logical Australia, 2019)

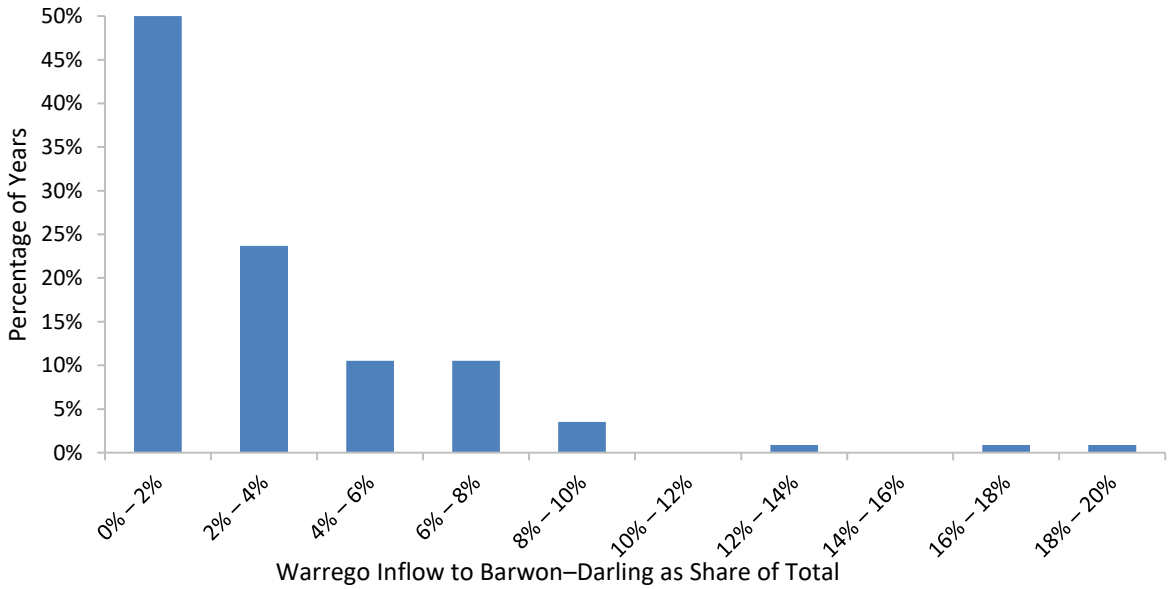


Figure 5-7: The distribution of Warrego River flows to Barwon-Darling inflows. (MDBA, 2016)

Water quality

Water Quality Objectives for Uncontrolled Streams within the Barwon-Darling and Far Western region (DECCW, 2006a) include:

- Aquatic ecosystems;
- Visual amenity;
- Primary and secondary contact recreation;
- Livestock water supply;
- Irrigation water supply;
- Homestead water supply;
- Drinking water at point of supply (disinfection only/clarification and disinfection/groundwater); and
- Aquatic foods (cooked).

Event based water quality sampling has been undertaken since 2015 through the Long-Term Intervention Monitoring (LTIM) project. This has been undertaken at Boera, and Booka Dams and in Ross Billabong, which previously received water from Peebles Dam (Commonwealth of Australia, 2017a). Water quality in the lower Warrego River within Toorale tends to be temporally variable in response to flow down the river. Turbidity tends to be relatively high (100 – 500 NTU) in the Warrego dams, typically above the ANZECC guidelines (6-50 NTU). Similarly, nitrogen, phosphorus and dissolved organic carbon are usually found in high concentrations within the Warrego dams. Measures of pH vary, but during drier periods as water levels in the dams drop, pH tends to increase above ANZECC guidelines (6-5 – 8). Electrical conductivity tends to remain within ANZECC guidelines (0.125 – 2.2 mS/cm) and dissolved oxygen tends to be below the ANZECC guidelines (85 – 110%). While water quality is variable, it has remained within safe levels for aquatic fauna throughout the LTIM sampling (Commonwealth of Australia 2015). During connection to the Darling River, Warrego River flows have been shown to improve Darling River water quality, reducing pH, Conductivity, total Nitrogen concentrations and Chlorophyll *a* concentration in the Darling downstream of the confluence (Commonwealth of Australia, 2017a).

Aquatic Ecology

The waterholes, wetlands and channels associated with the Warrego River provide aquatic refuge to animals and plants in an otherwise dry landscape (EcoLogical Australia, 2017). The Warrego River and its associated floodplain wetlands are part of the Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River, which is listed under the NSW FM Act as an Endangered Ecological Community (EEC). Artificial canals, water distribution and drainage works, farm dams, and off-stream reservoirs are excluded from this EEC. While Boera, Booka and Homestead Dams are artificial structures, they occur in the main channel of the Warrego River so are considered part of the EEC.

Areas of Toorale, and the Darling River downstream, are identified as priority environmental assets in the Intersecting Streams and the Barwon Darling Long Term Watering Plans (DPIE, 2019(a); DPIE, 2019(b)). The Long Term Watering Plans identify water management strategies for maintaining and improving the long-term health of the riverine, floodplain and wetland environmental assets and the ecological functions they perform.

While the Warrego River and floodplain at Toorale is semi-permanent compared to the Darling River, these areas provide potentially better-quality aquatic habitat and support a different assemblage of species than the Darling River alone (Commonwealth of Australia; 2015,2017a). For example, clear differences have been noted between the invertebrate communities of the Warrego and Darling Rivers,

with the Warrego communities displaying varied community structure over time contributing to increased regional diversity (Commonwealth of Australia, 2017a).

Nine species of fish have been surveyed in the dams and waterholes within Toorale during the LTIM project since 2015 (Table 5-3; OEH 2018a; Commonwealth of Australia 2015; 2017a; 2018; 2019). Six of these are native species, and three *Carassius auratus* (Goldfish), *Cyprinus carpio* (Common Carp) and *Gambusia holbrooki* (Mosquito Fish) are exotic species.

Table 5-3: Fish species surveyed within the Warrego River dams and waterholes during the LTIM project (2015 - 2018).

Species name	Common Name	Boera Dam	Booka Dam	Homestead Dam	Dicks Dam	Ross Billabong
*Carassius auratus**	Goldfish	x	x	x	x	
*Cyprinus carpio**	Common Carp	x	x	x	x	x
Gambusia holbrooki	Mosquito fish	x	x			
Hypseleotris sp.	Carp Gudgeon	x				
Leiopotherapon unicolor	Spangled Perch	x	x	x	x	x
Macquaria ambigua	Golden Perch	x	x	x	x	x
Melanotaenia fluviatilis	Australian Rainbowfish	x	x			
Nematalosa erebi	Bony Herring	x	x	x	x	x
Neosilurus hyrtlii	Hyrtl's Catfish	x	x	x	x	

* Denotes exotic species

In addition to these, a further four fish species that are listed as threatened under the FM Act or EPBC Act were noted in OEH (2018a) as being expected to occur on Toorale (Table 5-4; OEH 2018a). These are *Maccullochella peelii* (Murray Cod), *Ambassis agassizii* (Olive Perchlet), *Morgurnda adspersa* (Purple-spotted Gudgeon) *Bidyanus bidyanus* (Silver Perch). *Notopala sublineata* (River Snails) are another aquatic species listed as Endangered under the FM Act, that was suggested to be expected to occur on Toorale (OEH, 2018a). Given none of these species have been recorded within the Warrego River dams during the LTIM project, their presence is considered highly unlikely. However, changes to the flow regime of the Warrego River could have indirect impacts on these species in the Darling River downstream of the confluence.

Table 5-4. Species listed as threatened under the FM Act or EPBC Act and expected to occur on Toorale (OEH, 2018a).

Species Name	Common Name	FM Act status	EPBC Act status
Maccullochella peelii	Murray Cod		Vulnerable
Ambassis agassizii	Olive Perchlet	Endangered Population	
Morgurnda adspersa	Purple-spotted Gudgeon	Endangered	
Bidyanus bidyanus	Silver Perch	Vulnerable	

Notopala sublineata	Darling River Snail	Endangered	

The fish population in the Warrego River at Toorale fluctuates in response to prevailing water levels. Individuals appear to persist in this section of the Warrego because of the dams which provide refuge habitat during periods of no flow. Native species have been shown to spawn and recruit in response to connection events when the gates at Boera Dam are opened, even if they are only opened for a short period of time (<16 days; Commonwealth of Australia, 2017a). For Golden Perch, spawning has been linked to upstream flow events, with the juveniles moving downstream with the flow and into the Toorale section of the Warrego River through the existing regulating pipes (Commonwealth of Australia, 2019). Significant spawning of Carp and Goldfish were also noted following a larger flow event in the Warrego in 2016 (Commonwealth of Australia, 2017a). During this event, the Darling River was in flood, potentially providing the opportunity for fish to move up into the Warrego River. More widespread inundation of the channel network of the Warrego may have also provided improved conditions for the spawning of these exotic species.

Water bird and frog data collected through the LTIM project has shown that the dams in the Warrego River provide important refuge habitat during periods of low flow. Over the monitoring years, species richness, abundance and diversity have tended to change with habitat type and inundation, rather than season. Frog abundance has tended to be higher at sites such as Booka Dam and the Western Floodplain that have higher quality habitat (woody debris and shrubs such as lignum and River Cooba) near the edge of the waterholes. While Homestead Dam was not surveyed as part of the LTIM monitoring for frogs, the habitat likely to be present when the dam is reinstated will provide good quality frog habitat.

Species lists for frogs, birds and turtles can be found in Section 5.4.

5.3.2 Potential impacts

The proposed works include changes to the water infrastructure and, accordingly, changes to the way these systems currently operate. Any works may require an amended works approval application which will be assessed by NSW DPIE. The potential indirect impacts of these works will be discussed below in relation to changes in the hydrology of the Warrego River, its associated dams and the Darling River below the confluence with the Warrego River and the Western Floodplain within Toorale. These impacts will be dependent on the management strategy employed by the CEWHCEWH and NPWS. The proposed water management strategy to be employed at Toorale is presented in Section 3 and is further described below.

Effect of changed arrangements on water distribution

Delivery of more water to the Darling River comes unavoidably at the expense of water that would historically have diverted to the Western Floodplain and/or Ross Billabong.

The effect of changing the relative share of water between the Western Floodplain and the Warrego and Darling Rivers is challenging to determine with confidence, particularly in the context of predicted climatic changes.

The measures taken to minimise the risks associated with this uncertainty include:

- Proposed structure that allows flexibility in the timing and volumes of water passed from Boera Dam
- Retention of the existing full supply level in Boera Dam
- Development of an operating strategy that prioritises flow delivery based on the relative water demand, which can be revised over time as the understanding of the system response improves

- Water balance modelling to evaluate and refine the proposed operating arrangements relative to previous management arrangements and in line with ecosystem watering requirements as currently understood
- Continued monitoring of Western Floodplain and in-channel habitats to detect trends in ecosystem response
- Aligning flow management arrangements with related Basin Plan processes, particularly environmental watering requirement triggers and targets in the draft Barwon-Darling Long-Term Watering Plan.

Water balance modelling undertaken by Alluvium (Alluvium, 2019a; Alluvium 2019b) and DPIE staff of various management scenarios informs this assessment along with additional modelling of changes to flow regimes and their impacts on inundation of the Western Floodplain. The Alluvium (2019a; 2019b) modelling investigated several scenarios that reflected various baseline conditions and the proposed operating strategy case. These included two 'base case' scenarios, 1B and 2B, that represented mixed enterprise scenarios. Base Case 1B included the operation of Boera Dam to minimise flows to Irrigation and maximise flows to the Western Floodplain (within existing licence conditions), whereas Base Case 2B included the operation of Boera Dam to maximise flows to Irrigation and minimise flows to the Western Floodplain (within existing licence conditions). These effectively allow for the full range of potential operating strategies that could have been employed when Toorale was operated as an agricultural entity. The proposed operating scenario followed the operating strategy described above. These scenarios were run over a 44-year period from 1972 – 2015.

It is important to note that there is some uncertainty as to the accuracy of the base case modelling, given there is limited information available as to the particular way the structures were managed during the time Toorale was managed as an agricultural enterprise. The two scenarios used are likely to cover the range of probably decisions, but it is possible that in some cases they may not accurately represent what would have actually occurred. In addition, there is uncertainty around how well the model represents the physical system, especially with regard to losses on the Western Floodplain, and therefore return flows to the Darling River. There is little information to calibrate these aspects of the model and therefore model outputs should be considered indicative.

Warrego and Darling Rivers

The proposed activity will have varying impacts on the capacity and hence permanence of the dams along the Warrego River within Toorale. At Boera Dam, full supply level will remain the same post development. Due to the increased outlet capacity with the proposed activity, and more emphasis on passing flows down the Warrego River, the time Boera Dam is above full supply level (level at which water will flow down the western and eastern bywashes) will reduce (6-9% under base case, 5% under proposed operating strategy). The dam rarely dries out under both modelling scenarios.

In contrast, at Booka Dam, the lowering of the full supply level with the installation of the fishway will reduce the storage volume of this impoundment significantly, from a full supply volume of 106 ML currently to 27 ML following development. This will have obvious implications for the persistence of this storage, with substantial reductions in the proportion of time the storage will be at the new full supply levels (0.5 m below current 42-73% of days under base case, 14% of days under the proposed operating strategy). The surface area of the storage at full supply level will also reduce (Figure 5-8). However, as a result of increased flows from Boera Dam, the occurrence of complete drying of Booka Dam is predicted to be similar under the proposed and base case scenarios, with water remaining in the dam for at least 83% of days. Under current conditions, during inflows of around 600 ML/d, several bywashes to the west of Booka Dam are engaged, providing some level of water movement around the dam (Eco Logical Australia, 2019b).

The reinstatement of Homestead Dam will ensure the more efficient capture and storage of surface water within the Warrego River than currently occurs. Post construction, Homestead Dam will hold an increased storage area and volume of water (7 ha and 105 ML), compared to its currently breached state. This will increase the persistence of stored water, likely resulting in improved aquatic ecology outcomes. The proposed reinstatement of Homestead Dam wall will re-establish a physical barrier to fish and flows, when compared to the existing breached state. However, a rock ramp fishway will be installed at the spillway to maintain the current level of linear connectivity.

While no infrastructure changes are proposed at Dicks Dam, the increase in flows down the Warrego River is not likely to change the proportion of time water would flow over the low-level road crossing on the Toorale – Louth road compared to the base case scenarios (9-16% of days under base case, 11% of the time under the proposed operating strategy). Liaison with Bourke Shire Council suggests that the social impact of any change would be low, as there are other access routes to Bourke for residents living beyond the crossing.

Downstream of Dicks Dam, the removal of Peebles Dam along with the changes operating strategy will likely reduce the time water flows into Ross Billabong, a prominent waterhole on a secondary channel in the lower section of the Warrego River.

Figure 5-8: Comparison between current full supply level and the proposed full supply level of Booka Dam (Alluvium, 2016)

The proposed activity improves connectivity of flow for fish passage as well as providing greater capacity to deliver environmental water for downstream users and the environment. Under the proposed operating strategy flows down the Warrego River and into the Darling River will increase. These increases are more pronounced during wet years, than in dryer years, as a greater proportion of inflows will be released down the Warrego River. The increase is also greatest for medium to high flow conditions (330 – 900 ML/d; Table 5-5). These are the flows that will allow fish passage through the system and will occur for up to 7.9% of the time under the operating strategy (Table 5-5). In addition to increasing the connectivity of the main Warrego channel, increases in the connection of the whole channel network of the lower Warrego River would occur, providing increased access to off channel habitats, and movement of nutrients and organic matter through the river system, stimulating productivity (Commonwealth of Australia, 2019). These occur now at flow rates of 600 ML/d and would increase at flow rates higher than this. This increase in connection of the channel network would be offset by the loss of connection to channels including Ross Billabong, within the previous weir pool of Peebles Dam, which will now become inundated less as a result of the removal of this dam.

Table 5-5: Percentage of time flow rate is exceeded for Base Case and proposed arrangements (as modelled downstream of Peebles Dam site)

Description	Reporting criteria – Flow rate	Percentage of days flow exceeded	
		Base case	Proposed Operating Strategy
Nil Flow	-	80-92%	73%
Cease to flow	0 ML/d	7.7 - 20%	27%
Low flows	50 ML/day	3.6 - 12%	12%
Moderate flows	100 ML/d	2 - 12%	11%
Flow trigger in Darling River	330 ML/d	1 – 7.1%	7.9%
Maximum current discharge capacity from Boera	600 ML/d	0.2 – 4.9%	6.4%
High flows	800 ML/day	0.1-3.6%	5.3%
Proposed standard discharge capacity of Boera	900 ML/d	0.1 – 1.9%	4.6%
Proposed maximum discharge capacity of Boera	1,200 ML/d	0 – 0.1%	0.1%

In terms of downstream contributions of Warrego River water into the Darling River, the proportion of time flows would exceed the Louth flow threshold of 330 ML/d would increase from between 1 – 7.1% of the time under the base case scenarios, to 7.9% of the time under the proposed operating strategy. This is compared to 14% of the time assuming all flows entering Boera Dam could flow through to the Darling River.

Western Floodplain

In order to pass for water to the Darling River, flows diverted to the Western Floodplain must correspondingly reduce. This is likely to be more pronounced in dry years than in average or wet years (Alluvium, 2019a). These reductions are likely to be greater for medium discharge events out onto the floodplain of between 200 – 2,000 ML/d (Figure 5-9). Above this flow range, the operating strategy has little influence on the quantity of water flowing onto the Western Floodplain and below this flow range more water will likely flow onto the Western Floodplain (Alluvium 2019b; Figure 5-9).

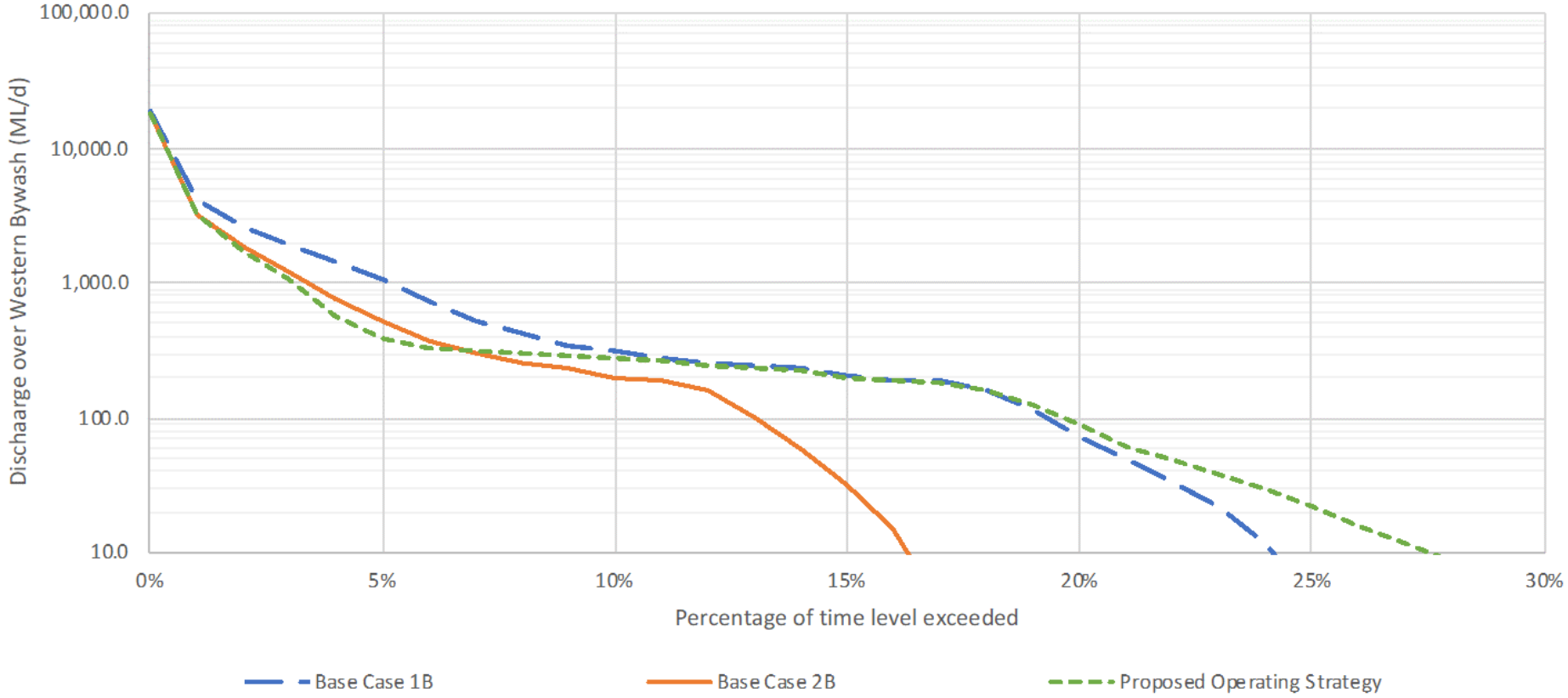


Figure 5-9: Flow duration curve for the Western Bywash (Alluvium, 2019a)

To gain an understanding of how these changes would influence inundation of the Western Floodplain, several watering events have been analysed and their frequency of occurrence, duration and duration between events assessed. The small and medium watering events defined in Table 5-6, form targets for the proposed operating strategy, while the large flood event is an environmental watering target defined in the Intersecting Streams long term water sharing plan.

Table 5-6: Watering events used to compare changes to the flow regimes as a result of the proposed activities.

Description	Definition	Objective: maximum days between events
Small watering event 1	Cumulative 30-day flow > 7 GL	730 days
Small watering event 2	Cumulative 30-day flow > 16 GL	1,095 days
Medium watering event	Cumulative 30-day flow > 33 GL	2,190 days
Large watering event	Cumulative 30-day flow > 75 GL	-

These watering events were based off average recurrence intervals for inundation events described in Cox *et al.* (2012) and correspond to inundation areas of between 1977 and 8,722 ha on the Toorale Western Floodplain (Table 5-7). The spatial extent of these watering events is provided in Table 5-7 from Cox *et al.* (2012).

Table 5-7: ARI values for Q30 river flows from the 39 year hydrograph and the corresponding mapped area within the Toorale boundary. Area is cumulative including the area of more frequent ARI values (adapted from Cox *et al.,* 2012).

Watering event	ARI	Cumulative 30-day discharge (ML)	Area of Toorale Western Floodplain inundated (ha)
Small watering event 1	0.5	6,950	1,977
Small watering event 2	1	15,886	3,647
Medium watering event	2	33,068	5,845
Large watering event	5	75,004	8,722

The modelling results suggest that the values for the operating strategy generally sit within the range of base case values (Table 5-8). The operating strategy was within the range of base case in terms of the percentage of years events occurred for the >7 GL and >75 GL events, with the >16 GL and >33 GL events occurring in slightly less years than under base case conditions. The operating strategy scenario showed higher average durations than the base case in all flow events considered (Table 5-8). Similarly, the operating strategy scenario generally fell within the range of the base case scenarios for the average time between events and the longest dry spell measures. The average dry spell measure ranges from less than 1 year for the >7 GL event to 5 years for the >75 GL event under the operating strategy scenario. Under the operating strategy scenario, the longest dry spell ranged from 3.6 years for the >7 GL event, to 12.5 years for the largest flow event considered (Table 5-8).

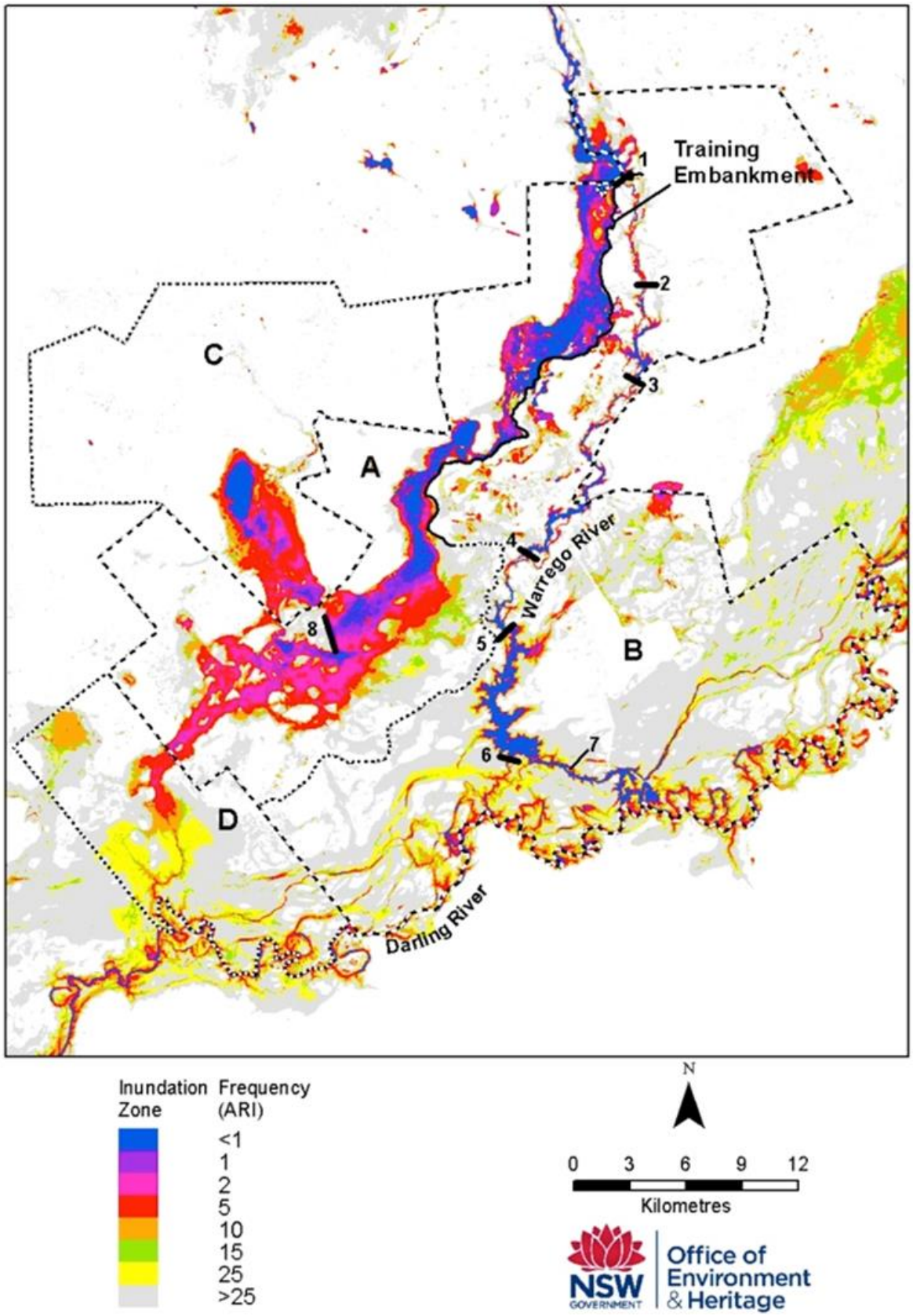


Figure 5-10: Inundation Frequency on Toorale showing the six dams: (1) Boera, (2) 12 Mile, (3) Booka, (4) Keernie, (5) Dicks, (6) Peebles; (7) the Ross Billabong Storage; (8) the Western Embankment and the downstream properties of Uteara and Talowla. Area partitioned into subsections (dotted lines) (A) Toorale Western Floodplain, (B) Toorale East, (C) Uteara Western Floodplain (D) Talowla Western Floodplain (From Cox *et al*., 2012)

Table 5-8: Modelling results for % of years event was achieved, average duration, average dry spell between events and longest dry spell between events for the Western Floodplain watering events considered.

Scenario	% years event achieved				Average duration (days)			
	>7 GL	>16 GL	>33 GL	>75 GL	>7 GL	>16 GL	>33 GL	>75 GL
Base case	70 - 73	41 - 52	34 - 41	16 - 23	55 - 100	125 - 137	138 - 146	159 - 171
Operating strategy	70	39	32	16	105	147	158	195
Scenario	Av dry spell between events (years)				Longest dry spell (years)			
	>7 GL	>16 GL	>33 GL	>75 GL	>7 GL	>16 GL	>33 GL	>75 GL
Base case	1	1.5 - 2.1	2 - 2.5	3.6 - 5.3	3.6 - 4.1	6.9 - 7	7.4 - 7.7	10.6 - 12.9
Operating strategy	0.9	2.1	2.5	5	3.6	7.6	7.6	12.5

The summary statistics presented above suggest that the proposed activities are likely to have only minor effect to flows to the Western Floodplain in terms of the frequency and duration of flow events. Assessment of individual events, such as those presented in Figure 5-11, suggest that the proposed activities are likely to reduce the magnitude of flow events when compared to the base case 1B scenario. This may reduce the inundation area that these events provide on the Western Floodplain, which in turn may affect vegetation condition on the floodplain, especially around the fringes of the inundation event.

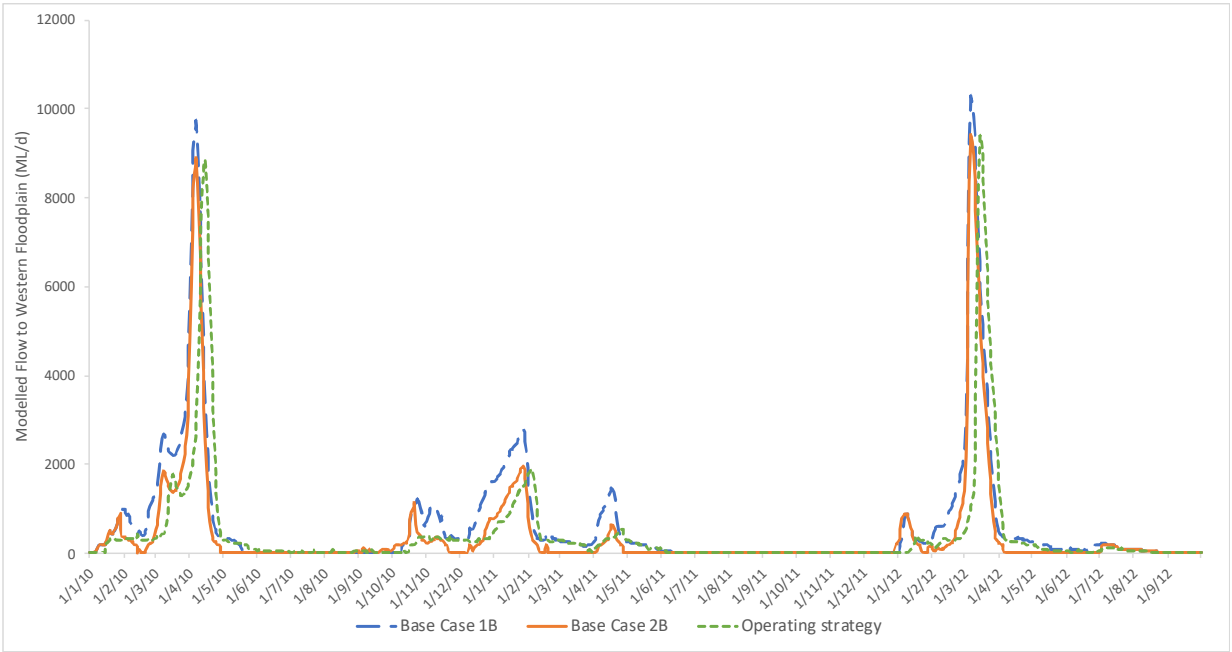


Figure 5-11: Comparison of several flow events modelled base case and operating strategy scenarios measured as flows to the Western Floodplain.

Water Quality

Overall, the proposed works will allow for better water management/quality outcomes compared to the current conditions in both the Warrego and Darling Rivers. Recent monitoring undertaken in the LTIM project found links with improved water quality and flow in both rivers, with increases in flow diluting water quality parameters (Commonwealth of Australia, 2019). In addition, when connected, the Warrego River improved Darling River water quality downstream of the confluence (Commonwealth of Australia, 2017a). With increased flows down the Warrego system, overall improvements in water quality would be anticipated.

Due to construction associated with the proposed activities, there is a risk of pollution of waters through hazardous materials management and localised erosion/sedimentation if banks are not stabilised, especially if heavy rainfall and/or high flows are encountered during construction. There would also be the potential for scour and downstream sedimentation as a result of high flows occurring through the newly established fishways on Boera, Booka and Homestead Dams, though this is likely to have been considered in the fishway designs at these locations. Through proper design and site management during construction, the risk of water pollution, erosion and sedimentation would be considered low.

Aquatic Ecology

Warrego River and dams

Depending on the timing of the proposed works, partial dam dewatering behind coffer dams may be required if there is water within the dams during construction. Should this occur, a prior aquatic survey would be required to assess the current populations present in each dam, and properly licenced ecologists or suitable qualified individuals would be required onsite during dewatering to relocate any stranded fauna. Fauna relocation would commence when the dam is shallower that 50 cm, and would occur as much as possible in the early morning during the coolest part of the day. Fish would be transported in properly aerated containers, and released at a suitable nearby site. NSW DPI Fisheries would be consulted prior to release to ensure the release of fish is appropriate for the site.

The addition of fishways on Boera, Booka and Homestead dams along with the removal of Peebles dam is likely to increase the passage of fish and other aquatic animals through the lower Warrego system, and between the Warrego and Darling rivers. While this will be positive for the movement of native species, there is also the potential for increased migration of exotic species through the system. Sampling during the LTIM project has shown that during some flows, especially when both the Warrego and Darling Rivers are in flood, large scale recruitment of Carp and goldfish can occur in the lower Warrego System. These recruitment events may increase in frequency and magnitude with the improved movement potential in this system leading to larger populations of exotic fish species in the lower Warrego system. This may impact on the aquatic ecology of the lower Warrego River through increased competition for resources, and deterioration of habitat quality. Based on advice from fisheries scientists it is considered that there a medium risk of this occurring.

While no individuals of the endangered Darling River snail have been recorded within Toorale, artificial structures such as the regulating pipes on the dams along the Warrego are the snails' preferred habitat. Although unlikely, there is a possibility that the snails may be present within the proposed work areas.

Boera Dam

The proposed installation of regulator gates (lay flat gates) and a fishway at Boera Dam will increase connectivity and movement opportunities for aquatic animals through the main channel of the Warrego River. Previous downstream movement of juvenile fish, in particular Golden Perch, has been noted through the regulator pipes of Boera Dam during the LTIM project (Commonwealth of Australia, 2019).

This appears to be a critical pathway for the dispersal of this species through the lower Warrego River. The vertical slot fishway that is proposed at this site is designed to provide upstream movement of fish. While the downstream movement of fish will also occur, this design is less effective at attracting fish to move downstream than other designs (G. Butler DPI fisheries, pers. comm.). Given the potential importance of the Warrego River as a source of Golden Perch for the Darling basin, ensuring the downstream movement of this species through this fishway is critical. Given the proposed activities present an improvement in potential fish passage compared to the previous regulator pipes this is considered a low risk of having a negative impact on the downstream movement of juvenile native fish, though monitoring the success of this structure for both upstream and downstream movement is recommended.

Under the proposed operational strategy, the duration of time Boera Dam will be at or near full supply level will be similar to the base case scenario. Therefore, there would be negligible change to the functioning of the storage as an important low flow aquatic refugia, and also minimal impact to fringing vegetation.

Booka Dam

The main ecological impacts relating to the proposed activities at Booka Dam are centred on the reduction to the full supply level of the dam. Booka Dam has been shown to support relatively abundant populations of frog species, linked to the inundation of high-quality fringing habitat in its upper reaches (Commonwealth of Australia, 2019), which is part of the rationale for it being retained, not removed. The reduced capacity of this Dam expected following the proposed activities will reduce access to these fringing habitats, in turn reducing the quality of habitat available to frogs and other aquatic species at the site. These losses in habitat are likely to be somewhat offset by increases in habitat availability with the reinstatement of Homestead Dam, but at a local scale, habitat loss will likely occur at Booka Dam, at least initially. In the longer-term fringing vegetation may encroach into the storage in response to the lower water levels, although to what extent and over what timeframe is unknown. This would constitute a medium risk to the populations of aquatic vertebrates at this location.

Similarly, when connected, the western bywashes that convey water around Booka Dam provide downstream passage and habitat for fish and invertebrates (Eco Logical Australia, 2019a). Any reduction to the connection frequency of these channels will impact on both fish passage and habitat availability in this section of the Warrego River. Again, the overall risk to the aquatic ecology of these losses will be offset but the installation of the rock-ramp fishway in the dam wall, which will allow increased passage through the dam itself. For this reason, the risk of reduced passage through the bywashes on the aquatic ecology is low.

Homestead Dam

The reinstatement of a dam wall at Homestead Dam will reduce connectivity and movement opportunities for aquatic animals within the main channel of the Warrego River relative to the currently breached condition. At present, in its breached condition, Homestead Dam provides a minor barrier to movement in this section of the Warrego. However, this loss of connectivity will be reduced by the installation of a rock ramp fishway at the spillway.

The impact of the reinstated dam wall at Homestead Dam on the aquatic ecology of the lower Warrego system will be offset by the increase in inundated area and permanence within the dam itself following installation. In its upper reaches, Homestead Dam has substantial areas of fringing lignum and river cooba, which has been shown to provide good habitat for frogs and other aquatic species at other locations within Toorale (Commonwealth of Australia, 2016; 2017a; 2019). Reinstating the permanence of the dam, even at a reduced full supply level of 1 m than the original embankment, will also benefit the aquatic ecology by providing suitable refuge habitat for longer periods of time. This is especially important in semi-arid systems like the Warrego, which only flow periodically.

Warrego River downstream of Homestead Dam

While no modifications are planned downstream of Homestead Dam, there are several potential impacts that should be considered. Increases to the flows into Dicks dam should benefit the aquatic ecology in this location, as it will form a more permanent refuge than it does presently. Increased inundation over the road crossing will also increase the potential for fish passage, which should benefit fish species present. As mentioned above, this will also increase the movement of exotic species into this section of the river.

Flow into Ross Billabong, east of the Peebles Dam site, may reduce with the proposed activities. This may subsequently impact the aquatic ecology of this waterhole. Reductions to the depth, area and duration of inundation would be expected, and hence its value as an aquatic refuge in the Warrego system for a range of species, including fish, invertebrates, frogs and birds may be reduced. For mobile species such as birds and frogs, a reduction in the permanence of Ross Billabong will be offset by an increase in the permanence of Dicks and Homestead Dams, lessening the regional impact of changes to Ross Billabong.

Western Floodplain

When inundated, waterholes and channels on the Western Floodplain support relatively diverse and abundant aquatic populations, likely driven by high primary productivity and the presence of high-quality habitat (Commonwealth of Australia, 2019). The Western Floodplain does not appear to support any aquatic species that are not also found in the waterholes of the Warrego and Darling Rivers. In addition, for less mobile species, the floodplain forms temporary habitat which is lost once connection with the Warrego River at Boera Dam ceases. It does, however, provide potentially important feeding grounds for waterbirds and vertebrates when it is inundated, which likely improves their overall condition.

The relative impact of the proposed reductions to inundation of the Western Floodplain on the aquatic ecology of the area is difficult to quantify. As outlined above, flow modelling suggests that there is likely to be a minor variance of the proposed activities on average annual flows to the Western Floodplain. Many of the larger waterholes at least in the northern section of the floodplain become inundated via the network of small channels that become connected at relatively low flow levels on the floodplain. Based on the modelling results, the availability of aquatic refuges should not change significantly under the proposed operating strategy. However, there are some uncertainties about the accuracy of the base case modelling and how these reflect the actual flow patterns on the floodplain over the past several decades that the ecology has adapted to.

There are also uncertainties surrounding the potential impacts on aquatic communities of a reduction in the availability of habitat on the Western Floodplain, and if a reduction in access to the highly productive habitats on the floodplain would impact on regional scale aquatic populations. The only significant monitoring of the aquatic ecology on Toorale has been undertaken in the LTIM project over the past 5 years, and as such has not identified any significant trends in links between connection or disconnection of floodplain habitats and overall aquatic animal populations at Toorale. It is likely that these trends will only become apparent as monitoring continues over longer timescales. Given the uncertainties in model accuracy and ecological response to changes in inundation of the Western Floodplain, it is difficult to assign a risk rating for this component of the REF. All indications are that there is likely to only be minimal impact, however if changes in flow are larger than those anticipated through the modelling then the impact could be greater. In this case, monitoring of aquatic populations on both the floodplain and in the Warrego channel will be critical to detect any changes to aquatic populations. If these occur, then the operating strategy should be adaptively managed where possible to arrest these changes.

Darling River

The proposed activity is likely to increase flows within the Darling River downstream of the confluence. This is likely to benefit the aquatic ecology of the river in several ways. Firstly, Warrego River water has been shown to improve the quality of the water in the Darling River during connection events (Section 5.3.1). In addition, small flows in the range that would be expected to come from the Warrego River (50-1,650 ML/d) have been shown to provide for a range of ecological processes in the Barwon-Darling River. For example, flows of around 350 ML/d have been linked to the enhancement of spawning in low flow spawning specialist fish, such as olive perchlet (endangered) and other small bodied native fish (Humphries and Walker, 2013). In addition, flows of around 400 ML/d have been linked with the suppression of persistence stratification and *Anabaena circinalis* growth in the Barwon-Darling River (Mitrovic *et al*, 2010). Flows of a similar magnitude have also been linked to the inundation of low level in-channel surfaces and associated habitat that are important for the maintenance of fish and invertebrate populations and water quality mediation (Carlisle, 2017). Flows entering the Darling River from the Warrego River have recently been shown to provide re-connection of relatively large (400 km) stretches of the Darling River downstream of the confluence (Eco Logical Australia, 2019b), improving the quality and persistence of water in these previously isolated Darling River waterholes.

In summary, the additional water expected from the Warrego River will likely have no negative impacts on the ecology of the Darling River. In contrast, the additional flow will likely improve conditions for aquatic populations downstream.

The Aquatic Ecological Community of the Lowland Darling River/Threatened Aquatic Fauna

An assessment of the nature and severity of any potential impacts arising during construction and operation of the Project on those threatened species and communities listed under the *Fisheries Management Act, 1994* (FM Act) and considered 'known', 'likely' or 'possible' to occur in the Project locality. The assessments, included in full in Appendix I, have been prepared in accordance with Part7A of the FM Act.

The assessment concludes that the Project would not significantly impact the *Lowland Darling River Aquatic Ecological Community* given:

- the extent of the occurrence of this EEC throughout NSW and the predicted minimal impact associated with the Project
- the Project would comply with the *DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)* (DPI Fisheries 2013)
- indirect impacts would be minimal.

The assessment concludes that the Project is unlikely to significantly impact threatened fish species and given that:

- The proposal is expected to modify the habitat in a way that is beneficial to these fish species.
- The proposal will increase in stream connectivity.
- The habitat is unlikely to be important to the long-term survival of these fish species.

Therefore, the proposal is unlikely to have a significant impact on the fish species listed above and their survival in the locality. As such, a Species Impact Statement is not required.

5.3.3 Mitigation measures

Mitigation measures for construction impacts

Sufficient measures will be included into a construction environmental management plan (CEMP) to control sedimentation and the introduction of hazardous material into the Warrego River adjacent the works sites.

If the storages require dewatering downstream of coffer dams, standard dewatering protocols should be followed including a pre-dewatering survey and then removal of any affected fauna by an ecologist or qualified person during dewatering.

Inspection of the existing pipes should be carried out during removal to confirm the absence of any Darling river snails. If any individuals are found, then ideally the pipes would be placed within the storage away from the works to continue to provide habitat.

Mitigation measures for operational changes to the inundation regime

Water infrastructure will be operated in accordance with relevant license conditions, environmental water strategies, and, where required, CEWHCEWH instructions.

The preparation of the proposed operating arrangements:

- has been informed by, and are consistent with, the environmental watering requirements proposed for the Warrego and Darling River assets in the relevant Long Term Watering Plans.
- has been guided by historical watering regimes to the extent that these are understood
- are able to be adapted in response to improved information on environmental outcomes both on Toorale and downstream.

These factors contribute to the mitigation of any unanticipated or unacceptable changes to the aquatic environment as a result of the new arrangements.

To mitigate any potential impacts to the aquatic ecology from the proposed activities and changed water regime, monitoring of hydrology (including floodplain inundation), water quality and aquatic communities (fish, frogs, invertebrates, waterbirds) should continue in line with the current Monitoring, Evaluation and Research program being undertaken by the CEWHCEWH. Given the increased uncertainties around the potential impacts to the aquatic ecology of the Western Floodplain, additional monitoring of water quality and aquatic communities (fish, frogs, invertebrates, waterbirds) should be undertaken at sites on the Western Floodplain. These should be centred on the larger more persistent waterholes in the central and northern sections of the floodplain that become inundated more often. Monitoring of fishway use above and below the fishways on all dams is also recommended to confirm their effectiveness during periods of flow – both native and exotic fish should be targeted during this monitoring. If any significant changes to both the diversity and abundance of aquatic communities are noted, then the operating strategy should be adaptively managed to minimise or arrest these changes, within the constraints of licence conditions.

5.4 Terrestrial Ecology

The terrestrial ecology assessment within this REF has been drafted using a four-step process to determine the likely presence of, and impacts to threatened species, populations, and ecological communities listed under either the NSW BC Act, FM Act and/or the Commonwealth EPBC Act as described below.

Step 1: Database review

A database review was undertaken to inform a preliminary list of candidate species for assessment for this REF. The following databases and reports were considered during the database search:

- A Vertebrate Fauna Survey of Toorale State Conservation Area and Toorale National Park (OEH, 2016a).
- Toorale Water Infrastructure Project – Biodiversity Status Report. (Eco Logical Australia, 2017).
- BioNet Atlas (OEH, 2019a), considering all species identified within Toorale NP and Toorale SCA.
- EPBC Act Protected Matters Search Tool (DoEE, 2019), considering all species identified within Toorale NP and Toorale SCA.
- Previous vegetation mapping of the Toorale NP and Toorale SCA.
- Survey of Vegetation and Vegetation Condition of Toorale (Gowans *et a*l, 2012)
- Toorale National Park and Toorale State Conservation Area Draft Plan of Management (OEH, 2018a,).

All flora and fauna candidate species are collated in Appendix D and Appendix E. Species that are identified as Marine under the EPBC Act have been removed from the likelihood assessment, as the area of investigation is not within a Commonwealth marine area.

Step 2: Site inspection

A site inspection was conducted from 8 – 10 May 2018 by ELA ecologists Lachlan Copeland and Ronnie Hill, with the aim of:

- Verifying Plant Community Type (PCT) mapping by conducting a floristic plot in each vegetation community at each dam site;
- Assessing each known PCT against the listing criteria under either the NSW BC Act and/or the Commonwealth EPBC Act;
- Conducting a high-level fauna survey; and
- Conducting a threatened flora meander in each area of disturbance.

The location and total survey area was confined to the boundaries of the original proposed development footprint as shown in Figure 5-14 - Figure 5-16.

Three cryptic flora species have recommended survey periods that were outside of the period that the site inspection was undertaken, as such presence/absence for these species could not be confirmed (Table 5-9)

Table 5-9: Recommended survey periods for threatened flora species

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atriplex infrequens	x	x									x	x
Dentella minutissima	Inundation dependent species											
Osteocarpum scleropterum	x	x	x						x	x	x	x

Step 3: Rationalisation of database data and likelihood assessment

Following capture of field data and understanding of the areas of impact, the database assessment was reviewed for validity and a likelihood of occurrence assessment was conducted for each species.

The assessment of likelihood was made for threatened and migratory species identified from the database search. This assessment applies to the impact assessment area only, not to the entire subject site. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposed development site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site.
- "likely" = a medium to high probability that a species uses the site.
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur.
- "unlikely" = a very low to low probability that a species uses the site.
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Species, populations and communities considered to have the potential, are likely or are known to occur are then considered against the impacts of the construction and operation of the proposal (Appendix G).

Step 4: Impact assessment

Construction Impacts

Those species, populations, or ecological communities that are likely to be directly impacted by the construction stage of the proposal have been assessed against section 7.3 of the BC Act to determine if a significant impact is likely (Appendix G). Species listed under the EPBC Act that are directly impacted by the proposal were also reviewed against the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Appendix h; DoEE, 2018a). Species listed under the NSW FM Act were assessed against the significant impact test as described in section 220ZZ of the FM Act (Appendix i).

The impact assessments presented within this REF have been updated through several iterations of the development footprint. As such, the number of impacted species is commensurate to a reduced development footprint.

Impacts from operational changes to inundation

Impacts to the terrestrial ecology derived from operational changes to inundation were assessed for riparian communities and communities on the Western Floodplain. This assessment has focused on vegetation communities that are reliant on surface water inundation. This was done by comparing anticipated changes to the flow regimes of the river and floodplain to the watering requirements of key species.

5.4.1 Existing environment

Toorale is a large, highly diverse park with extensive, high conservation value wetlands, floodplains and riparian habitats. Toorale supports a diverse biodiversity (OEH, 2016a), including many NSW and Commonwealth-listed threatened species and communities (EcoLogical Australia, 2017).

Four ecological communities were identified as potentially meeting NSW and Commonwealth definitions as Endangered Ecological Communities (EECs). These are presented in Table 5-10.

Table 5-10: Endangered Ecological Communities (EECs) that occur in Toorale

Community Name	NSW Status*	Commonwealth Status*
Artesian Springs Ecological Community in the Great Artesian Basin	BC - Critically Endangered	Not listed
Brigalow-Gidgee woodland/shrubland in the Mulga Lands and Darling Riverine Plains Bioregions	BC - Endangered	Not listed
Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion	BC - Endangered	EPBC - Endangered
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	FM - Endangered	Not Listed

* BC – *Biodiversity Conservation Act 2016*, FM – *Fisheries Management Act 1994*, EPBC – *Environment Protection and Biodiversity Conservation Act 1999.*

Vegetation Communities

There are 27 vegetation communities categorised as Plant Community Types (PCTs) in Toorale, 15 of which occur on the dryland landscapes, and 12 occurring on floodplain landscapes (Figure 5-12). Historic water management practices have helped to maintain a vast wetland ecosystem that encompasses nearly 30,000 hectares on Toorale and adjoining properties. Approximately 18,600 hectares (or roughly 20%) of Toorale is covered by Coolibah – Black Box Woodland EEC, a threatened floodplain woodland community (Figure 5-13).

The area of the four PCTs that occur within the disturbance footprint of Boera, Booka and Homestead Dams are presented in Table 5-11, and shown in Figure 5-14 - Figure 5-16.

Table 5-11: Plant Community Types within the project impact areas and locality

PCT	Community Common Name	Boera (ha)	Booka (ha)		Homestead (ha)	Toorale (ha)
			Impact	Access		
40*	Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	10.43	5.78	4.90	6.53	18,647
118	Gidgee chenopod woodland on red-brown clays in the semi-arid (hot) climate zone mainly in the Mulga Lands Bioregion	0	N/A	N/A	0	1,250
143	Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland on semi-arid and arid sandplains and dunes	0.75	0	0	0	1,600
212	Chenopod low open shrubland - ephemeral partly derived forbland saline	0	N/A	1.53	4.76	37,196

PCT	Community Common Name	Boera (ha)	Booka (ha)		Homestead (ha)	Toorale (ha)
			Impact	Access		
	wetland on occasionally flooded pale clay scalds in the NSW North Western Plains					
Total		11.18	5.79	6.43	11.29	N/A

* EEC

PCT mapping provided in Figure 5-14 - Figure 5-16 used regional vegetation mapping along with aerial imagery for areas outside the original disturbance footprint (survey area), and groundtruthed mapping by ELA within the original disturbance footprint that was provided at the time of survey. Six full floristic plots were captured within or nearby to the disturbance footprint to support ELA PCT mapping. The Coolabah EEC (mapped as PCT 40 in Figure 5-12, Figure 5-14, Figure 5-15) is found within proximity to all of the dams and is the main vegetation community found within the disturbance footprint. PCT 40 occurs broadly along the floodplain of the Darling and Warrego Rivers. Due to the long-term impacts of changed flooding regimes on its condition, and its rate of decline, this vegetation community is listed as Endangered as *"Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion"* on the NSW BC Act and as "*Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions*" under the Commonwealth EPBC Act). This EEC encompasses three vegetation communities, as mapped by Gowans *et al*., (2012) and is characterised by Coolabah (*Eucalyptus coolabah subsp. coolabah or subsp. excerata)* and often Black Box (*Eucalyptus largiflorens)* tree species (OEH, 2019a). Within the impact areas, these tree species typically provide habitat in the form of small hollows that may be used by parrots and microbats (L. Copeland pers. comm.). Three floristic plots (one at each dam) were collected within this PCT (Plots 2, 3 & 5; Table 5-12).

Chenopod low open shrubland vegetation community (PCT 212) is found in the Homestead Dam impact area (Figure 5-16). This is the largest vegetation community found at Toorale, covering approximately 40% of the total area (ELA, 2017). One floristic plot was collected within this PCT (Plot 1, Figure 5-17, Table 5-12).

Other vegetation communities found within the impact areas include Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland (PCT 143) at Boera Dam, and Gidgee chenopod woodland (PCT 118) at Booka Dam (ELA, 2017; Figure 5-14, Figure 5-15).

PCT 143 is characterised as a sand plain mulga shrubland that relies on rainfall events to stimulate regeneration rather than inundation (Figure 5-12). It grows on higher elevations to the floodplain and generally colonises areas of disturbance. This PCT covers an area of 1,600 ha (2%) within Toorale (Gowans *et al*., 2012). Dominated by Narrow-leaved Hopbush and *Acacia* species. This community occurs on red sands and would generally rely on rainfall events to stimulate revegetation (Gowans *et al*., 2012). One floristic plot was collected within this PCT at Boera Dam (Plot 4, Figure 5-17, Table 5-12).

PCT 118 is characterised as a Gibber transition shrubland composed of Gidgee (Figure 5-12). Within Toorale, the understorey varied from almost bare to a dense cover of ground species, and the dominant ground species also varied from grass dominated sites to low chenopods at other sites (Gowans *et al*., 2012). This community occurs on sand, sandy loam or clay soils on the sandplains and alluvial plains and is not reliant on flooding or inundation for regeneration. Within Toorale this PCT covers an area of 1,250 ha (1%) within Toorale (Gowans *et al*., 2012). One floristic plot was collected within this PCT at Booka Dam (Plot 6, Figure 5-17, Table 5-12).

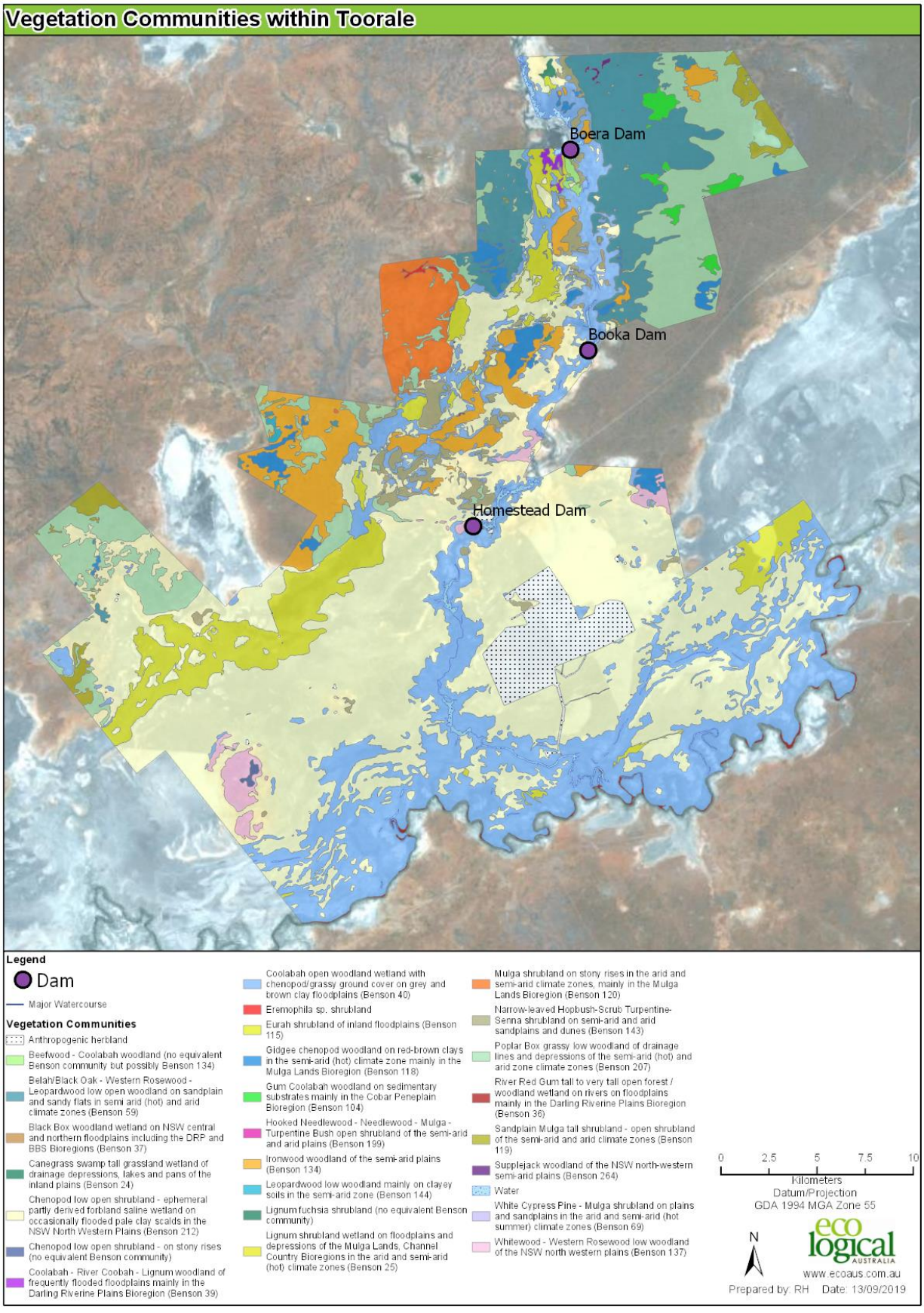


Figure 5-12: Vegetation Communities in Toorale

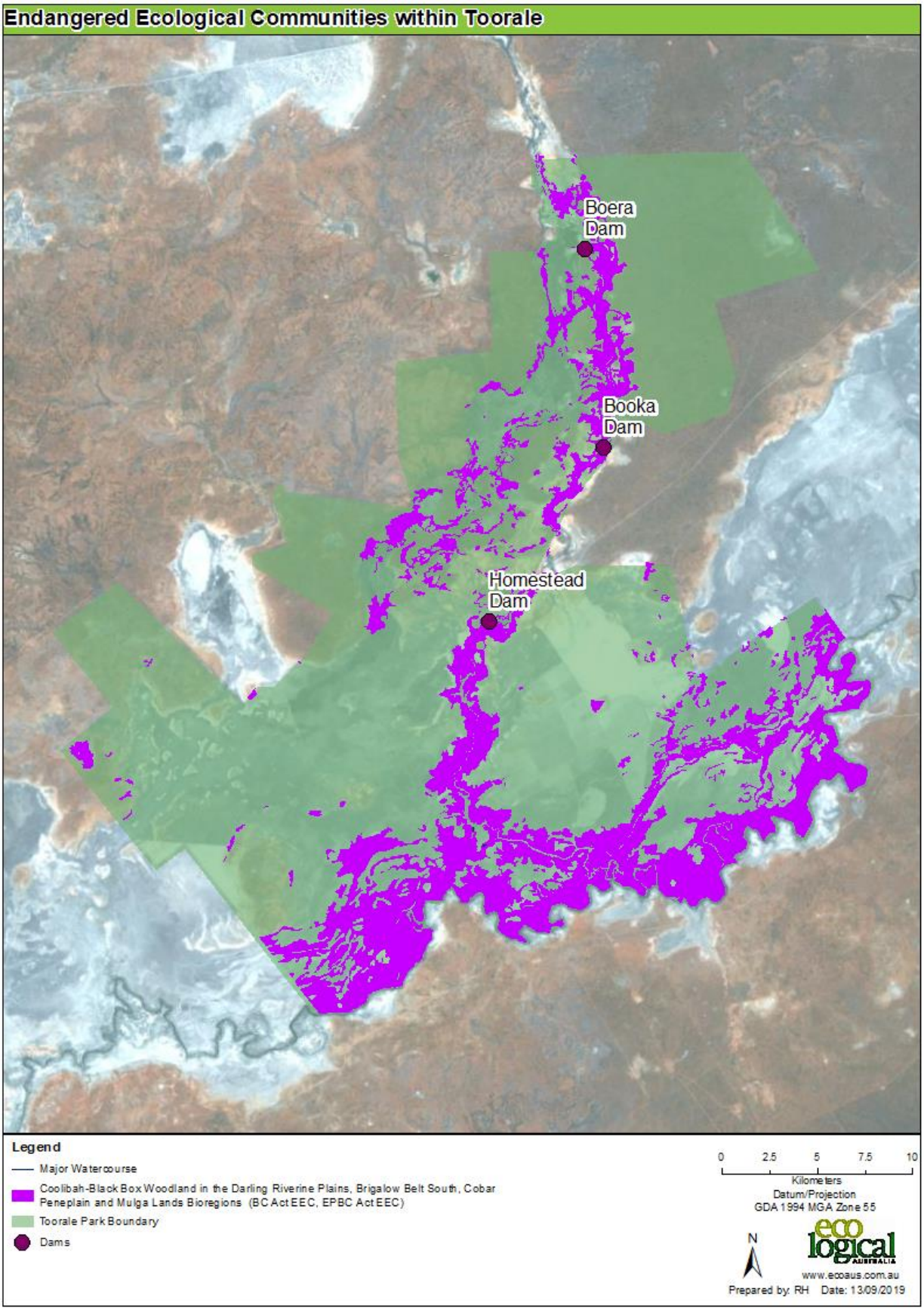


Figure 5-13: Coolibah – Black Box Woodland within Toorale

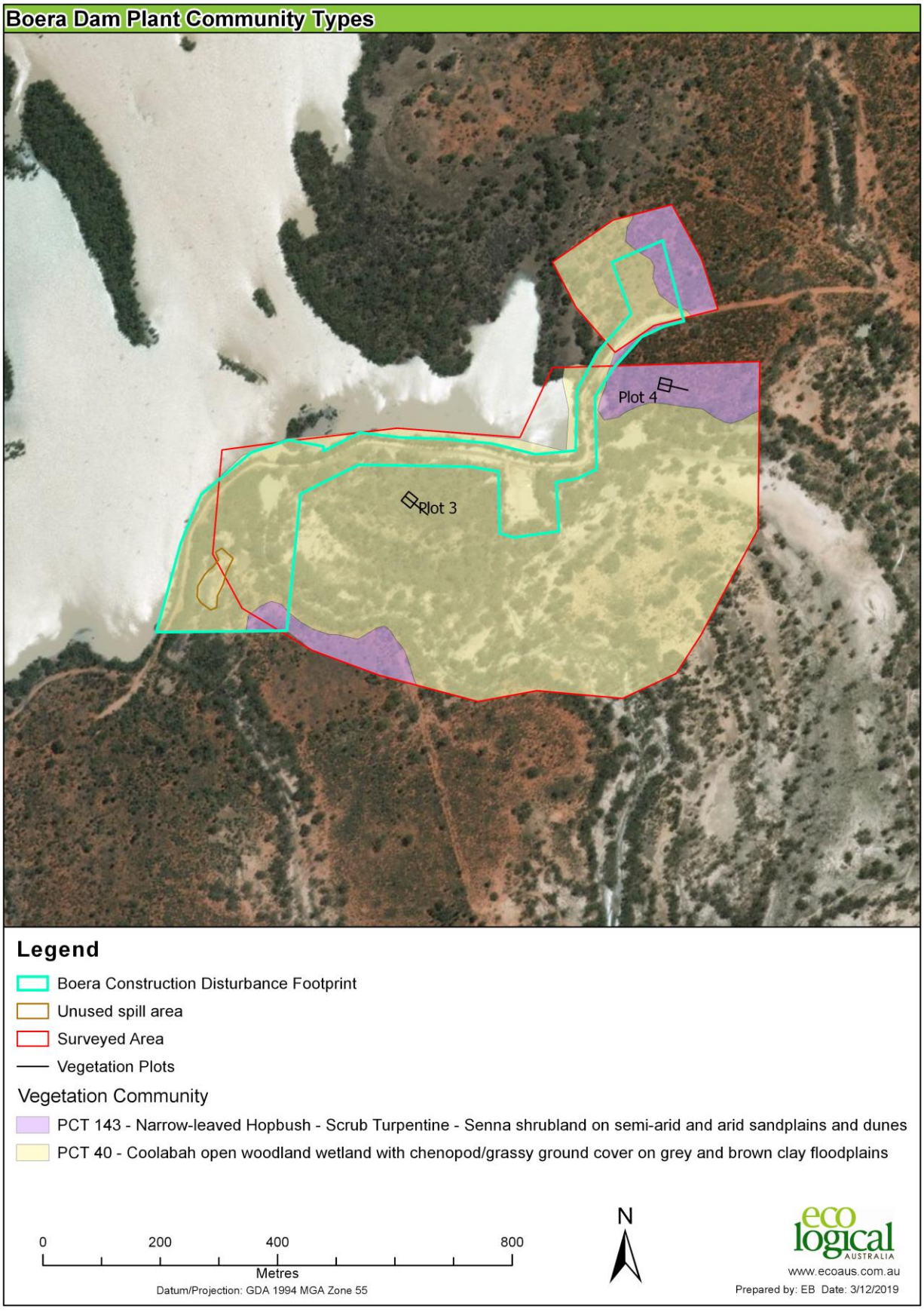


Figure 5-14: Plant Community Types at Boera Dam

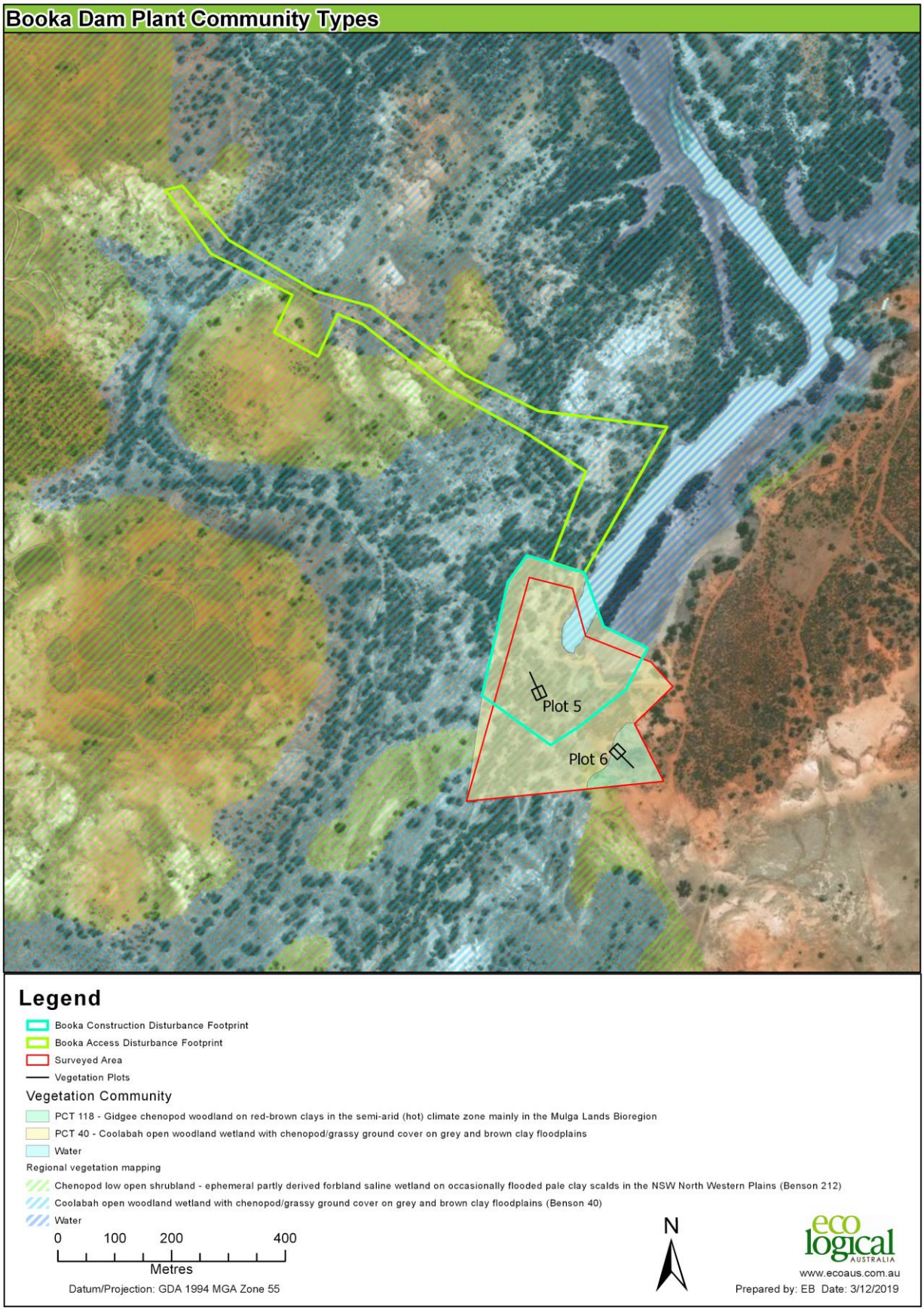


Figure 5-15: Plant Community Types at Booka Dam

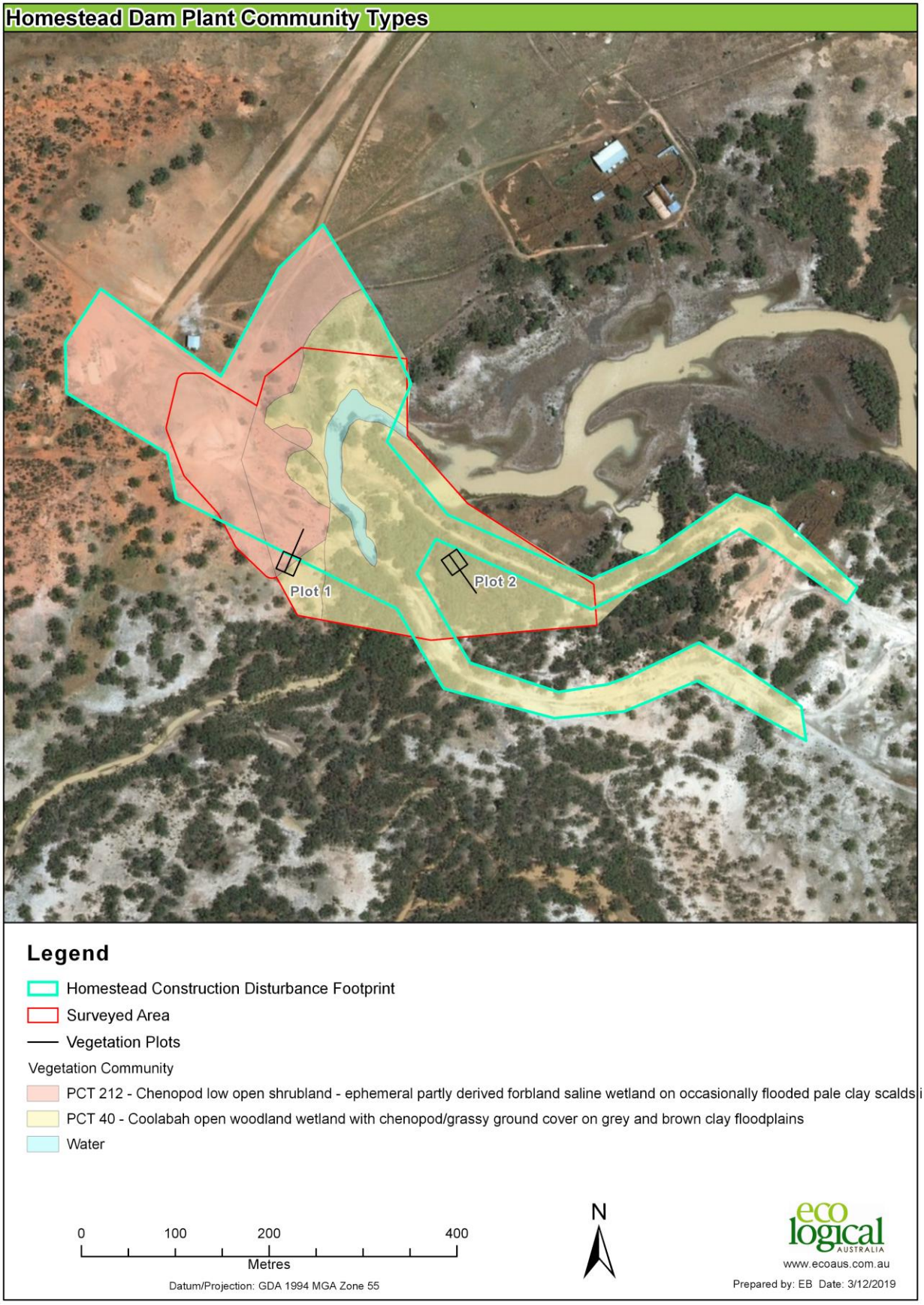


Figure 5-16: Plant Community Types at Homestead Dam

Figure 5-17: PCT types notes in the impact areas of the proposed development.

PCT 40 at Homestead Dam (top left), PCT 212 at Homestead Dam (top right), PCT 40 at Boera Dam (middle left), PCT 143 at Boera Dam (middle right), PCT 40 at Booka Dam (Bottom left) and PCT 118 at Booka Dam (bottom right).

Flora

ELA (2017) conducted a desktop assessment of the potential flora and fauna that could be found at Toorale. This report included records obtained through recent monitoring as part of the LTIM project at Toorale, which monitored vegetation community composition at 24 sites across the Western Floodplain from 2015-2019 (Commonwealth of Australia, 2019). This information, plus additional literature review and database searches (OEH, 2019a), resulted in a comprehensive list of 551 plant species known or likely to occur at Toorale (Appendix D). Native species dominate, comprising 506 species compared to 45 introduced exotic species. Of the exotics, one species was listed as a Priority Weed under the North West RSWMP (*Prosopis* spp.).

In addition to the desktop assessment on the likely flora at Toorale, fieldwork was conducted in May 2018 to confirm species currently present in the proposed impact areas. This included surveys of six biobanking plots which were completed within the proposed impact areas (Table 5-12). Table 5-13 shows the plant species that were found surrounding each dam site.

Table 5-12: Biobanking plots at Homestead, Booka and Boera Dam

Plot Location	Plot Number	Easting	Northing	PCT number
Homestead Dam	1	0343264	6649229	212
Homestead Dam	2	0343448	6649162	40
Boera Dam	3	348738	6669098	40
Boera Dam	4	349173	6669291	143
Booka Dam	5	349263	6658419	40
Booka Dam	6	349389	6658331	118

Table 5-13: Plant species found at within the Boera, Booka and Homestead Dam impact areas.

Scientific Name	Common Name	Status	Boera Dam	Booka Dam	Homestead Dam
Acacia cambagei	Gidgee	Native		x	
Acacia stenophylla	River Cooba	Native	x	x	x
Acacia victoriae	Elegant Wattle	Native	x		x
Atalaya hemiglauca	Whitewood	Native	x		
Chenopodium auricomum	Queensland Bluebush	Native			x
Dodonaea viscosa subsp. *angustissima*	Narrow-leaved Hopbush	Native	x		
Duma florulenta	Lignum	Native	x	x	x
Enchylaena tomentosa	Ruby Saltbush	Native	x	x	x
Eragrostis setifolia	Neverfail	Native		x	
Eremophila bignoniiflora	Eurah	Native		x	
Eremophila deserti	Turkeybush	Native	x		

Scientific Name	Common Name	Status	Boera Dam	Booka Dam	Homestead Dam
Eremophila mitchellii	Budda	Native	x		
Eremophila sturtii	Turpentine Bush	Native	x	x	
Eucalyptus camaldulensis	River Red Gum	Native			
Eucalyptus coolabah	Coolibah	Native	x	x	x
Eucalyptus largiflorens	Black Box	Native	x	x	
Geijera parviflora	Wilga	Native	x	x	
Glinus lotioides		Native			
Haloragis glauca	Raspwort	Native		x	x
Heliotropium supinum	Prostrate Heliotrope	Native	x		
Lycium ferocissimum	African Boxthorn	Exotic, *Priority Weed*	x		x
Maireana sedifolia		Native			x
Maireana coronata		Native			x
Myoporum montanum	Western Boobialla	Native	x	x	
Olearia pimeleoides	Daisy Bush	Native	x		
Paspalidium jubiflorum	Warrego Grass	Native	x	x	x
Persicaria prostrata	Creeping Knotweed	Native	x		
Rhagodia spinescens	Spiny Saltbush	Native	x		
Salsola australis	Roly Poly	Native	x		
Sclerolaena bicornis	Goathead Burr	Native		x	x
Sclerolaena birchii	Galvanised Burr	Native	x	x	
Sclerolaena calcarata	Redburr	Native			x
Sclerolaena divaricata	Tangled Copperburr	Native		x	x
Sclerolaena muricata var. *muricata*	Black Rolypoly	Native	x	x	
Sida corrugata			x		
Stemodia florulenta	Bluerod	Native			x
Verbesina encelioides	Crownbeard	Exotic	x		
Xanthium occidentale	Noogoora Burr	Exotic	x		

Threatened Flora

Of the six threatened flora species identified within the likelihood table (Appendix D), three are known from Toorale - *Atriplex infrequens, Dentella minutissima,* and *Osteocarpum scleropterum* as shown in Figure 5-18.

Atriplex infrequens (a saltbush) is a small spreading forb which is associated with broad drainage tracts, clay flats, and occasionally inundated habitats (OEH, 2019b). Very little is understood about this species. There is one record of the species within Toorale, approximately 3 km west of Booka Dam (Figure 5-18). The species was identified in the Survey *of vegetation and vegetation condition of Toorale* (Gowans, *et. al*., 2012) as occurring in the vegetation community Gidgee Chenopod Woodland on red-brown clays in the semi-arid (hot) climate zone mainly in the Mulga Lands Bioregion, which does not occur within or nearby to the disturbance footprint. This species requires seasonal rain to fruit and is most detectable 4 – 6 weeks after rain from November to February (Table 5-9). As the field survey was outside of this period, an assessment of this species has been included.

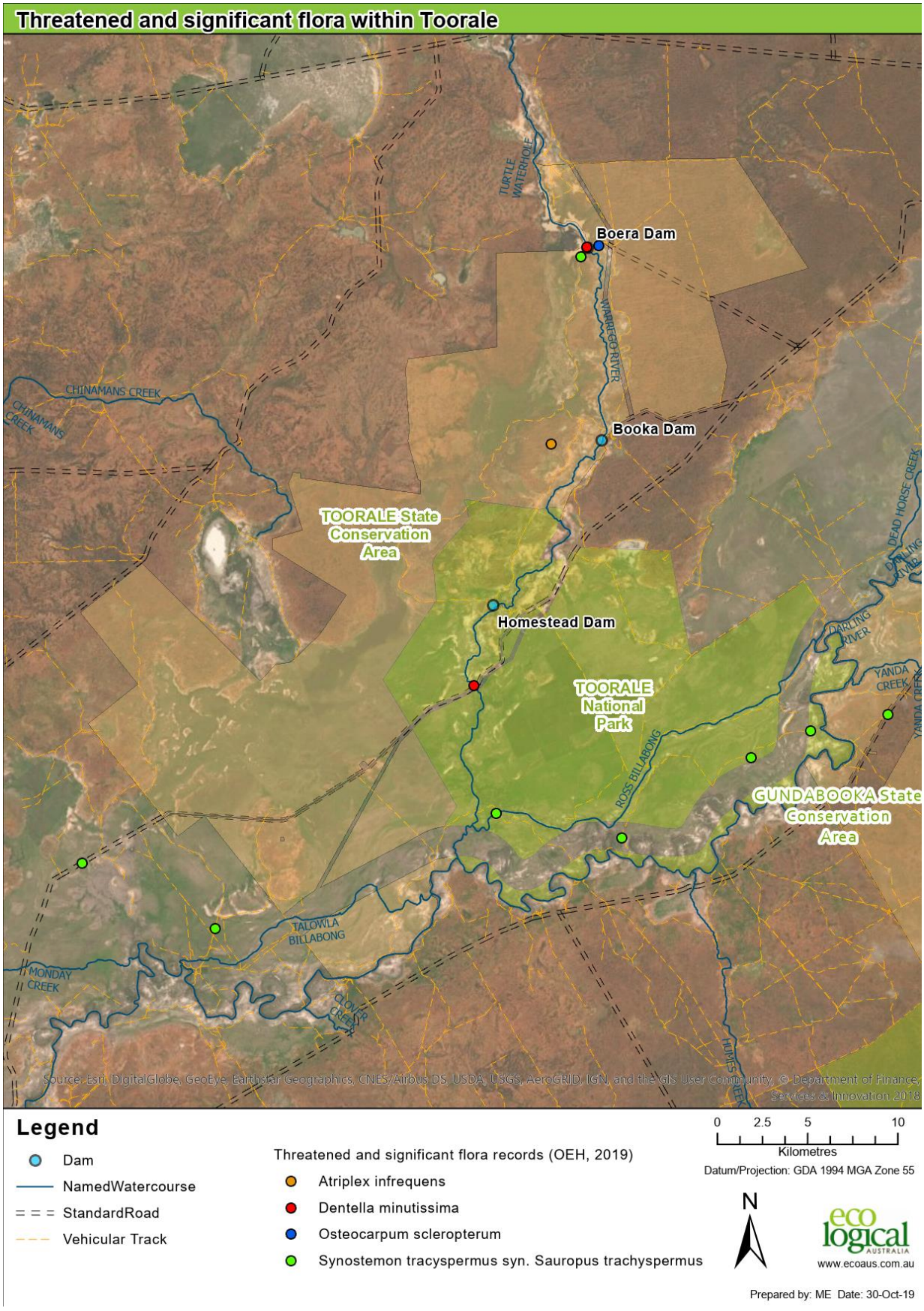


Figure 5-18: Threatened and significant flora records within Toorale

Dentella minutissima is a mat-forming plant which germinates on mud flats and grey cracking clays following receding flood waters (Figure 5-19). The species is known from only three locations in NSW: Nocoleche Nature Reserve 110 km west of Toorale, Naree Station 130 km north of Toorale, and from the drying river beds of Boera Dam, Homestead Dam, Dicks Dam, and Ross Billabong in Toorale NP (OEH, 2019b). The species is listed as Endangered under the BC Act. This species is inconspicuous and is unable to be located unless flowering. There is no specified survey time for this species and is likely respondent to wetting regime within its habitats (Table 5-9). This species occurs on slow-drying flats of previously inundated areas, which have little to no gradient (Figure 5-20). This species is known to occur along the Warrego channel and Western Floodplain. It has also been observed adjacent to Boera Dam at the western bywash (ELA, 2017). The species is unlikely to occur within areas of proposed disturbance due to the relatively steep topography of the disturbance areas. However, targeted surveys prior to construction works are recommended.

Figure 5-19: *Dentella minutissima* at Boera Dam (photos by L. Copeland)

Figure 5-20: *Dentella minutissima* habitat near Boera Dam (photo by L. Copeland)

Osteocarpum scleropterum (Squash bush) is a dwarf subshrub which is only known from two locations: along the Warrego River (collected 1885, Figure 5-18) and from Enngonia (collected in 1971). The species is reported to be sensitive to grazing (OEH, 2019b) and may be seasonally dependent on rainfall for seed dispersal. Fruiting has been recorded in November, and as such the recommended survey period for this species is September to March (Table 5-9). There is one record of the species within Toorale, 20 km north of Homestead Dam (Figure 5-18), although this record is identified with a 100 km accuracy so the actual location of this record within Toorale is unknown. Researchers from the University of Ballarat in 2011 surveyed sites at Homestead Dam (TRL020) and Ross Billabong (TRL109) nearby to Peebles Dam, and did not detect the species (Gowan *et a*l, 2012). This survey was conducted outside the recommended survey period for this species, as was the survey undertaken by ELA more recently. For this reason, surveys for this species within the disturbance areas within the September – March period are recommended before construction begins if possible.

Three other threatened flora species were identified in the database search: *Austrostipa metatoris* (a Speargrass), *Lepidium monoplocoides* (Winged Peppercress), and *Sida rohlenae* (Shrub sida), none of which have been recorded within Toorale including during the ELA surveys in May 2018. Records for these species are limited and broadly spread across north-western NSW (likely a result of lack of survey rather than lack of occurrence). All three of these species have potential to occur, although none of them are highly likely to occur due to their lack of records within Toorale from previous surveys along the Warrego River. Notwithstanding this, a pre-construction survey for these species would be pragmatic to further confirm their absence from the disturbance areas.

Other important flora species

Synostemon trachyspermus (Slender Spurge) is a low-growing herb known throughout northern Australia with limited records within NSW and Victoria. The species is not listed under the BC Act or EPBC Act, however is locally of conservation significance. Prior to discovery in 2008 on Toorale, the species had not been recorded in NSW for over 50 years. The location of records of this species are shown on Figure 5-18. The species is known from a location approximately 1100 m east of Peebles Dam.

Of the 557 species of flora known or likely to occur on Toorale only one species *Brachyscome lineariloba* (Hard-headed Daisy) is listed as a Rare or Threatened Australian Plant (ROTAP; Briggs & Leigh, 1996). No ROTAP were identified in any of the floristic quadrats.

Surveys for threatened and important flora species

A meander of the investigation area by ELA ecologists Lachlan Copeland and Ronnie Hill, was conducted to identify any potential threatened species outside of the disturbance footprint. Surveys were conducted on 9 and 10 May 2018. The aim of the survey was to identify any potential habitat or occurrence of threatened species. Whilst timing for the survey was not ideal, being outside the fruiting/flowering period for the selected threatened species (Table 5-9), the survey was conducted to identify if any habitat was present. No GPS tracks were recorded during threatened flora surveys. At the time of survey, site conditions were extremely dry. Coupled with grazing from macropods and goats, the likelihood of detecting threatened flora was reduced during these surveys.

No threatened flora species were recorded within floristic plots nor during meander searches, however as discussed the site inspection was undertaken outside of the recommended survey period for several cryptic flora species and therefore the absence of these species cannot be confirmed. As such an additional survey prior to construction in the appropriate season, under improved moisture conditions would be essential and may allow for some avoidance measures to be undertaken if the plants are found. A subsequent site inspection of Homestead Dam in May 2019 recorded flows down Warrego River as shown in Figure 5-21 and Figure 5-22. This flow may lead to favourable survey conditions in late 2019.

Figure 5-21: Flooding at Homestead Dam, May 2019 (photo by R. Hill)

Figure 5-22: Water in Homestead Dam, May 2019 (photo by R. Hill)

Weeds

Fourteen significant weeds have been recorded within Toorale as identified in Table 6 of the Draft PoM (OEH, 2018a) and outlined in Table 5-14 below; including five species listed as priority weeds under the Western RSWMP. Eight species have a wide distribution (African Boxthorn, Athel Pine, Bathurst Burr, Buffel Grass, Golden Dodder, Mexican Poppy, Noogoora Burr and Thornapple), while Phoenix Palm and Parkinsonia's distribution have been restricted to Homestead Dam and its vicinity (Toorale Homestead).

Table 5-14: Weeds identified in Toorale including their distribution and status

Species name	Common Name	Distribution	Western RSWMP
African Boxthorn	*Lycium ferocissimum*	Scattered throughout, prefers red soils	State (Asset Protection) and Regional (Asset Protection) Priority Weed
Athel Pine	*Tamarix aphylla*	Scattered riparian areas	State (Asset Protection) Priority level weed
Bathurst Burr	*Xanthium spinosum*	4 sites in 2011 vegetation survey (Gowans *et al*. 2012)	
Buffel Grass	*Cenhrus ciliaris*	Broadly distributed landscape weed	
Century Plant	*Agave americana*	Old Dara Homestead site	
Giant Reed	*Arundo donax*	Warrego Dam walls	Regional (Containment) Priority weed
Golden Dodder	*Cuscuta campestris*	Toorale's western floodplain	
Mexican Poppy	*Argemone ochroleuca* subsp. *ochroleuca*	Infestations on floodplains and disturbed areas; spread by floodwaters	
Noogoora Burr	*Xanthium occidentale*	Found along waterways	
Parkinsonia	*Parkinsonia aculeata*	One at Toorale Homestead (treated)	State (Eradication) Priority Weed
Phoenix Palms	*Phoenix* sp.	Homestead Dam walls	
Prickly Pear	*Opuntia* sp.	Garden of Original Boera Homestead site	
Thornapple	*Datura ferox*	Disturbed areas; mainly irrigation channels	
Wild Tobacco	*Solanum mauritianum*	Boera Dam wall	

Only one species listed above was identified during surveys undertaken for the proposed works. African Boxthorn was identified in one plot each at Boera, Booka and Homestead Dams with a low cover (<2%), while Noogoora Burr was identified at Boera and Booka Dams. Other exotic weeds identified during surveys included *Sisymbrium* sp. at Homestead Dam, and *Verbesina encelioides* (Goldweed) at Boera Dam. Number of individuals and cover of Goldweed and *Sisymbrium* sp. were low (<10%).

Fauna

Previous fauna surveys within Toorale were conducted in 2003, 2004 and 2015 (Kelly, 2004; Shelley *et al.,* 2003; Commonwealth of Australia, 2015). The Toorale Park supports over 250 known native terrestrial vertebrates from four classes including:

- 158 bird species
- 56 reptile species
- 41 mammal species
- 17 amphibian species

In 2017 ELA conducted a biodiversity review of Toorale and identified that a further 105 unrecorded species could potentially occur, based on the habitat characteristics present. A complete list of the 377 likely or known species is available in the *Toorale Water Infrastructure Project – Biodiversity Status Report* (Eco Logical Australia, 2017,). This list includes only vertebrate taxa and invertebrates with cultural or economic value, and contains the following numbers of species:

- 231 Aves – birds
- 67 Reptilia – reptiles
- 41 Mammalia – mammals
- 19 Actinoptergii – ray-finned fish
- 17 Amphibia – frogs
- 1 Crustacea - crustaceans
- 1 Gastropoda – snails

These animals occupy a wide range of ecological niches (for example, woodland birds, migratory wading birds, ground-nesting and hollow-nesting birds, and burrowing and arboreal mammals). The diversity of species reflects the variety of habitat elements in Toorale (OEH, 2018a).

Threatened Fauna

Of the 377 known or likely fauna species, 24 are listed under the NSW BC Act including:

- 19 bird species
- two (2) mammal species
- three (3) reptile species

A list of each known threatened species and their listing status under the BC Act or EPBC Act is shown in Table 5-15. No threatened amphibians are known from Toorale.

Four species listed as Migratory under the EPBC Act are known from Toorale including:

- *Ardea modesta* (Eastern Great Egret)
- *Plegadis falcinellus* (Glossy Ibis)
- *Oriental Pranticole* (Oriental Pranticole)
- *Merops ornatus* (Rainbow Bee-eater)

Figure 5-23 represents the threatened species desktop search. Given that the proposed development has the chance to affect the proposed disturbance areas and the floodplains of Toorale, the desktop search encompassed the entirety of Toorale (OEH, 2019a).

Table 5-15: Threatened fauna known from Toorale

Common Name	Scientific Name	BC status	EPBC Act
Aves			
Australian Bustard	*Ardeotis australis*	E	
Barking Owl*	*Ninox connivens*	V	
Black Falcon	*Falco subniger*	V	
Blue-billed Duck	*Oxyura australis*	V	
Brolga	*Grus rubicunda*	V	
Diamond Firetail	*Stagonopleura guttata*	V	
Dusky Woodswallow	*Artamus cyanopterus*	V	
Eastern Great Egret	*Ardea modesta*		M
Glossy Ibis	*Plegadis falcinellus*		M
Grey-crowned Babbler (eastern subspecies)*	*Pomatostomus temporalis*	V	
Grey Falcon*	*Falco hypoleucos*	V	
Hall's Babbler*	*Pomatostomus halli*	V	
Hooded Plover*	*Thinornis rubricollis*	E	
Little Eagle	*Hieraaetus morphnoides*	V	
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	
Oriental Pranticole	*Glareola maldivarum*		M
Painted Honeyeater*	*Grantiella picta*	V	
Rainbow Bee-eater	*Merops ornatus*		M
Red-tailed Black cockatoo (inland subspecies)	*Calyptorhynchus banksii samueli*	V	
Shy Heathwren*	*Hylacola cautus*	V	
Spotted Harrier*	*Circus assimilis*	V	
Varied Sittella	*Daphoenositta chrysoptera*	V	
White-fronted Chat	*Epthianura albifrons*	V	
Mammallia			
Little Pied Bat	*Chalinolobus picatus*	V	
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	
Reptillia			
Interior Blind snake	*Ramphotyphlops endoterus*	E	
Leopard Ctenotus	*Ctenotus pantherinus*	E	
Ringed Brown snake	*Pseudonaja modesta*	E	

V – Vulnerable, E – Endangered, M = Migratory, * denotes species not identified in BioNet dataset

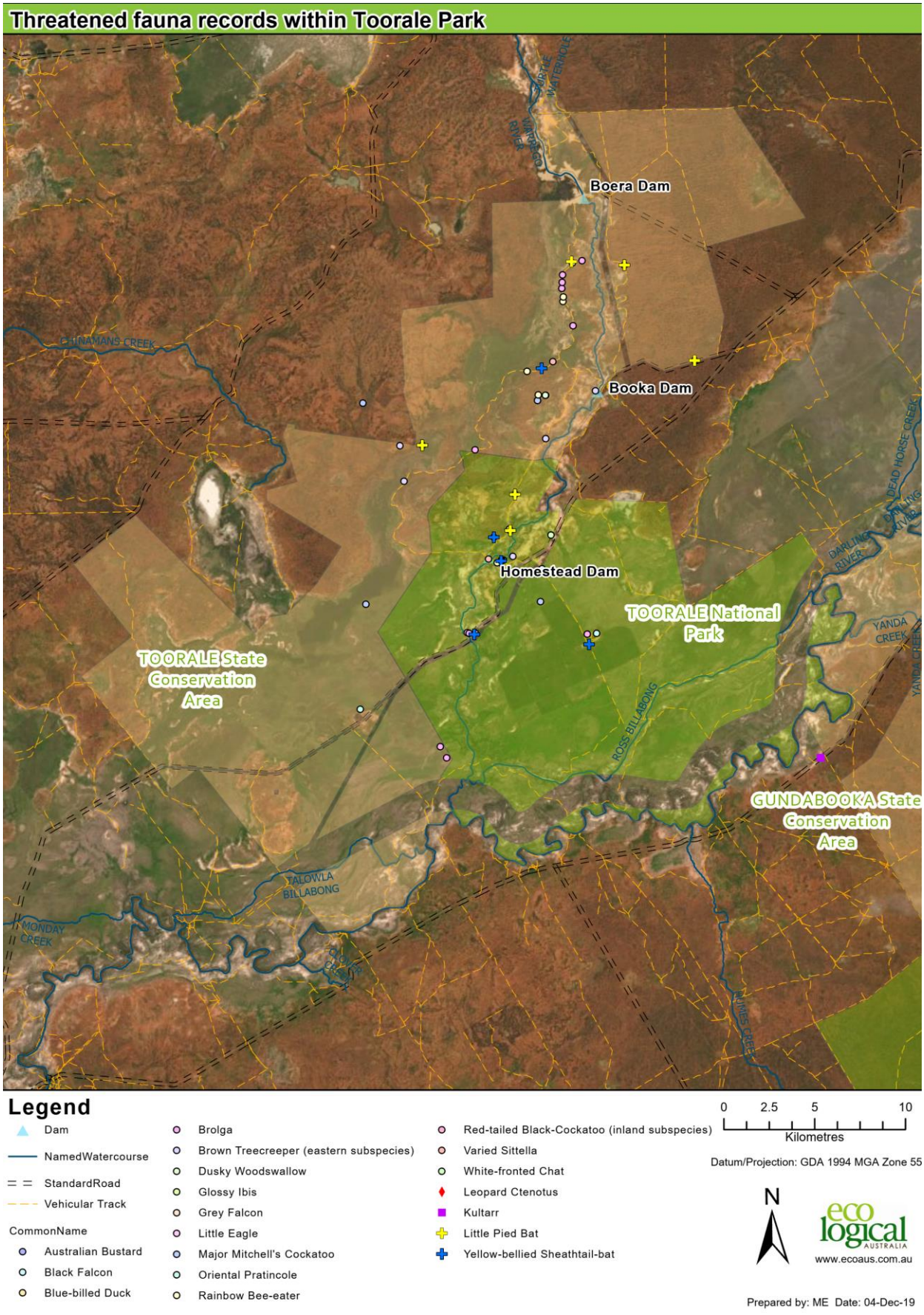


Figure 5-23: Threatened fauna records within Toorale

Other Important Fauna species

In addition to the threatened species identified within Toorale, there are a further sixteen species that are described in the Toorale Draft PoM as species of conservation concern in the NSW Western Division of NPWS , as they are locally rare or have limited breeding abilities (Table 5-16).

Table 5-16: Species that are rare or have limited breeding abilities

Class	Common Name	Scientific Name
Amphibia	Broad-palmed Frog	*Litoria latopalmata*
	Desert Froglet	*Crinia deserticola*
	Rough Frog	*Cyclorana verrucosa*
Aves	Australian Pelican	*Pelecanus conspicillatus*
	Bourke's Parrot	*Neopsephotus bourkii*
	Crested Bellbird (southern)	*Oreoica gutturalis*
	Australasian Darter	*Anhinga novaehollandiae*
	Great Cormorant	*Phalacrocorax carbo*
	Olive-backed Oriole	*Oriolus sagittatus*
	Pied Cormorant	*Phalacrocorax varius*
Mammalia	Swamp Wallaby	*Wallabia bicolor*
Reptilia	Macquarie Turtle	*Emydura macquarii*

Pest Fauna species

Eight species of pest animals have been recorded at Toorale (Table 5-17), specifically goats and pigs. Goats contribute to the total grazing impact on native vegetation. The goats have been recorded in the dryland landscapes and areas adjacent to permanent water. Pigs are also widespread throughout the property.

Table 5-17 Pest vertebrates recorded within Toorale

Species name	Common name
Capra hircus	Feral Goat
Felis catus	Feral Cat
Lepus capensis	Brown Hare
Mus muscus	House Mouse
Oryctolagus cuniculus	Rabbit
Ovis aries	Feral Sheep
Sus scrofa	Feral Pig
Vulpes vulpes	Fox

Surveys for threatened and important Fauna species

Fieldwork undertaken in May 2018 which involved a two-person transverse across the investigation areas around Boera, Booka and Homestead Dams, confirmed the presence of 26 bird species (Table 5-18). No other vertebrates were encountered.

Table 5-18: Bird species identified at Boera, Booka and Homestead Dams

* indicates species is listed under either the BC or EPBC Acts.

Common Name	Scientific Name	Boera Dam	Booka Dam	Homestead Dam
Australian Magpie	*Cracticus tibicen*			x
Apostlebird	*Struthidea cinerea*			x
Australian Raven	*Corvus coronoides*	x		
Australian Ringneck	*Barnardius zonarius*	x		x
Black Kite	*Milvus migrans*			
Black Swan	*Cygnus atratus*		x	
Common Bronzewing	*Phaps chalcoptera*	x		x
Crested Pigeon	*Ocyphaps lophotes*	x	x	
Emu	*Dromaius novaehollandiae*	x		
Fairy Martin	*Petrochelidon ariel*	x		
Grey Shrike-thrush	*Colluricincla harmonica*	x	x	x
Magpie Lark	*Grallina cyanoleuca*			x
Peaceful Dove	*Geopelia placida*	x		
Pied Butcherbird	*Cracticus nigrogularis*	x	x	
White-plumed Honeyeater	*Lichenostomus penicillatus*			x
Red-winged Parrot	*Aprosmictus erythropterus*	x		
Rufous Songlark	*Megalurus mathewsi*	x		
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	x		
Spotted Bowerbird	*Chlamydera maculata*	x		
Varied Sittella	*Daphoenositta chrysoptera*		x	
Variegated Fairy-wren*	*Malurus lamberti**	x		
Welcome Swallow	*Hirundo neoxena*	x	x	
White-necked Heron	*Ardea pacifica*		x	
White-plumed Honeyeater	*Lichenostomus penicillatus*	x	x	x
Willie Wagtail	*Rhipidura leucophrys*	x		
Yellow-throated Miner	*Manorina flavigula*	x	X	x

Varied Sitella (*Daphoenositta chrysoptera*) listed as Vulnerable under the BC Act, was identified during the May 2018 field survey flying low overhead in the Coolabah community at Booka Dam. No other threatened species were identified during this survey.

5.4.2 Potential impacts

Assessment limitations

Several limitations have been identified and considered when constructing the below impact assessments:

- Survey times did not fully align to the optimal survey period for threatened flora.
- Revised disturbance footprints since project inception have altered the original study area; as such regional mapping along with aerial imagery has been used to identify PCTs outside of the areas where surveys have been undertaken – mainly for the access track at Booka Dam.
-
- Revised footprints have also left areas of potential habitat unidentified, although recommended mitigation measures presented in section 5.4.3 and iterated times throughout this REF indicate the importance of surveys, including targeted threatened species searches and pre-clearance surveys prior to construction that will be essential to reducing biodiversity impacts.
- There is some uncertainty as to the accuracy of the base case inundation modelling, given there is limited information available as to the particular way the structures were managed during the time Toorale was an agricultural enterprise.

Summary of likely impacted threatened species

The likelihood of occurrence assessment, in conjunction with a review of previous surveys and available datasets determined 44 of the 65 fauna species, and six flora species in the likelihood assessment have the potential to be directly or indirectly impacted by the proposed works at Boera, Booka and Homestead Dams (Appendix f). These species are those that are known to utilise riparian vegetation or temporarily flooded ponds along the Warrego River. Species that are widely distributed across northern NSW, not reliant on riparian vegetation for a significant component of their life-cycle, known form multiple locations across Toorale, or are not dependent on ponded areas, have been excluded from any further assessment as they are unlikely to be significantly impacted by the proposal.

A list of the likely impacted species is shown below in Table 5-19 and Table 5-20.

Table 5-19: Listed flora species with potential to occur within the study area

Scientific Name	Common Name	BC Act	EPBC Act
Atriplex infrequens	A saltbush	V	V
Austrostipa metatoris	A speargrass	V	
Dentella minutissima		E	
Lepidium monoplocoides	Winged peppercress	E	E
Osteocarpum scleropterum	Squash bush	E	
Sida rohlenae	Shrub sida	E	

P – Protected, V – Vulnerable, E – Endangered

Table 5-20: Listed terrestrial fauna species with potential to occur within the study area

Class	Scientific Name	Common Name	BC Act	EPBC Act
Aves	*Actitis hypoleucos*	Common Sandpiper		M
	Apus pacificus	Forktailed Swift		M

Class	Scientific Name	Common Name	BC Act	EPBC Act
	Ardea alba	Eastern Great Egret		M
	Ardea ibis	Cattle Egret		M
	Ardeotis australis	Australian Bustard	E	
	Artamus cyanopterus	Dusky Woodswallow	V	
	Burhinus grallarius	Bush Stonecurlew	E	
	Calidris acuminata	Sharptailed Sandpiper		M
	Calidris ferruginea	Curlew Sandpiper	E	CE
	Calidris melanotos	Pectoral Sandpiper		M
	Calyptorhynchus banksii	Redtailed Black-Cockatoo	V	
	Certhionyx variegatus	Pied Honeyeater	V	
	Daphoenositta chrysoptera	Varied Sittella	V	
	Epthianura albifrons	Whitefronted Chat	V	
	Gallinago hardwickii	Latham's Snipe		M
	Geophaps scripta	Squatter Pigeon	CE	V
	Glareola maldivarum	Oriental Pratincole		M
	Grantiella picta	Painted Honeyeater	V	V
	Grus rubicunda	Brolga	V	
	Limosa limosa	Blacktailed Godwit	V	
	Melanodryas cucullata	Hooded Robin	V	
	Melithreptus gularis	Blackchinned Honeyeater	V	
	Merops ornatus	Rainbow Beeeater		M
	Motacilla flava	Yellow Wagtail		M
	Oxyura australis	Bluebilled Duck	V	
	Plegadis falcinellus	Glossy Ibis		M
	Polytelis swainsonii	Superb Parrot	V	V
	Pomatostomus halli	Hall's Babbler	V	
	Pomatostomus temporalis	Grey crowned Babbler (eastern subspecies)	V	
	Pyrrholaemus brunneus	Redthroat	V	
	Rostratula australis	Australian Painted Snipe	E	
	Stagonopleura guttata	Diamond Firetail	V	
	Stictonetta naevosa	Freckled Duck	V	
	Tringa nebularia	Common Greenshank		M

Class	Scientific Name	Common Name	BC Act	EPBC Act
Mammalia	*Antechinomys laniger*	Kultarr	E	
	Chalinolobus picatus	Little Pied Bat	V	
	Mormopterus elery	Bristle-faced free-tailed bat	E	
	Nyctophilus corbeni	Corben's Long-eared Bat	V	V
	Phascolarctos cinereus	Koala	V	V
	Sminthopsis macroura	Stripe-faced Dunnart	V	
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	
	Vespadelus baverstocki	Inland Forest Bat	V	
Reptilia	*Antaresia stimsoni*	Stimson's Python	V	
	Pseudonaja modesta	Ringed Brown Snake	E	

V – Vulnerable, E – Endangered, M = Migratory

Assessments of likelihood are provided for all listed flora, fauna and EECs in Appendix F. Assessments under the BC Act, EPBC Act, and FM Act, where relevant are given in Appendix G, Appendix H, and Appendix I.

The most recent fieldwork conducted by ELA in May 2018 found that a single individual of a threatened species (Varied Sittella) was observed flying low overhead in the Coolabah at Booka Dam. It is listed as Vulnerable on the NSW BC Act.

5.4.2.1 Boera Dam

A potential impact area of approximately 40 ha was originally assessed at Boera Dam and surrounds during the field survey. Of this, 11.18 ha has since been proposed to potentially be directly impacted by construction activities, with levels of impact varying between full clearing and ground disturbance, to minimal tree trimming along access tracks to allow for larger machinery to access work areas.

The primary construction impacts to biodiversity of the proposed works at Boera Dam will be the removal of native vegetation (and the species habitat it provides) associated with the redevelopment of the dam wall. The construction of a coffer dam is also included within the proposed works, although this is to be removed following completion of the dam wall.

Secondary impacts associated with the construction works at Boera Dam will be the impact of machinery and workers using the site, and the piling of spoil during the construction phase. Impacts will be limited to the proposed disturbance area and spoil will be mostly be reused in the construction works - or removed following job completion to allow for regeneration. Any temporary buildings or laydown areas will be rehabilitated after the construction has finished.

Other potential major impacts at Boera Dam include the alteration to the watering and inundation regime between the Warrego River and the Western Floodplain. Although increasing flows down the Warrego River is likely to provide improvements to riverine habitat and fringing vegetation, this could be at the consequence/expense to ecological values in the Western Floodplain (depending on local and regional climatic conditions and where the watering priorities lie at the time in accordance with the proposed Operating Strategy).

Impacts to vegetation communities, threatened flora, threatened fauna, and species of conservation significance are described below.

Vegetation Communities

The assessed proposed area of disturbance at Boera Dam consists of two PCTs: 10.43 ha of *Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains* (PCT 40) and 0.75 ha of the *Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland on semi-arid and arid sandplains and dunes* (PCT 143). Vegetation within these communities that will be impacted by the proposal comprises of trees, shrubs and groundcover. Survey work identified minimal hollow-bearing trees (HBTs) within the impact area (2 HBTs within plots) but the survey was not exhaustive. Mature and/or hollow bearing trees within potential impact area should be avoided as much as possible as they have a higher ecological value and will provide good seed for natural regeneration following construction. This will be achieved by undertaking the mitigation measures outlined in Section 5.4.3 which includes a an in-depth survey of mature hollow-bearing trees within the impact area and discussions with the Site Supervisor to work out where impacts can be minimised within the disturbance footprint prior to impacts. The relative impact to these vegetation communities is small on a local scale given that a further 18,636 ha of PCT 40 and 1,599 ha of PCT 143 will remain in the locality. It is not ideal to impact on vegetation, especially PCT 40 which is likely to conform to the Coolabah-Blackbox EEC criteria, but impacts will be mitigated where possible, rehabilitation undertaken and disturbance to these vegetation communities is likely to have insignificant impact on the vegetation communities at a regional scale.

Threatened Ecological Communities

As discussed above, approximately 10.43. ha of the assessed disturbance area contains PCT 40: Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains. This PCT represents a Threatened Ecological Community (TEC) under both the BC Act and EPBC Act.

An assessment of significance (5-part test) under the BC Act (**Appendix G**) and an EPBC Act assessment under the EPBC Act Significant Impact Guidelines (**Appendix H**) was prepared for the *Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions* EEC under the BC Act, and the *Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions* EEC under the EPBC Act. The proposed disturbance area of the Coolabah-Black Box woodland is 10.43 ha in the worst-case scenario of impact. This is considered relatively minor in the context of relatively large areas of the EEC that will remain intact adjacent to the study area (0.05% of total in the locality). The proposed works are not likely to further isolate or fragment areas of the EEC due to the surrounding areas of intact vegetation, but will impact/reduce the amount of this EEC within the immediate impact area. It is expected that most of the area impacted of Coolabah-Black Box woodland will regenerate after construction has finished. An area of 18,636 ha of this EEC will remain within the Park.

For these reasons, assessment results conclude that the impacts are unlikely to be significant and as such no SIS or EPBC Act referral is considered necessary for this vegetation community.

Threatened Flora

Six threatened flora species were identified to have the potential to occur within the impact area surrounding Boera Dam. These were:

- *Atriplex infrequens* – A saltbush (Vulnerable);
- *Austrostipa metatoris* – A spear-grass (Vulnerable);
- *Dentella minutissima* (Endangered);

- *Lepidium monoplocoides* – Winged Peppercress (Endangered);
- *Osteocarpum scleropterum* – Squash Bush (Endangered); and
- *Sida rohlenae* – Shrub Sida (Endangered).

These species were identified during the database search as having the potential to occur on site, however none were located during the field survey These surveys were conducted outside of the recommended survey period, therefore, as a precautionary measure, a pre-clearance survey prior to the commencement of works in the area, during the suitable detection period for threatened flora to eliminate the chance of these species occurring. Should they occur in the disturbance footprint, a revised Assessment of Significance must be considered prior to works.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works is unlikely to result in a significant impact upon these species, therefore, no SIS and / or EPBC Referral is required at this time.

Threatened Fauna

A total of 44 terrestrial fauna species were identified as having the potential to be impacted by the proposal. This section assesses the impact the proposed construction works may have (removing native vegetation, habitat and fragmenting habitat).

All the threatened fauna species identified have potential to use habitat on and around Boera Dam – especially the riparian areas, the hollow-bearing trees and the fallen woody debris. Although many of the threatened species likely to use the site are mobile, there will be direct impacts to their habitat. Implementing best practice clearing methods (including pre-clearance surveys – section 5.4.3) as a mitigation measure will hopefully enable any individuals within the impact area to move to neighbouring habitat which is homogenous surrounding the impact area. However, it is acknowledged that impacts will occur as a consequence of this project. Retaining woody debris and replacing it after construction is another measure that can be used to minimise impacts on threatened fauna habitat.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works are unlikely to result in a significant impact upon these species, therefore, no SIS and / or EPBC Referral is required.

Flora and fauna of Conservation Significance

Under the *Guidelines for preparing a Review of Environmental Factors* (OEH, 2016) the assessment must consider the likelihood an activity will endanger, displace or disturb, or create a barrier to the movement of species of conservation significance. The construction of Boera Dam is unlikely to result in any significant effect for species of conservation significance (Table 5-21).

Table 5-21 Consideration of species of conservation significance at Boera Dam

Common name	Species name	Will the activity:		
		Endanger the species?	Displace or disturb the species?	Create a barrier to their movement?
Flora				
Slender spurge	*Synostemon trachyspermus*	No, the species is not known form the disturbance area, and occurs widely locally.	No	No

Common name	Species name	Will the activity:		
		Endanger the species?	Displace or disturb the species?	Create a barrier to their movement?
Amphibians				
Broad-palmed Frog	*Litoria latopalmata*	No	There may be temporary displacement of frogs during construction	Unlikely, fishway will allow for movement whilst regulator gates are closed.
Desert Froglet	*Crinia deserticola*			
Rough Frog	*Cyclorana verrucosa*			
Aves				
Australian Pelican	*Pelecanus conspicillatus*	No	There may be temporary displacement of birds during construction	No, the activity will not create a barrier for birds
Bourke's Parrot	*Neopsephotus bourkii*			
Crested Bellbird (southern)	*Oreoica gutturalis*			
Australasian Darter	*Anhinga novaehollandiae*			
Great Cormorant	*Phalacrocorax carbo*			
Olive-backed Oriole	*Oriolus sagittatus*			
Pied Cormorant	*Phalacrocorax varius*			
Mammalia				
Swamp Wallaby	*Wallabia bicolor*	No	There may be temporary displacement of mammals during construction	No, the activity will not affect mammal's ability to move through the landscape
Reptilia				
Macquarie Turtle	*Emydura macquarii*	No	There may be temporary displacement of turtles during construction	Unlikely, fishway will allow for movement whilst regulator gates are closed.

Weeds

Xanthium occidentale (Noogoora Burr) was identified within the proposed impact area at Boera Dam. The use of machinery in areas of weeds and inadequate weed management procedures may facilitate the spread of these weeds.

Biosecurity mitigation measures presented in Section 5.4.3 will assist in stopping the spread of weeds.

Inundation regime change

As discussed above, the proposed inundation regime change is expected to impact upon terrestrial ecology around Boera Dam and surrounds – including the Western Floodplain. Potential impacts were assessed using inundation modelling of a baseline situation (mixed enterprise) and future proposed water management scenarios, as well as time-series analyses. Results were then analysed and refined by DPIE staff and other agency stakeholders to develop a proposed operating strategy that balances the water delivery needs of the Western Floodplain and the Warrego and Darling Rivers.

Analysis of modelled data compared the baseline scenario against various future water management options to estimate (and quantify) the level of impacts each option would incur. The 'environmental water requirements' of the vegetation and fish communities in the Western Floodplain have been developed and used to inform this analysis (for example – how frequently does lignum shrubland need to be inundated to survive – what is the maximum period it can go without being wet before it starts to die?). These environmental water requirements were used in the analysis to estimate environmental impacts. Options were analysed against 7, 16, 33 and 75GL scenarios.

Under the defined baseline case, the estimated average annual flow to the Western Floodplain is between 50-73GL per year. Under the draft proposed operating strategy, the average annual flow is estimated to be 54GL per year, which is within the range of current hydrology. Under the 7GL, 16GL, 33GL and 75GL scenarios, analysis found that environmental water requirements of the Western Floodplain would likely be met at similar frequency of years to the current/baseline situation – except at the lower end of each range. Similarly, the maximum interval periods (the maximum time a vegetation community can go without being wet before it starts to decline) of the proposed strategy are within the range of the base case scenarios. These results indicate that the proposed watering arrangements should minimise impacts to the flow regime change on the western floodplain and minimise losses of vegetation communities and wetland/floodplain habitats. Monitoring of the condition of habitats in the Western Floodplain and the Warrego River will be implemented to determine and confirm whether the outcomes expected from the modelling exercises are achieved.

Changes to inundation may also result in impacts to fringing vegetation around Boera Dam, and improvements to riparian and fringing vegetation along the Warrego River downstream of Boera Dam as a consequence of increased flows. Modelling estimates that the Warrego River downstream of Peebles Dam will have up to a 24GL/year on average increase in flows compared to the baseline scenario (1B baseline used), depending on the climatic conditions at the time. If the Boera Dam level drops or changes significantly relative to its historic drying regime, it may have impacts on vegetation surrounding the dam. The proposal to maintain this dam at its current full supply level should mitigate such impacts.

As with much of western NSW, climatic conditions at Toorale are highly variable between dry, average and wet years. The prevailing climate has a large bearing on the condition of vegetation and habitats on Toorale, eg plants that only bloom in response to rain., DPIE has also tested the proposed arrangements under these different climatic conditions to identify potential environmental impacts under the proposed operating strategy. Under all dry, average and wet year scenarios, the proposed operating strategy will be highly likely to provide an increase in flows down the Warrego River. This is very likely to enhance the condition and prevalence of riparian vegetation fringing the Warrego River, including in Dicks Dam which provides an important habitat refuge for birds, frogs and fish and access to water for mammals). Positive impacts to terrestrial ecology habitats are expected to extend Into the Darling River.

Based upon these findings, changes to terrestrial flora may occur upon the fringes of Boera dam's riparian zone due to the 4.6% reduction in time that the dam is above full supply level and in closest proximity to

fringing riparian vegetation. These changes are likely to be greatest for the faster responding forb species and impacts to the longer-lived species such as Lignum and Coolibah would be minimal.

See section 5.4.2.5 for more detail on expected impacts from the change in inundation.

5.4.2.2 Booka Dam

A potential impact area of approximately 8.31 ha was originally assessed at Booka Dam (Figure 5-15). Since then the potential impact footprint has increased to approximately 12.22 ha. This is including 5.78 ha for the development footprint and a further 6.43 ha for access via the Western Floodplain should access not be gained from the east via Booka Station. As such, this assessment includes the cumulative area of the disturbance, although the total area may not actually be impacted with alternative access. The western access through to this site has not been thoroughly surveyed, so the REF has used vegetation mapping to estimate impacts. DPIE plans to survey the area in early 2020.

The primary direct impact to biodiversity of the proposed works at Booka Dam will be the removal of native vegetation associated with the modification of the dam wall, which conforms to the Coolabah Black Box EEC under the NSW BC Act and the Commonwealth EPBC Act. The construction of a coffer dam is also included within the proposed works, although this is to be removed following completion of the dam wall.

Secondary impacts associated with the works at Booka Dam will be the access route to the west (if used), the use of borrow pits and the piling of spoil during the construction in the designated laydown and spoil stockpile areas.

The potential western access route follows an existing, undefined access track to Boera Dam that has historically been used to access and operate the gates on this dam. However, sections may need to be widened for larger machinery, particularly through an existing gateway. For this reason, the disturbance area for the access route as shown represents the maximum area of potential disturbance to allow some flexibility for vehicles to move through without clearing additional vegetation. These activities are to occur within the proposed construction disturbance area and will be removed and rehabilitated following job completion.

Impacts to vegetation communities, threatened flora, threatened fauna, and species of conservation significance at Booka Dam are described below.

Vegetation Communities

The assessed construction disturbance footprint at Booka Dam consists of two PCTs. Approximately 10.68 ha of PCT 40 *(Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains* Coolabah open woodland wetland and 1.53 ha of PCT 118 *(Gidgee chenopod low open shrubland – ephemeral partly derived forbland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains*). Vegetation to be potentially impacted by the proposal comprises trees, shrubs and groundcover. Mature and/or hollow bearing trees within potential impact area will be avoided where possible during construction. Given that a further 18,636 ha of PCT 40 and 37,196 ha of PCT 212 will remain within Toorale, disturbance to these vegetation communities is not expected to have a significant impact on the vegetation communities at a local or regional scale.

Threatened Ecological Communities

Approximately 10.68 ha of the assessed area is located within *PCT 40: Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains*. This PCT represents a Threatened Ecological Community (TEC) under both the BC Act and EPBC Act.

An assessment of significance (5-part test) under the BC Act (Appendix G) and an EPBC Act assessment under the EPBC Act Significant Impact Guidelines (Appendix H) was prepared for the *Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions* EEC under the BC Act, and the *Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions* EEC under the EPBC Act.

The proposed construction disturbance area of the Coolabah-Black Box woodland (10.68 ha) that may potentially be impacted is relatively minor (0.06% of total), and there are relatively large areas of the EEC that will remain adjacent to the construction disturbance area. The proposed works at Booka Dam are not likely to further isolate or fragment areas of the EEC, and a further 18,600 ha of this EEC remains within Toorale National Park. Additional clearing for the access route could fragment this community either side of the track, however as discussed above, it is intended to minimise the width of the access track and choose a path of least impact through this area (overlapping with the current access track) in order to minimise this fragmentation. Regeneration of this EEC will occur post construction.

For these reasons, assessment results concluded that the impacts are unlikely to be significant and as such no SIS or EPBC Act referral is considered necessary for this vegetation community.

Threatened Flora

Six threatened flora species were identified as known to or of having the to potential to occur within the impact area surrounding Booka Dam. These include:

- *Atriplex infrequens* – A saltbush (Vulnerable);
- *Austrostipa metatoris* – A spear-grass (Vulnerable);
- *Dentella minutissima*[2] (Endangered);
- *Lepidium monoplocoides* – Winged Peppercress (Endangered);
- *Osteocarpum scleropterum* – Squash Bush (Endangered); and
- *Sida rohlenae* – Shrub Sida (Endangered).

An assessment of significance under the BC Act and/or EPBC Act was prepared for these species.

These species were identified during the database search as having the potential to occur on site, however none were located during the field survey. ELA notes that these surveys were conducted outside of the recommended survey period; therefore, as a precautionary measure, a pre-clearance survey is recommended prior to the commencement of works in the area, during the suitable detection period for threatened flora to eliminate the chance of these species occurring. Should they occur in the disturbance footprint, a revised Assessment of Significance must be considered prior to works.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works is unlikely to result in a significant impact upon these species, therefore, no SIS and / or EPBC Referral is required at this time.

Threatened Fauna

A total of 44 terrestrial fauna species were identified as having the potential to be impacted by the proposal. This section assesses the impact the proposed construction works may have (removing native vegetation, fragmenting habitat, removal of habitat).

[2] Known to occur in the sediments of Booka and Boera Dams

All the threatened fauna species identified have potential to use habitat on and around Booka Dam – especially the riparian areas, the hollow-bearing trees and the fallen large woody logs. Although many of the threatened species likely to use the site are mobile, there will be direct impacts to their habitat. Implementing best practice clearing methods (including pre-clearance surveys – section 5.4.3) as a mitigation measure will enable any individuals within the impact area to move or be relocated to homogenous neighbouring habitat surrounding the impact area. Retaining woody debris and replacing it after construction is another measure that will be used to minimise impacts on threatened fauna habitat. However, it is acknowledged that impacts will occur as a consequence of this project.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works is unlikely to result in a significant impact upon these species, therefore, no SIS and/or EPBC Referral is required.

Flora and fauna of Conservation Significance

Under the *Guidelines for preparing a Review of Environmental Factors* (OEH, 2016) the assessment must consider the likelihood an activity will endanger, displace or disturb, or create a barrier to the movement of species of conservation significance. The construction of Booka Dam is unlikely to result in any significant effect for species of conservation significance (Table 5-22), though reductions in storage volume may reduce available habitat for amphibian and turtle species. Little change is expected for the permanence of the Dam however, reducing the potential impact on these species.

Table 5-22: Consideration of species of conservation significance at Booka Dam

Common name	Species name	Will the activity:		
		Endanger the species?	Displace or disturb the species?	Create a barrier to their movement?
Flora				
Slender spurge	*Synostemon trachyspermus*	No, the species is not known form the disturbance area, and occurs widely locally.	No	No
Amphibians				
Broad-palmed Frog	*Litoria latopalmata*	No	There may be temporary displacement of frogs during construction. Changes to full supply level may reduce viability to quality habitat	Unlikely
Desert Froglet	*Crinia deserticola*			
Rough Frog	*Cyclorana verrucosa*			
Aves				
Australian Pelican	*Pelecanus conspicillatus*	No	There may be temporary displacement of birds during construction around the construction area – but not across the wider dam area	No, the activity will not create a barrier for birds
Bourke's Parrot	*Neopsephotus bourkii*			
Crested Bellbird (southern)	*Oreoica gutturalis*			
Australasian Darter	*Anhinga novaehollandiae*			

Common name	Species name	Will the activity:		
		Endanger the species?	Displace or disturb the species?	Create a barrier to their movement?
Great Cormorant	*Phalacrocorax carbo*			
Olive-backed Oriole	*Oriolus sagittatus*			
Pied Cormorant	*Phalacrocorax varius*			
Mammalia				
Swamp Wallaby	*Wallabia bicolor*	No	There may be temporary displacement of mammals during construction	No, the activity will reduce barriers for mammals
Reptilia				
Macquarie Turtle	*Emydura macquarii*	No	There may be temporary displacement of turtles during construction, especially with the use of a coffer dam. Reduction in full supply level may reduce available habitat	No, the activity will not create a barrier – it is modifying a current barrier which may lessen the barrier for this species.

--

Weeds

African Boxthorn were identified within the proposed impact area at Booka Dam. The use of machinery in areas of weeds and inadequate weed management procedures may facilitate the spread of these weeds.

Biosecurity mitigation measures presented in Section 5.4.3 will assist in stopping the spread of weeds.

Inundation regime change

The current inundation regime will be altered by the new structure and operating arrangements at Boera Dam and changed full supply level. Areas downstream will receive more water owing the intention to increase flows down the Warrego River in the proposed operating strategy and the removal of Peebles Dam. This will improve water availability to fringing riparian vegetation, and subsequently terrestrial fauna and their habitat. The proposed reduction of Booka Dam's full supply volume from 106 ML to 27 ML will significantly reduce its surface area (Figure 5-15), which will impact on the availability of water to the fringing riparian vegetation. In particular, Booka Dam supports significant areas of lignum shrublands, which may be impacted by the reduction in water availability. Over time the lignum is expected to grow to the new supply level of the dam however this is considered as a medium risk to these communities. A discussion of the impacts to frogs and other aquatic species is provided in Section 5.3.2. See section 5.4.2.5 for more detail on expected impacts from the change in inundation.

5.4.2.3 Homestead Dam

An impact area of approximately 7.08 ha was originally assessed at Homestead Dam (Figure 5-16). However, the impact area has since increased to an area of 11.29 ha to take into account existing access

routes and laydown areas in a disturbed to the west of the river which is largely scalded earth. It is unlikely that all of this area will be directly impacted by the proposed activities (the area within and around the channel where the embankment will be constructed is most likely to be affected

The primary direct impact to biodiversity of the proposed works at Homestead Dam will be the removal of native vegetation associated with the construction of the dam wall, which is a listed EEC under the NSW BC Act and the Commonwealth EPBC Act. The construction of a coffer dam is also included within the proposed works, although this is to be removed following completion of the dam wall.

Secondary impacts associated with the works at Homestead Dam will be the use of laydown areas, access and the piling of spoil during the construction phase. This is to occur within the proposed construction disturbance area and will be removed following job completion.

Impacts to vegetation communities, threatened flora, threatened fauna, and species of conservation significance are described below.

Vegetation Communities

The assessed construction disturbance footprint at Homestead Dam consists of two PCTs: 6.53 ha of PCT 40 (*Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains*) and 4.76 ha of PCT 212 (*Chenopod low open shrubland - ephemeral partly derived forbland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains*). The vegetation within a large part of the impact footprint is in a degraded condition due to vehicle traffic. Vegetation to be potentially impacted by the proposal comprises trees, shrubs and groundcover. Mature and/or hollow bearing trees within potential impact area will be better documented before construction, mapped, and avoided where possible. This will be achieved by undertaking the mitigation measures outlined in Section 5.4.3. Given that a further 18,636 ha of PCT 40 and 37,196 ha of PCT 212 exist within Toorale, disturbance to these vegetation communities will have insignificant impact on the vegetation communities at a regional scale.

Threatened Ecological Communities

Approximately 6.53 ha of the assessed area is located within *PCT 40: Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains*. This PCT represents a Threatened Ecological Community (TEC) under both the BC Act and EPBC Act.

An assessment of significance (5-part test) under the BC Act (**Appendix G**) and an EPBC Act assessment under the EPBC Act Significant Impact Guidelines (**Appendix HI**) was prepared for the *Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions* EEC under the BC Act, and the *Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions* EEC under the EPBC Act.

The proposed construction disturbance area of the Coolabah-Black Box woodland (6.53 ha) that may potentially be impacted is relatively minor (0.04% of total) relative to its distribution on Toorale, and there are relatively large areas of the EEC that will remain adjacent to the construction disturbance area. Post construction, it is expected that the vegetation will return with the same community following future rainfall events. In addition, the proposed works are not likely to further isolate or fragment areas of the EEC, and a further 18,600 ha of this EEC remains within Toorale.

For these reasons, assessment results concluded that the impacts are unlikely to be significant and as such no SIS or EPBC Act referral is considered necessary for this vegetation community.

Threatened Flora

Six threatened flora species were identified to have the potential to occur within the impact area surrounding Homestead Dam. These were:

- *Atriplex infrequens* – A saltbush (Vulnerable);
- *Austrostipa metatoris* – A spear-grass (Vulnerable);
- *Dentella minutissima* (Endangered);
- *Lepidium monoplocoides* – Winged Peppercress (Endangered);
- *Osteocarpum scleropterum* – Squash Bush (Endangered); and
- *Sida rohlenae* – Shrub Sida (Endangered).

An assessment of significance under the BC Act or EPBC Act was prepared for these species.

These species were identified during the database search as having the potential to occur on site, however none were located during the field survey. ELA notes that these surveys were conducted outside of the recommended survey period; therefore, as a precautionary measure, a pre-clearance survey is recommended prior to the commencement of works in the area, during the suitable detection period for threatened flora to eliminate the chance of these species occurring. Should they occur in the disturbance footprint, a revised Assessment of Significance must be considered prior to works.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works is unlikely to result in a significant impact upon these species, therefore, no SIS and/or EPBC Referral is required at this time.

Threatened Fauna

A total of 44 terrestrial fauna species were identified as having the potential to be impacted by the proposal. This section assesses the impact the proposed construction works may have (removing native vegetation and/or fragmenting habitat).

All the threatened fauna species identified have potential to use habitat on and around Homestead Dam. However, due to the mobile nature of these species and the high homogeneity and comparatively low cumulative area of habitat being impacted, the project is deemed to not significantly impact any of the fauna species observed during the survey period.

All the threatened fauna species identified have potential to use habitat on and around Homestead Dam – especially the riparian areas, the hollow-bearing trees and the fallen large woody logs. Although many of the threatened species likely to use the site are mobile, there will be direct impacts to their habitat. Implementing best practice clearing methods (including pre-clearance surveys – section 5.4.3) as a mitigation measure will enable any individuals within the impact area to move to neighbouring homogenous habitat surrounding the impact area. Retaining woody debris and replacing it after construction is another measure that will be used to minimise impacts on threatened fauna habitat.

Furthermore, pre-clearance surveys suggested within the mitigation measures in Section 5.4.3 prior to the construction works will reduce damage to threatened fauna dwelling within the footprint.

The test of significance and Significant Impact Criteria assessment carried out for each of these species concluded that the proposed disturbances associated with these works is unlikely to result in a significant impact upon these species, therefore, no SIS and/or EPBC Referral is required.

Flora and fauna of Conservation Significance

Under the *Guidelines for preparing a Review of Environmental Factors* (OEH, 2016) the assessment must consider the likelihood an activity will endanger, displace or disturb, or create a barrier to the movement

of species of conservation significance. The construction of Homestead Dam is unlikely to result in any significant effect for species of conservation significance.

Table 5-23: Consideration of species of conservation significance at Homestead Dam

Common name	Species name	Will the activity:		
		Endanger the species?	Displace or disturb the species?	Create a barrier to their movement?
Flora				
Slender spurge	*Synostemon trachyspermus*	No, the species is not known form the disturbance area, and occurs widely locally.	No	No
Amphibians				
Broad-palmed Frog	*Litoria latopalmata*	No	There may be temporary displacement of frogs during construction	Unlikely, fishway will allow for movement whilst outlets pipes are closed
Desert Froglet	*Crinia deserticola*			
Rough Frog	*Cyclorana verrucosa*			
Aves				
Australian Pelican	*Pelecanus conspicillatus*	No	There may be temporary displacement of birds during construction	No, the activity will not create a barrier for birds
Bourke's Parrot	*Neopsephotus bourkii*			
Crested Bellbird (southern)	*Oreoica gutturalis*			
Australasian Darter	*Anhinga novaehollandiae*			
Great Cormorant	*Phalacrocorax carbo*			
Olive-backed Oriole	*Oriolus sagittatus*			
Pied Cormorant	*Phalacrocorax varius*			
Mammalia				
Swamp Wallaby	*Wallabia bicolor*	No	There may be temporary displacement of mammals during construction	No, the activity will not affect mammal's ability to move through the landscape
Reptilia				
Macquarie Turtle	*Emydura macquarii*	No	There may be temporary displacement of this species during construction	Unlikely, fishway will allow for movement whilst regulator gates are closed.

Weeds

African Boxthorn and *Sisymbrium* sp. were identified within the proposed impact area at Homestead Dam. The use of machinery in areas of weeds and inadequate weed management procedures may facilitate the spread of these weeds.

Biosecurity mitigation measures presented in Section 5.4.3 will assist in stopping the spread of weeds.

Inundation regime change

The current inundation regime will be altered by the construction of Homestead Dam to areas both up and down-stream of the construction disturbance footprint. Given the small capacity of the storage, it is likely to exert little impact on the flow regime, as it has been designed to pass inflows up to 900ML/d and higher flows will spill and return to the river via an eastern bywash. This will likely benefit some of the fringing riparian vegetation downstream. The increased volume and area of water within Homestead Dam storage as a result of the proposed activity will provide an overall benefit to the riparian vegetation in the upper reaches of the Dam. While flooding of vegetation that has encroached into the dam bed since the breach may occur, this will likely be a short-term impact and we would expect the vegetation to re-establish quickly following the first filling of the dam. The proposed activities will benefit terrestrial fauna by providing a more permanent water source in a dry landscape. See section 5.4.2.5 for more detail on expected impacts from the change in inundation.

5.4.2.4 Warrego River downstream of Homestead Dam

While no modifications are planned downstream of Homestead Dam as part of Phase 2, there are several potential impacts that should be considered. Increases to the flows into Dicks Dam are anticipated to benefit the fringing vegetation at this location and enhance drought refuge. This will also benefit terrestrial fauna.

With the removal of Peebles dam, it is probable that Warrego River flow into Ross Billabong, east of Peebles Dam, will be reduced. This reduction in flow level, may be counteracted by a potential increase in the extent to which water will back up into this section of the Warrego River during times when the Darling River is in flood. A reduction in flow to Ross Billabong may subsequently impact the fringing Coolibah Open woodland communities that likely rely on water in Ross Billabong when inundated, either directly or through localised groundwater recharge. The extent to which this will impact on these communities is uncertain given the lack of information on the historical watering regime of Ross Billabong during the time Toorale was managed for mixed enterprise agriculture. Given these uncertainties, future monitoring of the condition of these fringing Coolibah woodland communities is recommended. If a reduction in condition is noted, options to restore the connection of Ross Billabong will be investigated.

5.4.2.5 Floodplains and the potential impacts associated with the change in hydrology

A summary of the likely impacts of the proposed activities on the hydrology of the Western Floodplain were presented in Section 5.3.2. This suggests that there is the potential for a reduction in flooding regime, which could impact on the terrestrial ecology of the Western Floodplain.

Floodplain vegetation

The watering requirements of several floodplain vegetation species within the Murray Darling Basin were defined by Roberts and Marston (2011), mainly from work within the southern sections of the Basin. Further work undertaken as part of the MDBA northern basin review, confirmed the applicability of these watering requirements for wetland and floodplain communities within the northern Murray Darling Basin (Cassanova, 2015). While it is acknowledged that these requirements were not specifically generated from studies within Toorale, they are considered to be representative of the communities within the study area. While monitoring of floodplain vegetation communities has been undertaken over the past 5 years through the LTIM project, this has been at a relatively limited number of locations (8 locations) on the floodplain (Commonwealth of Australia, 2019). There has been no comprehensive assessment of vegetation condition on the Western Floodplain. In the absence of detailed information on the broader condition of vegetation, this assessment has been based on modelled inundation regimes under base

case and operating strategy scenarios compared to the watering requirements of different communities from the literature.

Lignum is found on the floodplain within lignum shrublands which are relatively widespread through the floodplain, and in association with Coolibah and River Cooba in the north of the floodplain. To remain in good condition, lignum requires inundation every 1-1.5 years (Table 5-24). For the small watering event 1 (>7 GL) considered in Section 5.3.2, the average frequency of inundation for both the modelled base case (7-7.3 years in 10) and the operating strategy (7 years in 10) should provide sufficient flow frequency to maintain lignum within the central and northern areas of the floodplain in good condition (Table 5-24). The higher flooding frequency in these areas is consistent with the larger, densely clumped nature of the lignum plants in these areas (Figure 5-24; Roberts and Marston 2011). The modelled increase in average duration of these events would continue to provide wetting of sufficient duration to maintain this species. As presented in Section 5.3.2, the magnitude of flow events onto the Western Floodplain may reduce under the proposed operating strategy, which may reduce the extent of flooding for a given flow event. This may impact on the condition of lignum plants on the outer areas of the floodplain where inundation may reduce for a given inflow volume. Lignum found on the southern sections of the floodplain tend to be smaller and sparser in nature, and often appear in relatively poor condition (Figure 5-24). This is characteristic of lignum plants that experience less frequent inundation (Roberts and Marston, 2011). As the duration and frequency of medium and large flood events that inundate these areas are not anticipated to reduce, there would be a low risk of lignum communities in these areas reducing in condition as a result of the proposed activities.

Figure 5-24: Thickly clumped lignum on the northern section of the Western Floodplain (Top) and smaller sparser lignum on the southern section of the Western Floodplain (bottom)

Another important driver of the condition of floodplain vegetation is the duration between watering events. Under the operating strategy, small flow events (>7 - >16 GL) are modelled to occur between 0.9 – 2.1 years on average. These are within the range of the base case scenarios (1 – 2.1 years on average), and would maintain lignum in good to medium condition in areas inundated by these flows (Table 5-24). Recent monitoring for the LTIM project has shown a positive response of lignum to flooding after an extended dry spell of around 2.5 years (Commonwealth of Australia, 2019). This suggests that the lignum communities on the Western Floodplain are resilient to dry periods of this range. Similarly, the average and maximum duration between flooding events for medium to large flow events under the operating strategy is similar to those experienced under the base case scenarios and is consistent with the typically reduced condition of lignum in the southern areas of the floodplain. This would not be considered to change under the changed flow regime provided by the proposed operating strategy.

The watering requirements for the other dominant water dependent species on the floodplain (River Cooba, River Red Gum, Black Box and Coolibah) are less critical than for Lignum. To remain in good condition, River Cooba, River Red Gum and Black Box require inundation for a maximum of once every three years. Coolibah trees are sustained in good condition if they are inundated once every 7-15 years (Table 5-24). These requirements are well within the proposed inundation frequencies, the average

duration between watering events and the longest dry spells of the operating strategy (Table 5-8). Hence, the modified inundation regime is unlikely to have a significant impact on the long-term health of these species.

Table 5-24: Inundation requirements of several major wetland species (Cassanova, 2015)

State (Overton *et al*. 2014)	Inundation requirements (Cassanova, 2015)				
	Lignum	River Cooba	River Red Gum	Black Box	Coolibah
Good	1 in 1–1.5 years, duration from 3 to 5–8, or 6–12 months. > 1 years dry to Medium	1 in 3–5 years, duration of 2–3 months. > 5 years dry to cause decline to Medium	> 5 in 15 years, duration of 2–7 months. 5 years dry to Medium	1 in 3–7 years, duration of 3–6 months (av. 55 days year-1). 5 years dry to Medium.	1 in 7–20 years, duration of 9 days – 2 months
Medium	> 1 in 3 years, duration of 3 months. 6 years dry to Poor	< 1 in 7 years, duration of 2–3 months (insufficient data	1 in 4–5 years, duration of 3 months. 4 years dry to Poor	< 1 in 7 years, duration of 2 months. 5 years dry to Poor.	Unknown
Poor	> 1 in 8 years, duration of 3 months. 4 years dry to Critical.	Unknown	1 in 4–7 years, duration of < 2 months. 4 years dry to Critical.	< 1 in 10 years, duration of 2 months. 5 years dry to Critical.	Unknown
Critical	< 1 in 11 years, duration of 3 months. < 5 years dry to death.	Unknown	< 1 in 10 years. > 1 years dry to Death; time period dependent on cumulative stresses.	< 1 in 15 years. > 1 years dry to death.	> 20 years. Less if no access to groundwater.

Recruitment studies of the above species have determined that inundation can play a role within both seed production and dispersal. Therefore, a reduction in inundation frequency may contribute to a loss in recruitment rates, although it is unclear to what extent the impact will be given that most of these species are also known to respond to climatic conditions (Cassanova, 2015). Monitoring undertaken in the LTIM project did not detect a strong relationship between water availability and the recruitment of Coolibah and River Cooba on the Western Floodplain, with other factors such as resource competition and grazing influencing recruitment success (Commonwealth of Australia 2019). Therefore, there will likely be minimal impact of the proposed activities on the recruitment of key floodplain vegetation species.

In addition to the species mentioned above, there is a range of herbaceous species that respond quickly to inundation when it occurs on the Western Floodplain. Some of the more common species include common nardoo (*Marsilea drummondi*)**,** water couch *(Paspalum distichum*), Warrego Grass (*Paspalidium jubiflorum*) and various spike sedge (*Eleocharis*) and rush (*Juncus*) species. These species tend to form good habitat and feeding grounds for a range of terrestrial and aquatic fauna on the floodplain during inundation. The specific watering requirements of many of these species is uncertain, however, observations during LTIM monitoring suggest that they respond quickly to wetting presumably from a seed bank and maintain on the floodplain for several months following initial inundation. Given many of these species are well adapted to the variable wetting and drying cycles of the floodplain and can persist

during dry times through a drought resistant seed bank (Mackay and James, 2016) there is a low risk that the proposed activities will impact on these species.

In summary, while there may be some reduction to the condition of key species on the outer limits of the floodplain due to a reduction in the magnitude of flows to the floodplain, in general, the watering requirements of the dominant floodplain vegetation species should be met adequately under the proposed operating strategy.

Floodplain Fauna

As discussed above and in Section 5.3.2, modelling suggests that there is likely to be relatively minor impact on the inundation regime of the Western Floodplain and in turn the condition of vegetation that provides the majority of habitat for the fauna on the floodplains of Toorale. While in some cases the extent of individual flooding events may reduce due to a reduction in inflow magnitudes, the proportional reduction to available habitat would be considered minor. The fauna species of Toorale are also well adapted to the 'boom and bust' type environment they inhabit, and species will continue to utilise the floodplains in times of inundation, while the Warrego River and dams will still provide refugia for many species during dry periods.

Threatened and migratory species

Assessments of significance for threatened species under the BC, EPBC and FM Act completed within Appendixes G,H, and I took into consideration the potential impacts to these species and their habitat that may arise from changes to inundation patterns across the floodplains. These assessments concluded that no significant impact is likely to occur due to the proposed works – see the appendices for full detail.

5.4.3 Mitigation measures

Mitigation measures for construction impacts

The proposed development footprints represent a worst-case scenario for impact areas. It is highly likely that not all areas within these footprints will be impacted, and DPIE will work with the successful contractor to minimise impacts within those footprints through a CEMP.

Once the actual impact area has been confirmed, DPIE staff will work with contractors during the mark-up of the site before construction in an effort to minimise disturbance to habitat and vegetation (especially hollow-bearing trees).

The proposed western access route at Booka currently incurs a relatively large impact area. Although not all vegetation within this area will be removed, there may be an opportunity to reduce impacts if alternative access can be obtained through neighbouring properties. This will require further negotiation with landholders before construction.

A CEMP will be developed including a section outlining flora and fauna mitigation measures that include:

- Maintain native vegetation where possible and reduce impact by the following actions:
    - Clearly marking construction zones.
    - Minimise root disturbance or compacting in the drip zone of trees and shrubs.
    - Avoid removal of hollow-bearing trees where possible (as identified during pre-construction mark-up surveys with the contractors).
    - Should mature trees or habitat trees be required to be removed, the trees should be surveyed by a suitably qualified person and any hollows marked for supervised clearing.

  - Should hollow bearing trees need to be removed, nest boxes should be installed adjacent to the impact area at a 1:1 ratio to offset the removal of habitat.
  - Any felled hollow bearing trees will be placed on the outskirts of the impact area to remain as on ground habitat.
  - Large woody debris will be salvaged from the impact area where practical and returned post construction, to aid habitat restoration.

- Where necessary the following biosecurity measures will be applied during completion of works:
  - All machinery and vehicles brought on site will be free of any soil, seed or plant material.
  - Restrict vehicle and personal access from areas of known weed infestation during the proposed works to prevent spread and reinfestation.
  - Control African Boxthorn, Noogoora Burr and any other weed infestations prior to proposed works commencing to prevent the spread of infestations by machinery and in spoil.
  - Evidence of compliance with biosecurity requirements should be documented, e.g. a Vehicle wash down register.
  - Follow up monitoring of work sites post construction to assess the potential establishment of weed species.

Native vegetation will be clearly marked on the Environmental Control Maps (ECMs) to identify approved vegetation removal (disturbance footprint) and then the exclusion areas should be marked up with flagging tape (or equivalent) before construction. Mitigation measures will be communicated to all project staff in a site induction and at toolbox talks.

Mitigation measures for operational changes to the inundation regime

To mitigate any potential impacts to the terrestrial ecology from the proposed activities and changed water regime, monitoring of vegetation communities will continue in line with the current Monitoring, Evaluation and Research program being undertaken by the CEWHCEWH. This includes assessments of vegetation cover, diversity and recruitment within four representative vegetation communities on the floodplain. Additional broader scale monitoring of vegetation condition either through remote sensing or photo points will be investigated to provide a fuller landscape understanding of temporal and spatial trends in vegetation condition over time on the Western Floodplain. Additional sites may be established within the upstream sections of Booka Dam, Homestead Dam and around Ross Billabong to monitor potential changes to vegetation community health, condition and composition in these locations with changes in water availability. If any significant changes to both the diversity and abundance of terrestrial communities are noted, the operating strategy will be revised as required to address these changes.

5.5 Social and Community Impacts

5.5.1 Existing environment

Toorale was purchased and gazetted as a national park and state conservation area to protect its outstanding natural and cultural values for the people of NSW. It offers a variety of visitor experiences focusing on its rivers, floodplains, biodiversity and heritage. Activities such as bushwalking, birdwatching, fishing, picnicking and sightseeing are promoted to the public and the Park offers visitors opportunities to appreciate the spectacular natural environment in a setting that articulates the shared history between Aboriginal and non-Aboriginal peoples (OEH, 2018a).

Since 2012, NPWS has been progressively implementing the Toorale and Gundabooka Nature Tourism Action Plan (NTAP; NPWS, 2012). The NTAP contains a suite of actions to support establishment of visitation and tourism at Toorale. Amongst the initiatives implemented, NPWS has made a significant investment in developing the Homestead Precinct, which was opened to visitors in August 2017.

Park Management and Operations

Prior to the breach in 2012, the embankment across Homestead Dam was one of two points of access for NPWS staff to the western side of the Park when flows in the Warrego River were high. The other point, at Boera Dam, is more difficult to get to and more problematic in wet conditions. Since the breach, NPWS has used the low-level causeway downstream of the breach site to cross the Warrego River but is unable to cross once flows increase. NPWS requires a safe route across the river in high-level flows.

Local Roads and Tracks

Access to the Park is via Toorale Road which joins designated vehicle tracks and walking trails to identified visitor sites. Visitors and NPWS staff access to Toorale is by an unsealed road classified as Rural Local Road 10 (RLR10). Toorale Road is the only public road through the Park and is administered and maintained by Bourke Shire Council. Toorale Road provides the most direct route between Louth and Bourke, as well as being a primary access road for surrounding stations. All other park internal roads and management trails are managed by NPWS, consistent with the Rural Fire Service Bush Fire Coordinating Committee 'category 1 fire management trails'. All trails and roads within the Park are periodically affected by flooding and may become impassable during wet conditions due to the presence of black soils.

The Toorale Road crosses the Warrego River at a location known as Dick's Dam, a concrete causeway that allows traffic to cross the river at low flows. Bourke Shire Council closes Toorale Road when wet weather conditions render it unpassable to traffic and to prevent damage to the road surface. If road closures are not abided by, there is the potential for damage to the road surface to occur, such as incised wheel tracks, and fines are incurred if the road closure is not observed. Toorale Road is also closed to through traffic when flows over the causeway at Dick's Dam reach a certain level (approximately 30cm depth). During periods when the road is closed due to wet weather, the Park is not accessible to the public.

Communities and Water Users

Several properties adjoin Toorale, some of which have benefitted for many decades from management of and access to water from Boera and Booka dams and the western floodplain for livestock and domestic water supply, and pasture production. During the consultation period, local landholders also indicated the importance of water in this dry landscape to them on a spiritual and emotional level, for recreation, as well as an appreciation of the bird and fish life that occurs.

Communities living on the Darling River, downstream of its confluence with the Warrego River, benefit from the water flows contributed by the Warrego catchment area, including those flows supplied by the CEWHCEWH water entitlements. Although the total contribution of flows from the Warrego into the Darling is relatively minor, downstream water users and community groups will benefit from increased availability of water, especially during connecting flow events that occur when water levels are low in the Darling. Downstream landholders and communities are keen to see additional flows delivered to the Darling River, particularly during times of critical human need.

Since 2011 approval has been given to six commercial operators to fish along the Warrego River, accessing Boera, Booka, Homestead, and Dick's Dams. In 2016 additional access was granted to commercially fish Peebles dam, as well as the Darling River and Ross Billabong. At the time of writing, there two commercial fishers are using Toorale, however access has been restricted to Dick's dam and the Darling River. These operations predominately catch yabbies, although in the past carp have been caught. Native fish species are not allowed to be commercially caught.

5.5.2 Potential impacts

Recreation and Tourism

Visitors to the Park may be impacted during construction activities as a result of visual changes (see section below of Visual Impacts), restricted access, noise and safety hazards. These potential impacts are not anticipated to be high due to the low level of visitation to the areas of the park where works will be undertaken. However, the following actions will be implemented to mitigate these risks:

- Works will be undertaken within the identified footprints, much of the construction activities will be screened by surrounding vegetation
- During construction, equipment, materials and temporary facilities, such as site offices and portable toilets, will be stored on-site and temporary facilities, such as site offices and portable toilets, would be stored on-site behind temporary construction fencing.
- Construction areas will be clearly partitioned and visually segregated from public areas where possible.

Park Management and Operations

Access across the Warrego River at the three works sites may be restricted during the construction period. Works will be planned and scheduled so that NPWS has access to areas of the park as required.

The proposed works will improve the ability of NPWS personnel and Park visitors to safely cross the Warrego River and/or to access the structures for maintenance purposes.

The new arrangements will require ongoing maintenance by local NPWS staff, mainly related to keeping fishways clear of debris. This is considered commensurate with the current maintenance liability of the existing gates.

Local NPWS staff must currently manually open and close the gates on the existing pipes to pass flows downstream. The installation of automated gates, combined with the removed need to open and close gates that will be able to be operated remotely will reduce time and resources needed to regulate flows through the dams.

Local Roads and Tracks

There will be a short term, minor increase in heavy vehicle traffic along Toorale Road as the works are being implemented to allow for delivery of construction plant and materials. This equipment is not dissimilar to that used for existing agricultural and routine road maintenance activities within the district. The existing road infrastructure is considered adequate (during normal conditions) to accommodate a minor increase. Construction works and/or deliveries will not be undertaken in the event of rain and/or when the road is closed to avoid damage to the road base.

DPIE will liaise with the owners of Boera and Booka to access works sites at these dams via existing private roads. In these circumstances, DPIE will contact the relevant land holder for concurrence and enter into a formal agreement. Any such access arrangements will ensure there is no nuisance or detriment to the relevant landholder as a result of utilising these alternative points of access, and tracks will be maintained for the life of the works. Alternative routes on-park will be used if these private access routes are not an option.

While no infrastructure changes are proposed at Dicks Dam, the increase in flows down the Warrego River is not likely to change the proportion of time water would flow over the low-level road crossing on the Toorale – Louth road compared to the base case scenarios. Liaison with Bourke Shire Council suggests that the social impact of any change would be low, as there are other access routes to Bourke for residents living beyond the crossing. Impacts from construction related activities, including amenity of each development site, will be temporary for the duration of the works only. Access to the river at these locations will be prohibited to tourists and visitors for a short period of time

The proposed activity is not likely to significantly affect existing community services or infrastructure including access roads, power supply, water supply, storm water drainage or waste management.

Recreational Values

Reinstatement of Homestead Dam will enhance the visitor experience of the Homestead Precinct by returning water to the storage area. The dam represents an important part of the historic and cultural context of the precinct and the basis for its occurrence in this location.

Impacts at Homestead Dam during the construction phase will be short-term and spatially restricted. Temporary signage and barriers will be erected during the construction phase to ensure visitors cannot access the works area. Access across the Warrego at Homestead Dam will only be available via the existing causeway in case of emergencies or essential activities for NPWS staff or others with the agreement of NPWS Bourke Area.

Relatively few Park visitors progress past the Homestead visitor precinct, hence impacts to recreational values at Boera Dam and Booka Dam during the construction phase will be comparatively minor and short term for the duration of works only.

Impacts to Water Users

Planning and design of the Project has had regard to the needs of those people on the Warrego and Darling Rivers that are directly impacted by the impending changes. To pass more water to the Darling River means that less water can be diverted or retained on Toorale. However, the Project has attempted to minimise impacts and maximise benefits to Warrego and Darling River communities by:

- Designing structures and operating arrangements that provide flexibility to respond to prevailing conditions to optimise outcomes for each flow event

- A commitment to provide flows to the Warrego and Darling Rivers equal to or greater than that currently required by existing works approval and licence conditions
- Retaining the existing full supply level at Boera Dam
- Retaining and modifying Booka Dam (as opposed to full removal)
- Retaining regulating capacity to water the Western Floodplain, and to prioritise flows to this part of the park when the Darling River demand is not deemed as high
- Improved environmental flows in the Warrego River and retention of important refugia ensure the fisheries resource is not compromised
- Increasing the discharge capacity at Boera Dam to 1,650ML/d and prioritising flow to the Darling River to help meet critical environmental and human needs during dry times in the Darling River

Impact to Warrego River Water Users adjoining Toorale

The proposed activity will have varying impacts on the capacity and hence permanence of the dams along the Warrego River within Toorale. At Boera Dam, full supply level will remain the same post development. Due to the increased outlet capacity, and more emphasis on passing flows down the Warrego River, modelling indicates that the time Boera Dam is above full supply level (level at which water will flow down the western and eastern bywashes) will reduce (6-9% under base case, 5% under proposed operating strategy). The dam rarely dries out under the base case and new arrangement modelling scenarios

In contrast, at Booka Dam, the lowering of the full supply level with the installation of the fishway will reduce the storage volume of this impoundment significantly, from a full supply volume of 106 ML currently to 27 ML following development. This will have implications for the persistence of this storage, with substantial reductions in the proportion of time the storage will be at the new full supply levels (0.5 m below current 42-73% of days under base case, 14% of days under the proposed operating strategy). The surface area of the storage at full supply level will also reduce (see Figure 5-8). However, as a result of increased flows from Boera Dam relative to the base case, the occurrence of complete drying of Booka Dam is predicted to be similar under the proposed and base case scenarios, with water remaining in the dam for at least 83% of days.

The predicted changes to flows to the Western Floodplain is discussed in Section 5.3, and impacts to pasture productivity can be inferred from this. Modelling suggests that the changes will result in a 6-9% to the average annual flow to the Western Floodplain. However, the impacts on an event-by-event basis are more variable. Time series analysis undertaken for the period of 1973-2016 indicates there may be some impact to the duration and extent of flooding to the floodplain during smaller-moderate events, with those in the northernmost section less likely to be impacted than those further downstream. However, the larger events that penetrate further down the floodplain are less likely to be impacted by the proposed arrangements since inflows are still likely to exceed the capacity of the new regulator to pass, and/or due to the longer duration of larger events.

Impact to downstream Darling River Communities and Landholders

Whilst the Warrego River only contributes a small proportion of total flows in the Darling River, downstream landholders will benefit from the proposed new arrangements, particularly during prolonged dry periods when delivery of all inflows (to the capacity of the Boera regulator) will be passed downstream. Increasing the capacity of the Boera gates to pass up to 1,650ML/d means that a much greater proportion of small-moderate events will be able to be delivered downstream in response to critical environmental and human needs.

Modelling indicates that most flow events will be managed under the “normal” arrangements where (depending on inflows) flows of up to 900ML/d will be delivered to the Darling River for 14 days before

the gates are closed to enable watering of the floodplain. This, combined with the additional contribution to flow made from the use of CEWHCEWH-held Darling River Water Access licence, will contribute to improved water quality outcomes as well as contributing to replenishment of flows that will benefit downstream landholders and communities. Additional inflows to the Darling that occur when the Western Floodplain training embankment breaches and/or the eastern bywash on Boera Dam flows have not been included in the modelling, but will add to achieving downstream objectives.

Details on the modelled changes to average annual flow rates delivered as described in Section 5.3. However, the actual impacts are likely to be more pronounced on an event by event basis. By way of example, an event from 2007 demonstrates how the proposed operating strategy contributes flow from the Warrego River to the Darling River when the Darling River is a priority. In this example, (done for a 1,200ML/d discharge), the event occurs in the Warrego River at Fords Bridge (upstream of Boera), lasting 97 days with a peak of 499 ML/day. In the absence of inflows from the Darling River at Bourke, this arrangement leads to a peak flow of 377 ML/day at Louth around five days later. This event has a total volume of 18.7 GL entering Boera Dam, of which 16.4 GL passes out of Boera Dam down the Warrego River, and 9.0 GL reaches the Darling River. While a relatively small peak flow, this event breaks a 145 day cease to flow period for the Darling River. The flow releases from Boera Dam last 85 days, based on the priority of the Darling River. This is significantly longer than what would be required to meet the existing works approval passing flow condition only.

The proposed structure would have passed the April-June 2019 flow event (which peaked at 1400-1500 ML/d at Fords Bridge) to pass through Boera without inundating the Western Floodplain. “

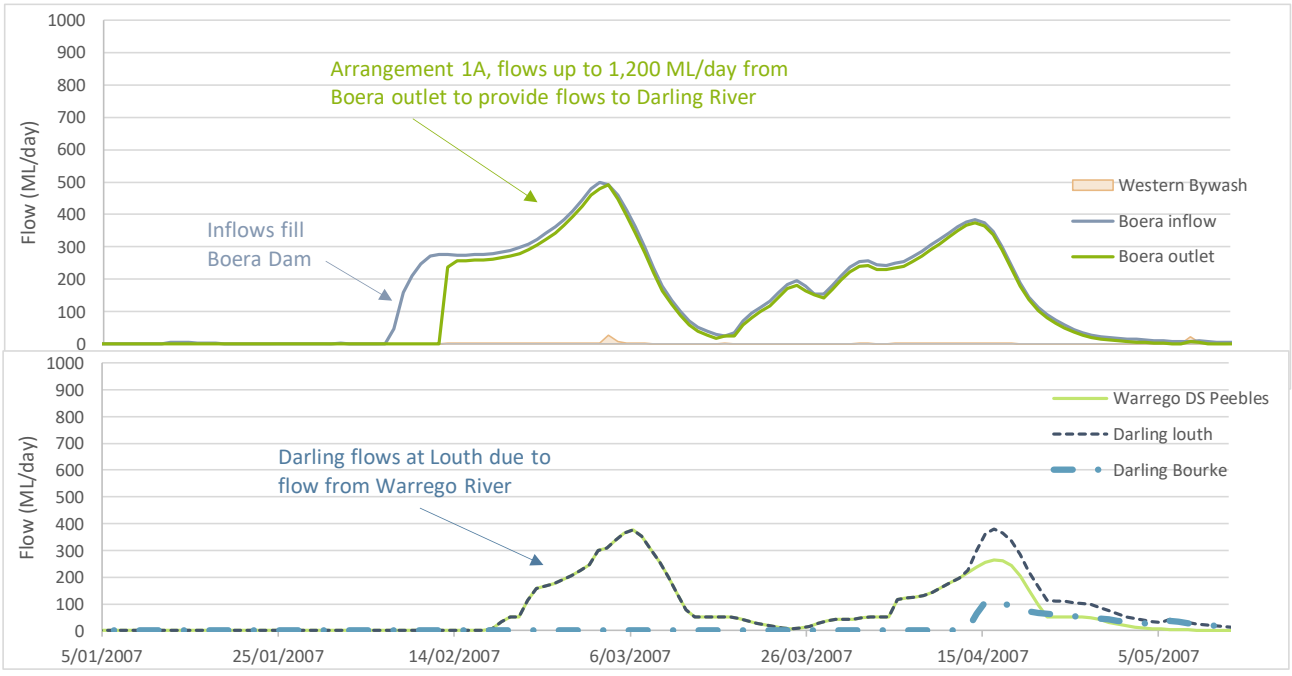


Figure 25: 2007 event managed to pass 1200 ML/d

Safety & Security

Short term construction impacts along Louth Road may occur to the community as the project is being completed. Particular impacts may be certain access restrictions for the public to the construction zone which will be demarcated, and no public will be allowed access for their safety.

Upon reinstatement of the bank and crossing at Homestead Dam, the potential safety risk to visitors will be reduced from the present situation with the breach, and safe vehicle access across the river will be provided for NPWS staff.

The structures, including fishways and bridges will comply with all relevant construction codes and safety standards. All work will be undertaken in accordance with relevant safety standards.

Bushfire Risk

All construction materials for the proposed works are non-combustible. A section 100b referral to RFS is not triggered in this instance as the proposal is not defined as integrated development under the Rural Fires Act 1997. The proposed works would have no impact to bushfire risk within the Park and would not increase occurrence of bushfires or threat to life in an emergency bushfire event.

As per the NSW Planning Portal (NSW Government, 2018), the Bushfire risk at Toorale is listed as medium (Vegetation class 3). The proposed activity will not result in any changes to the bushfire risk rating. The proposed activities do not increase the bushfire risk due to the location of the proposed works and use of existing tracks within Toorale. All works will be undertaken in accordance with the operational guidelines under the *Toorale National Park Fire Management Strategy* which includes provisions pertaining to operation of earthmoving equipment and visitor management.

Bushfire hazard

Potential ignition sources during the construction and operations phases of the proposed works would include:

- Vehicle exhaust systems in dry vegetation;
- The storage of waste and combustible materials onsite;
- Storage of flammable liquids; and
- Lightning strikes

The bush fire hazard associated with the activities listed above is considered highly manageable through equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed in Toorale's Fire Management Strategy. As per NPWS policy, during high fire danger periods the Park will be closed to all visitors, and this closure extends to contractors.

Visual impact or scenic landscape

The proposed structures at all three sites will be visually prominent, particularly relative to current and historic situation. Of the three dams to be modified, Homestead Dam is the only one in the vicinity of an established visitor precinct, and is not an area visited by most who come to the park. Furthermore, the Homestead Precinct contains building, roads and other structures that lessens the aesthetic impact of the proposed works relative to other parts of the park.

The Toorale Joint Management Committee (JMC) indicated concern with the visual impacts of earlier designs proposed, particularly in regard to the rock ramp-style fishways. The designs for Homestead and Booka Dam have been revised over time in an attempt to limit the visual impact of the rock ramp fishway. The proposed "rock-like" ridges for these sites are a compromise design reached that complies with NSW Fisheries fish passage criteria whilst also mitigating their visual impact and the concerns of the JMC.

The proposed activity is likely to cause a net positive impact on the scenic landscape for visitors to Toorale Homestead and the JMC culture camp activities which will benefit from increased water permanence.

The reduced full supply capacity of Booka Dam is likely to be a moderate-high visual impact for neighbours, due to potential frequency to dry sooner and impacts to fringing vegetation. Due to the climate of the area and the ephemeral nature of the Warrego, all three storages periodically dry out under current arrangements, although complete drying of Boera is understood to be infrequent.

Dicks Dam is likely to benefit from increased delivery of flows downstream and so its visual qualities are anticipated to remain the same.

During the construction phase, there will be considerable, but localised, visual impact and impact to the scenic landscape. This is not considered to be significant since these sites are not generally visited by the public. The visual impact is anticipated to "soften" over time as the surrounding earthworks settle and revegetate, and the materials used in the structures age/are coated in sediment.

No advertising signage or interpretive signage or artworks are proposed for the Phase 2 water infrastructure works.

Environmental Issues (Noise, pollution, loss of privacy, glare or overshadowing)

The proposed activity is not likely to cause noise, pollution loss of privacy, glare or overshadowing to members of the community, including adjoining landholders.

Each site is located in a remote environment; hence background noise is low and consists of mostly of natural and rural sounds. Anthropogenic sources of noise are mainly restricted to Homestead Dam due to its proximity to the Toorale Homestead precinct and includes vehicles accessing the precinct and areas west of the Warrego River which are mostly recreational visitors to the Park

The proposed works will generate construction noise and some additional traffic noise. It is anticipated that the noise impact from traffic created by personnel moving to and from site will be short-term and minimal, and in-line with the NSW *Road Noise Policy*. Heavy vehicle movements at the construction site following initial mobilisation will be restricted to the work area and therefore expected to be minimal. With the exception of recreational users, there are no additional residents that may be impacted by construction noise due to the remote location and absence of rural residences in the vicinity of the works.

Dust emissions will likely be generated during the proposed earthworks. There are no rural residents in proximity to the proposed works or sensitive receptors that would be impacted by elevated levels of dust. Dust emission impacts are also not anticipated at the Toorale Homestead precinct, located approximately 1 km east of the proposed works at Homestead Dam.

The extent of environmental impacts pertaining to noise, pollution and visual impact would only occur over isolated incidents during the construction period. The construction works are isolated to remote sites within the Park and as such there will be no adverse impacts in terms of loss of privacy, glare or overshadowing during the operational phase.

5.5.3 Mitigation Measures

Construction Phase

The community will continue to be consulted and kept informed of the progress of the works.

Construction areas, including the compound areas, are to be maintained in a neat and orderly manner to reduce visual impacts as the Park will remain open to visitors. However, access to certain areas will be limited during this time. The Contractor shall be responsible for administering appropriate actions to maintain a clean and tidy work area and ensure all plant and equipment is located within the approved laydown areas.

Project information will be provided on site and other relevant sites (such as the tourist information boards and NPWS website) to briefly explain the need for the works, the expected duration of construction activities and predicted interruptions to visitor access.

Aside from recreational users and environmental receptors, there are no potential sensitive receivers that would be impacted by noise and dust due to the remoteness of the site and large setbacks to surrounding residences. As such, no noise or dust mitigation measures are proposed during the construction phase.

Construction phase impacts, including adverse impacts to visual amenity, noise, air quality and traffic would be managed through the preparation and implementation of a Construction Environmental Management Plan (CEMP) and environmental safeguards. Any adverse impacts arising during the construction phase would be temporary and for the duration of works only. The CEMP for the proposed works would include a detailed schedule of mitigation measures and environmental safeguards, as summarised below: -

- Provide community information regarding potential impacts on amenity and increases in heavy traffic during construction, including potential noise impacts.
- Public access should be excluded from the construction zone, including laydown and stockpile areas.
- Signage to prevent access by non-construction related traffic to the construction zone.
- Signage to indicate construction laydown areas and location of firefighting equipment.
- Grade road and access tracks as necessary once works have ceased.
- Project information will be available to parties that do have access to areas of Toorale to outline the need for the works, potential impacts, changes to access and the expected duration of the proposed works.
- Make project team aware of noise issues and mitigation measures through induction processes and restrict construction works (particularly the use of heavy vehicles and machinery) to approved hours under the Building Code of Australia (7 AM and 6 PM).

Nuisance dust generation from vehicle movements on access tracks will be controlled by the following measures on site:

- All vehicles on-site should be confined to a designated route;
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips;
- Excessive dust to be managed by application of water using a water truck.
- Manage stockpiles as per the ESCP.

Details of compliance with the Parks fire management strategy and State of NSW and OEH Fire *Management Manual* (2017) and associated strategy for emergency response actions in times of fire risk. Protocols to be used in the environmental management plans may include safety protocols such as:

- Basic training of all staff in the use of firefighting equipment onsite
- Firefighting equipment lists will be detailed in the Work Method Statements;
- Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and
- Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors.

De-watering requirements for the dams as well as management of inflows will be specified during detailed design in the CEMP and throughout construction, and will be dependent on the seasonal conditions and water levels in the Warrego at the time. Where possible the proposed construction works will be

scheduled for dry weather periods when water levels in the dam are lowest, this will minimise the requirement for de-watering of the water storage areas prior to construction works commencing.

All sites will be “made good” after works have been completed.

Active revegetation of the disturbance footprints is considered problematic due to the semi-arid nature of the region, and the high susceptibility of the sites to disturbance by fluvial processes. It is anticipated that areas in the disturbance footprint will naturally regenerate following local rainfall and flooding. These sites will be monitored and if natural regeneration fails to re-establish, active intervention will be considered.

Operation Phase

The impacts of modified flow management arrangements will continue to be monitored once the they are implemented. The structures provide for an adaptable approach to flow management which can be adjusted to mitigate unanticipated impacts, pending amended *Water Management Act* approval conditions.

Stakeholders will continue to be consulted in regard to future flow management arrangements. Both the NSW and Commonwealth governments support the establishment of a process by which a range of stakeholder interests can have ongoing input to the management of future flow events in the Warrego. This will be progressed pending Project approval.

DPIE is undertaking additional modelling to refine understanding of different flow management scenarios and this will be considered before finalising flow management arrangements.

5.6 Aboriginal Cultural Heritage

5.6.1 Existing Environment

The area around the junction of the Warrego and Darling rivers is part of Country for the Kurnu-Baakandji Aboriginal People. Toorale has extensive evidence of Aboriginal occupation and activity, including over 500 known Aboriginal sites. These include artefacts, quarries, scarred trees, ovens, middens, stone arrangements, burials, tool manufacturing sites and Aboriginal post-contact sites. Subsurface artefacts recorded during test excavations undertaken during 2018 near Boera Dam have been dated at over 50,000 years old, supporting the long connection of Aboriginal people to the area and its historical significance (Biosis, 2018b).

Many Aboriginal people and families have a strong and ongoing connection to Toorale, having worked on the station for many generations over the past 150 years as stockmen, drovers, shearers, fencers and domestic workers. Toorale therefore represents a unique opportunity for these individuals as well as the broader Kurnu-Baakandji community to maintain connections or reconnect with Country, renew kinship relations, support the teaching of younger generations, and develop and practice traditional customs (more information is included in Martin, 2009). More recently Kurnu-Baakandji individuals have been employed by the Project as field assistants in all the archaeological fieldwork which has occurred at the site in 2017 and 2018.

A Memorandum of Understanding exists between the Toorale JMC and the NPWS to provide advice on the management of the Park. Feedback from the JMC has been used in the planning and design of this Project and is included in the Aboriginal Community Values sub-section of Section 5.6.2.

Aboriginal Community Values and Issues of Concern

The Toorale Joint Management Committee (JMC) has been consulted to discuss heritage values and potential issues throughout planning and design to identify potential impacts to Aboriginal cultural heritage

as a result of the proposed works and what should be considered during the Project and/or incorporated into the final designs. Feedback from the JMC included:

- Input into the design process regarding the fishways, siting of structures, number and width of culverts;
- Impacts to Aboriginal sites & artefacts to be minimised;
- Homestead Dam to be repaired for cultural water storage and access to cultural flows;
- Homestead Dam repair works to be done as a priority;
- Ross Billabong area of high cultural significance and junction of the Darling & Warrego is the location of a dreamtime story;
- Concern over the potential for additional flows to impact on sites;
- Flows to Western Floodplain to be maintained;
- Management of flow regime to achieve cultural objectives;
- Training and employment opportunities to be provided to the local community during the Project.

Previous Assessments

Several Aboriginal and historical archaeological assessments have taken place within the Toorale area. These assessments were largely development driven and therefore concentrated on targeted surface and subsurface investigations. Suzanne R. Hudson Consulting (2009) and Martin (2010, 2012, 2013a, 2013b) have undertaken both large scale and small targeted investigations within Toorale Station. The assessments have identified that the entire Toorale Station site, especially areas associated with the Darling and Warrego River floodplains and sandy lunettes, are significant to the local Aboriginal community.

A desktop and field study were conducted by Biosis in 2017 to determine the likelihood of previously unrecorded Aboriginal archaeological sites or areas of Aboriginal archaeological sensitivity being present within the direct impact footprint for this assessment. A search of the Aboriginal Heritage Information Management System (AHIMS) database for previously registered Aboriginal sites at Toorale identified a total of 791 registered sites. In addition, the archaeological field survey identified twenty previously unregistered Aboriginal sites (Biosis. 2017). Two Aboriginal Cultural Heritage Assessments (ACHA) have been prepared by Biosis (April [Biosis. 2018a] & November 2018 [Biosis. 2018b]) which provide detailed information about the process followed, methodology, consultation, results and recommendations for management. Consultation with the Aboriginal community has been undertaken in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW. 2010).

In additional to the ACHAs, there are two approved Aboriginal Heritage Impact Permits (AHIP) for the potential impact areas of the proposed works. AHIP C0003079 covers the survey, geotechnical investigations and construction works at Boera, Booka, Homestead, Dick's and Peebles Dams. A second AHIP (C004300) covers the modified project works area at Boera, Booka, Homestead and Peebles Dams and includes permission to harm all Aboriginal objects located within the AHIP boundary.

Results of Previous Assessments

Boera Dam

Five Aboriginal sites were recorded (Biosis, 2017) within the boundaries of the Boera Dam study area (Figure 5-26). Three of the sites (Boera 1, Boera 2, and Boera 4) were assessed as having high significance (Biosis, 2017). Boera 1 (AHIMS# 16-3-1719) comprises 101 artefacts within an area of 200 m by 200 m, is in good condition, and represents a common example of a site within the area. Artefacts were noted as eroding from the edges of the sandhill, indicating the site has subsurface archaeological potential. Boera 2 (AHIMS# 16-3-0727) is a potential archaeological deposit (PAD) measuring 50 m by

60 m. There is relatively little disturbance noted and it represents a common site within the area. Boera 4 (AHIMS# 16-3-0726) is a men's ceremonial site, with an associated artefact scatter, hearth, and culturally modified tree in an area of 1 km by 1 km. The site is in excellent condition and represents a less common site type in the area. Biosis (2017) assessed Boera 5 (AHIMS# 48-1-1014) has being of moderate significance, as it comprises of 56 artefacts and four in situ hearths in an area of 600 m by 400 m. It has evidence of some disturbance and is representative of a common site type. Finally, Boera 3 (AHIMS# 16-3-0733) has been assessed as having low significance: it comprises of two artefacts, has evidence of disturbance, and is a common site type within the area. All sites identified within the Boera Dam study area were assessed to have low historical significance in relation to Toorale Homestead (see Biosis, 2017 for more detail).

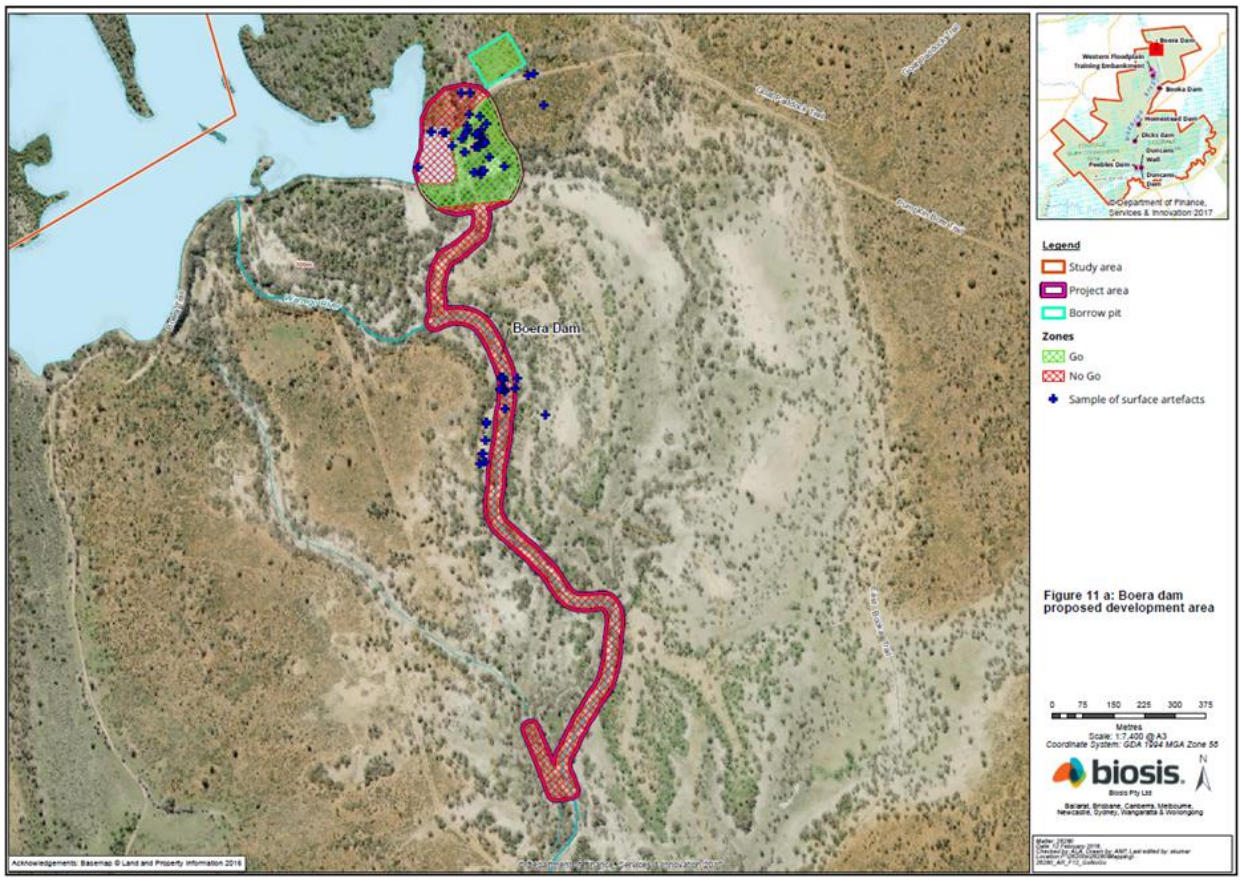


Figure 5-26: Boera Dam AHIP area and recorded AHIMS sites (Biosis, 2018b)

In late 2017, Biosis undertook test excavations at the Boera 1 site which revealed a subsurface deposit of both Aboriginal and historical heritage items. Radiocarbon dating of charcoal samples taken from approximately 750 cm depth returned a date exceeding 50,000 years (Biosis, 2018a). As a result, further assessment to characterise the age of the Boera 1 soil profile has been undertaken and are reported in the Boera Excavation Report (Biosis, 2019)

An additional survey was conducted by Biosis to assess areas that may be impacted by the project but were not examined during the initial study. Two additional sites were identified in proximity to Boera Dam: Boera Dam 1 (AHIMS# 16-3-0763) and Boera Dam 2 (AHIMS# 16-3-0103). Boera Dam 1 on the eastern bank of the Warrego River, approximately 25 metres south of Boera Dam comprises an artefact scatter, a campfire site and two modified trees, one of which also has European axe marks on its opposite surface.

Boera Dam 2 located 350 m east of Boera Dam 1 comprises moderate density chert and silcrete artefact scatter with a number of heat retainer fragments within an area of 118 m by 85 m (Biosis, 2018b).

Booka Dam

Five Aboriginal sites were also recorded within the Booka Dam study area (Figure 5-27). Four of the sites (Booka 1, Booka 3, Booka 4, and Booka 5) were assessed as having high significance (Biosis, 2017). Booka 1 (AHIMS# 16-3-0734) comprises 55 artefacts within an area of 400 m by 100 m, is in good condition, and represents a common site type within the area. It is likely that these artefacts were deposited within the dam through erosional processes; the sand dunes adjacent to Booka Dam have the potential to contain in situ archaeological deposits and are the likely origin of these artefacts. Booka 3 (AHIMS# 16-3-0731) is a culturally modified tree, approximately 10 m in diameter and 30 m high. It has one scar, measuring approximately 80 centimetres high and terminating 1.25 m above the ground surface (Biosis, 2017). It is in good condition and represents a less common site type in the area. Booka 4 (AHIMS# 16-3-0732) consists of 51 artefacts, in an area measuring 170 metres by 80 m, and is in good condition. It has a high scientific potential due to its proximity to Booka 1. Whilst it was not recorded due to its location being outside of the study area, Booka 5 (AHIMS# 16-3-0730) has also been assessed to have high significance: an extensive artefact scatter, hearth features, and its associated landform morphology indicate that in situ subsurface archaeological deposits may be present. Finally, Booka 2 (AHIMS# 16-3-0735) has been assessed as having moderate significance. Whilst it does comprise of 43 artefacts, several hearth stones have likely been deposited at the site through erosional processes. All sites identified within the Booka Dam study area were assessed to have low historical significance regarding Toorale Homestead (Biosis, 2017).

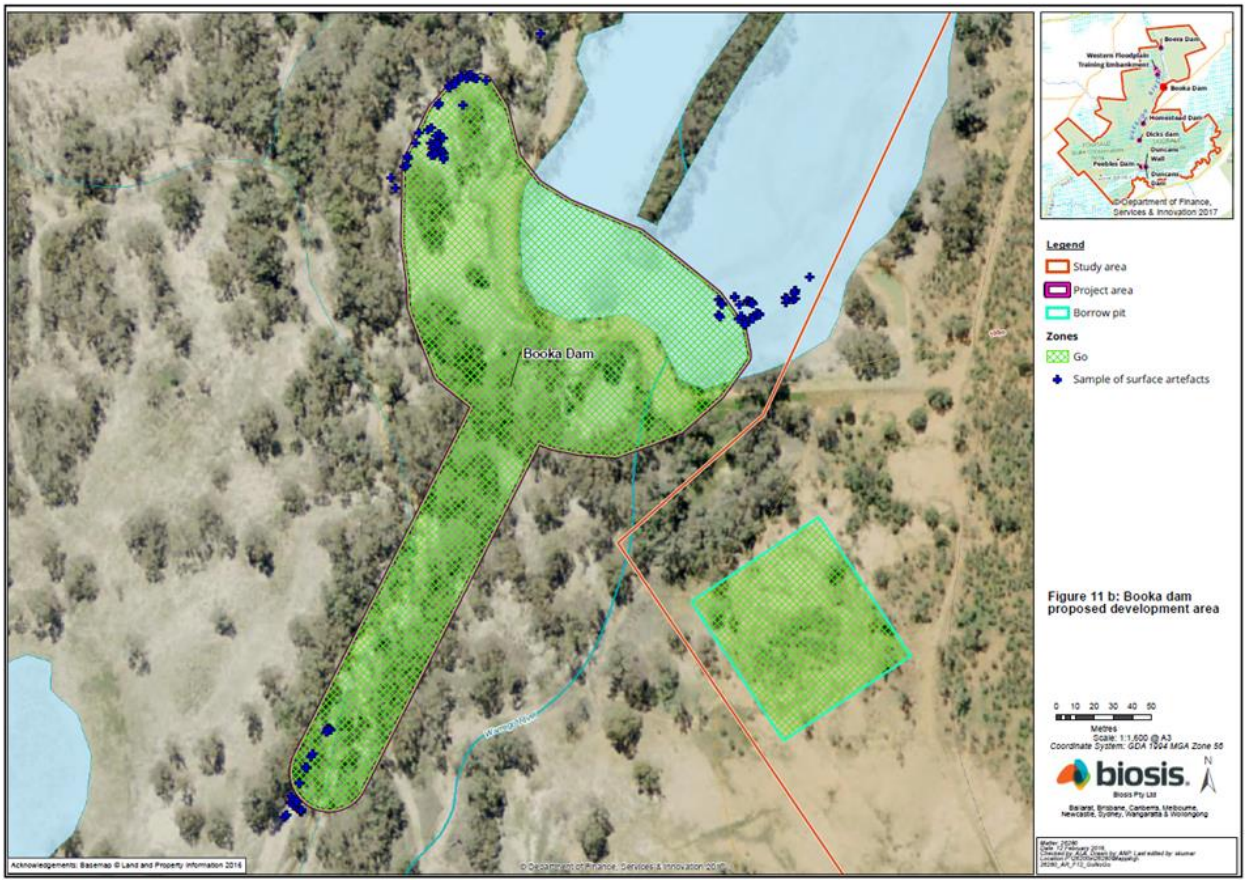


Figure 5-27: Booka Dam AHIP areas and recorded AHIMS sites (Biosis, 2018b)

Homestead Dam

An Aboriginal artefact scatter consisting of 51 artefacts and two hearth features were recorded within the boundaries of the Homestead Dam study area in the south eastern portion of the site (Figure 5-28). The site (Homestead 1 AHIMS# 16-3-0720) measures 450 metres by 250 metres, has evidence of some disturbance and represents a common example of a site within the area. The site has direct historical associations with Toorale Homestead. Biosis has assessed the site as having moderate scientific potential, due to the potential of intact subsurface archaeological deposits. The significance of this site has been assessed as high (Biosis, 2017).

In late 2017, Biosis undertook test excavations at Homestead Dam which revealed a subsurface deposit of both Aboriginal and historical heritage items. Further archaeological test excavations at this site have not been recommended (Biosis, 2018b).

The Homestead Dam precinct has high significance to the Kurnu-Baakandji people, represented by the Toorale JMC. Throughout consultation undertaken for this project, the JMC has consistently emphasised their wish to have the dam wall repaired at Homestead Dam so that they can continue cultural practices, including a future aspiration to access and store cultural water there. The JMC also wishes to see access across the river during flow reinstated at this site, for both Aboriginal people and for the NPWS personnel managing the Park.

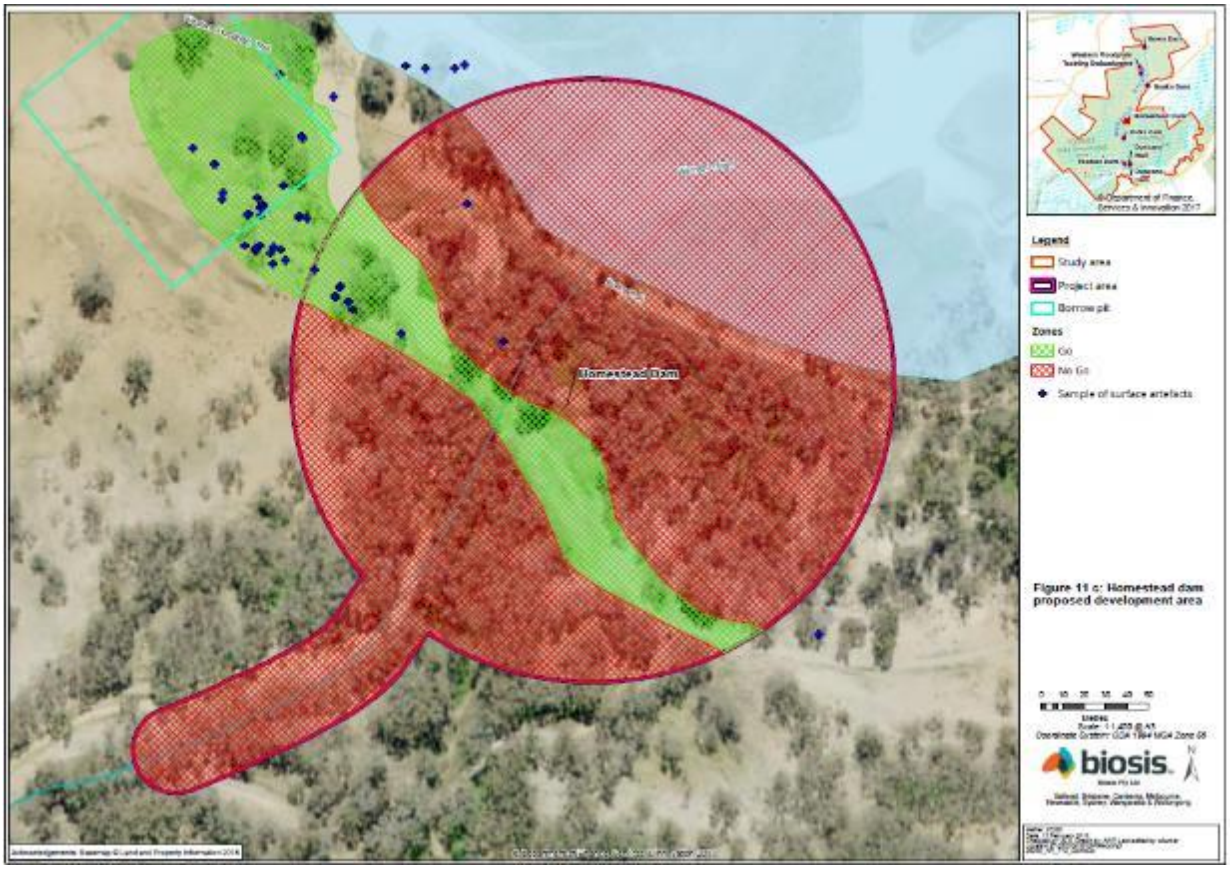


Figure 5-28: Homestead Dam heritage assessment and artefacts found (Biosis, 2018b)

5.6.2 Potential Impacts

The proposed activity will result in varying levels of impact to the soil profiles within the study area and may impact upon the following elements:

- Disturbance of bank within the Warrego River;
- Disturbance to embankments of Boera and Booka Dams to install fishways;
- Direct impact on Boera 1, Boera 5, Booka 1, Booka 2, Booka 3, and Booka 4 sites;
- Direct impact on Boera Dam 1, Boera Dam 2, and Booka Hearth 1 sites;
- Indirect ground disturbance for machinery access;
- Indirect impacts on artefact scatters surrounding Boera and Homestead Dams; and
- Indirect impact on culturally modified tree near Homestead Dam.

Boera Dam

The previously recorded Aboriginal heritage sites Boera 1 (AHIMS# 16-3-0719), Boera 4 (AHIMS# 16-3-0726), and Boera 5 (AHIMS# 48-1-1014) are located within the study area and will be impacted by the proposed works (Biosis 2017). The significance of these sites has been assessed as high (Boera 1 and Boera 4) and moderate (Boera 5). Biosis (2018a) has assessed that the impacts from geotechnical and construction works will result in direct harm and total loss of value for Boera 1, and cumulative harm and partial loss of value for Boera 5. However, it is recognised that both sites represent a common example of sites within the area and in cases where conservation is not practical, options for management such as salvage and community collection are considered as mitigative measures. Boera 4 has been assessed as likely being indirectly impacted by the reinstatement of water flows at the lower end of the site, resulting in partial loss of value. Where conservation is not practical, options for management such as salvage and community collection are considered as mitigative measures. Boera 2 (AHIMS# 16-3-0727) and Boera 3 (AHIMS# 16-3-0733) will not be impacted by the proposed works. Boera Dam 1 has been assessed as having high significance and is likely to be partially damaged by geotechnical and construction works (Biosis, 2018a). Boera Dam 2 has been assessed as having moderate significance and is also likely to be partially damaged by geotechnical and construction works (Biosis, 2018a).

As a result of AHIP C0003079, a partial surface collection of visible artefacts from Boera 1, Boera 4, and Boera 5 in the Boera Dam study area in areas that would potentially be impacted by geotechnical and construction works has been permitted. -

Approved AHIP C004300 covers the project works area and includes permission to harm all Aboriginal objects located within the AHIP boundary (Figure 5-26).

Booka Dam

Booka 1 (AHIMS# 16-3-0734), Booka 2 (AHIMS# 16-3-0735), and Booka 4 (AHIMS# 16-3-0732) are located within the study area and will be impacted by the proposed works. Biosis (2018a) has assessed that the impacts from geotechnical and construction works will result in partial loss of value for Booka 1 and total loss of value for Booka 2 and Booka 4. However, it is recognised that both sites represent a common example of sites within the area and in cases where conservation is not practical, options for management such as salvage and community collection are considered as mitigative measures. If Booka 3 (AHIMS# 16-3-0731) is impacted by the proposed works, it will result in total loss of value. However, Biosis (2017) have indicated that this can be avoided. Booka 5 (AHIMS# 16-3-0730) will not be impacted by the proposed works. The Booka 1 Dam site has been assessed as having high significance and is likely to be partially damaged by geotechnical and construction works (Biosis, 2018a).

As a result of AHIP C0003079, partial surface collection of visible artefacts from Booka 1, Booka 2, and Booka 4 in areas that would potentially be impacted by geotechnical and construction works has been permitted. Salvage of the Booka 3 culturally modified tree has also been permitted.

Approved AHIP C004300 covers the project works area and includes permission to harm all Aboriginal objects located within the AHIP boundary (Figure 5-27).

Homestead Dam

The previously recorded Aboriginal site (Homestead 1, AHIMS # 16-3-0720) is located within the study area and will be impacted by the proposed works. The significance of this site has been assessed as high. Biosis (2018a) has assessed that the impacts from geotechnical and construction works will result in direct and partial harm and partial loss of value. However, it is recognised that the site represents a common example of sites within the area and in cases where conservation is not practical, options for management such as salvage and community collection are considered as mitigative measures.

As a result of AHIP C0003079, a surface collection of visible archaeological artefacts has been conducted within the Homestead Dam study area in areas that would potentially be impacted by geotechnical investigations. The collection was undertaken with a representative of the Toorale JMC.

Approved AHIP C004300 covers the project works area and includes permission to harm all Aboriginal objects located within the AHIP boundary (Figure 5-28).

5.6.3 Mitigation Measures

The proposed designs have incorporated the following mitigation measures in response to JMC input:

- Tailored design and colour of rock-like ridges in Homestead and Booka fishways to mimic natural rock appearance
- Homestead Dam to be reinstated as a storage
- Flows to the Western Floodplain to be maintained
- Boera structures sited having regard to JMC wishes and to reduce impact to sites of high significance
- Access across Homestead Dam reinstated
- Kurnu-Baarkindji employed during surveys, site salvage and site monitoring activities

ACEMP will be developed and include a section outlining archeologically sensitive areas. The CEMP will detail mitigation measures for Aboriginal cultural heritage impacts including the following:

- Carry out the project in accordance with the conditions under the AHIPs (AHIP number C0003079, permit ID 4175 and AHIP number C0004300, permit ID 4369). Any residual discrepancy between impact areas and AHIP areas shall be subject to a further AHIP application, if required, prior to commencement of construction activities.

- Create clear maps of the site with areas in/out of the construction footprint to aid inductions and daily construction activities as well as highlighting ‘no go’ areas. Archeologically sensitive areas, boundaries of AHIP area and AHIMS sites are also to be marked on ECMs.

- Mark up the site before construction, to highlight ‘no go’ areas – make these areas very clear in the field.

    - Avoid impact to modified trees by fencing off to prevent any unintentional impacts.

    - Avoid impact to archaeological sites not covered by the AHIP by fencing off to prevent any unintentional impacts.

  - Laydown areas or site office areas must be kept within the area covered by the AHIP.
  - Vehicles to keep to existing tracks outside of areas covered by AHIP.

- Heritage inductions are to be undertaken for all site workers and contractors in order to prevent any unintentional harm to Aboriginal sites located within the study area and its surrounds. Induction to address elements related to relevant legislation, AHIP conditions, location of identified heritage sites, basic identification skills for Aboriginal and non-Aboriginal artefacts and human remains, penalties and non-compliance.
  - Brief project team on unexpected finds and discovery of human remains process at induction.
  - Point out sensitive sites and any AHIMS sites in the work area for that day in pre-start briefing 'tool box talks' before works commence each day
- Ongoing Aboriginal consultation with members from the JMC. A Kurnu-Baakandji community member to act as a cultural officer on site for site monitoring when works are being undertaken.
- If impacts on AHIMS Sites and areas of archaeological sensitivity cannot be avoided outside areas covered by an AHIP, a new AHIP will be required.
- Stop work if any potential heritage sites or human remains have been identified during construction. Aboriginal objects are protected under the NPW Act regardless if they are registered on AHIMS or not. If suspected Aboriginal objects, such as stone artefacts or scarred trees are located during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, DPIE must be notified under section 89A of the NPW Act. Appropriate management and avoidance or an approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed.
  - In the event that human remains are found, works will immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, DPIE may also be contacted at this time to assist in determining appropriate management.
  - In consultation with JMC, collect surface artefacts, store in keeping place, put back in same location once works complete. Pending approval of the works, the remaining Aboriginal sites in the impact footprint will be subject to archaeological salvage to be catalogued and analysed to contribute to knowledge of Aboriginal archaeological site type and distribution through the Bourke region.
- Complete any remaining conditions outlined in AHIP and submit to DPIE a report about harm to Aboriginal Objects at the completion of works under the AHIP. Complete Aboriginal site impact recording forms following completion of works

5.7 Historic Heritage

5.7.1 Existing environment

Toorale National Park and State Conservation Area has important Aboriginal and non-Aboriginal historical values and is home to several heritage precincts. NSW National Parks and Wildlife Service (NPWS) has implemented a repair and conservation project to protect this property and its farming history for future generations.

Toorale is considered an icon of Australian pastoral heritage. At its peak in the late 19th century, it was a significant part of the largest sheep station in the world, where up to 265,000 sheep were shorn in its 46-stand shearing shed. Historically, Toorale has made a significant contribution at a local, State and Federal-level as a large pastoral enterprise. The property has changed hands several times since being first leased in 1857 by W. B. Tooth. In particular, Toorale Station is associated with two of the most significant Australian wool barons, Sir Samuel Wilson and Sir Samuel McCaughey.

Toorale played a role in the stories that shaped the national mythologies of that era. Henry Lawson's brief stint at Toorale in 1892 was inspirational to his subsequent poetry. Toorale is also associated with the 1890s battles between shearers and pastoralists along the Darling River, the rise of unionism and the birth of the Labor Party in Australia. Combined with its continuous pastoral use, Toorale exemplifies the history of land settlement and pastoralism in New South Wales that has defined much of Australia's cultural identity.

Toorale also embodies evolving environmental perspectives towards the environment, and the relational history between Aboriginal and non-Aboriginal people that has underpinned the pastoral industry (Polychrest, 2013).

The historic buildings at Toorale, in particular the Old Toorale Woolshed (built around 1873–74) and Toorale Homestead (built around 1896), are considered 'iconic monuments to the pastoral history of the nation' as they represent 'the biggest and the best of the far western region's surviving historic pastoral buildings with the most significant technology and history attached' (Jill Sheppard Heritage Consultants, 2013).

Toorale is largely a landscape of absence, as much of the very old historic fabric was ephemeral or was removed by the corporate owners after 1969 (OEH, 2018a). The current Conservation Management Plan (CMP) for Toorale (Jill Sheppard Heritage Consultants, 2013) concludes that there are four precincts considered to possess very significant historic fabric, these are:

- The Toorale Homestead Precinct;
- The Old Toorale Woolshed Precinct;
- The Boera Precinct (i.e. the Boera Dam and Floodwaters Scheme); and
- The Nissen & Quonset Huts Shearing Sheds Precinct.

The CMP states that each of these precincts meet the criteria for State Heritage listing. However, the precincts and property as a whole are not the subject of an interim heritage order, nor has it been added to the State Heritage Register in accordance with the *Heritage Act 1977*.

The infrastructure used to harvest and divert water from the Warrego River includes embankments constructed across the river and its floodplain to capture and divert flow. These embankments (dams) were progressively installed from the 1880s and have been the subject of numerous modifications, failures, rebuilds and upgrades over time. The historical construction and operation of these embankments has resulted in the establishment of water bodies and floodplain wetlands with important ecological, cultural and social values. Boera was the first dam constructed. Additional dams followed

expanding the Boera Dam in to the Boera Dam and Floodwaters Scheme. The CMP includes both Booka and Homestead Dams as part of the Boera Dam and Floodwaters Scheme. They are small components of a much larger water management scheme and the Dams are not individually identified as heritage items.

Boera Dam

The construction of the Boera Dam and Floodwaters Scheme by Sir Samuel McCaughey in c.1882 is one of the largest 19th century civil engineering and water management constructions known to have been undertaken by a private individual in remote New South Wales (Jill Sheppard Heritage Consultants, 2013). The placement of the earthen Boera Dam at a natural narrowing of the Warrego River and the installation of a series of dam walls across the River channel enabled for the capture and subsequent dispersal of water across the lower Warrego floodplain (Jill Sheppard Heritage Consultants, 2013). As a result of the extensive and sustained flooding, the western floodplain has developed into a wetland ecosystem encompassing nearly 30,000 ha.

A search of the Bourke Shire LEP, State Heritage Register, the National Parks Historic Heritage Information Management System (HHIMS) and Australian Heritage Database did not reveal any heritage listings within the Boera Dam Development Footprint or within a 10 km radius.

Boera Dam is the only dam included in the Toorale Historic Heritage Inventory (Polychrest, 2013).

Booka Dam

Booka Dam is approximately 12 km downstream from Boera Dam. It was constructed c.1880, presumably as part of the improvement works occurring to the Boera Dam and Floodwaters Scheme. Although it was flooded and partially destroyed during the construction process, Booka Dam was successfully repaired and became a valuable addition to the Boera Dam and Floodwaters Scheme (Jill Sheppard Heritage Consultants, 2013).

A search of the Bourke Shire LEP, State Heritage Register, the National Parks Historic Heritage Information Management System and Australian Heritage Database did not reveal any heritage listings within the Booka Dam Development Footprint or within a 10 km radius.

Homestead Dam

Homestead Dam is a 540 m long embankment 30 km downstream from Boera Dam. Homestead Dam was constructed in the 1870s to provide water for domestic purposes and amenity following the construction of the Homestead property (Jill Sheppard Heritage Consultants, 2013). Flooding as early as 1880 carried away portions of the dam infrastructure, which was replaced by July 1880 (Polychrest, 2013). The Dam was breached during flooding in 2010 and has not been repaired.

A search of the Bourke Shire LEP, State Heritage Register, the Historic Heritage Information Management System for National Parks (HHIMS) and Australian Heritage Database revealed two heritage listings located within the Homestead Dam development footprint, which are also the only listings within 10 km (Figure 5-29):

- Old Toorale Homestead and Outbuildings, Toorale Station via Bourke, NSW, Australia is listed on Schedule 5 of the Bourke LEP (Item 28) and is 1 km to the west of the Homestead.
- Toorale is listed on NPWS Historic Heritage Inventory and covers Built Heritage, Archaeological Resources and Landscape.

Heritage values associated with Toorale Homestead are described under the ‘Significance’ sub-heading below.

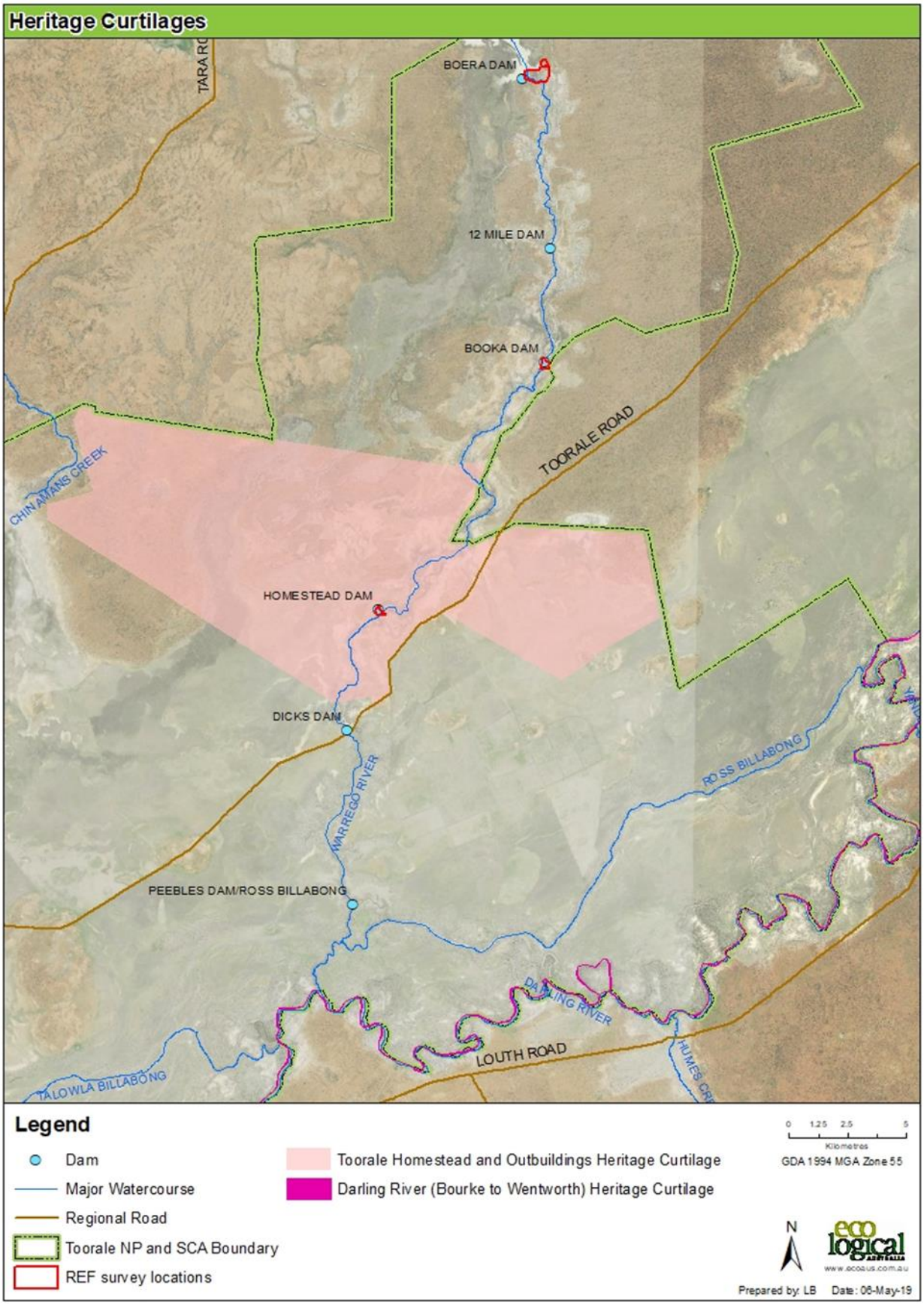


Figure 5-29: Historic heritage listings in the vicinity of the proposed works.

Relationship of the historic precincts to the Proposed Works

The CMP (Jill Sheppard Heritage Consultants, 2013) includes Boera, Booka and Homestead Dams as part of the Boera Dam Floodwaters Scheme. They are components of a much larger water management scheme. The Dams and water management in general across the entire Toorale property has constantly evolved and has been modified through time to adapt to new technologies, uses and farming practices. Homestead Dam is located within the Toorale Homestead and Outbuildings heritage curtilage. The Homestead is located over 1 km from the Homestead Dam repair works footprint.

Site survey

Detailed pedestrian survey of all dams and the Toorale Homestead and its surrounds was undertaken over three days (28-30 May 2018) by a qualified and experienced ELA Archaeologist and heritage consultant. The dam structures and associated water management infrastructure at Boera, Booka and Homestead Dams have been photographed in detail.

The historic heritage site survey undertaken by ELA did not identify any historically significant features or fabric associated with the sections of Boera and Booka Dams that will be modified, or the section of Homestead Dam that will be repaired.

Significance

The State Heritage Inventory statement of significance and a physical description of the locally listed Toorale Homestead and Outbuildings is provided below.

Statement of Significance:

"The homestead of 'Toorale' represents well the prosperity and challenge of remote rural 'Australian pastoral settlers. The National Trust on their visit of August 1986 stated: 'Toorale' is a remarkable example of a large western homestead of unpretentious appearance yet with an interior of surprisingly sophisticated details. The house is remarkable too for its size, and spacious atrium, the scale and variety of outbuildings, the extensive collection of rural equipment within its curtilage, that make the complex of outstanding significance"

Physical Description:

'Toorale' homestead is both magnificent and unusual. Built primarily of 'lath and plaster' walls internally and ripple iron cladding externally, it contained 27 large rooms. A formal section of the house for the owners at the south is connected directly to a generous central hall 18m x 6m (atrium) with all the service rooms arranged around it containing stores, kitchens, servant's accommodation and wash rooms. The 4m high hall is lit by coloured glass roof lights, and a generous verandah surrounds the whole homestead flanked by enormous Phoenix palm trees, creating an 'oasis' setting.

Once beautifully finished internally, today only remnants of the elaborate wall papers (dating from the late 19th and early 20th C) remain, but most of the delicately patterned Wunderlich ceilings are still intact, and the broad panelled solid timber doors, with fanlights and side lights reflected the wealth and prosperity of the good wool seasons before the drought of 1895. Toorale's single storey building features a large gabled section roof behind, a smaller hipped section. The roof is of corrugated iron, and there are original ogee gutters and timber eaves. Verandahs on all sides of the building have been partially enclosed. The front door is a large four-panel door with bolection mouldings, semicircular Georgian fan and sidelights. There were several very ornate marble fireplaces, including one exceptional one in coloured marble; one of the fireplaces was removed to the Royal Hotel (now The Port of Bourke) in Bourke. Ceilings in the house are very high (3 metres or more). The long hallway leading from the front door to the atrium features a square fanlight and coloured sidelights, while there are fine plaster motifs on the arch above the door. From the atrium, three panels of coloured glass and corresponding roof lights are visible. Roof timbers are of heavy sawn timber construction. In the structure there is some termite damage. The remains of the laundry are located in the northeast corner of the house and include copper troughs. The small cellar is entered by stairs off the northern verandah. Outside the main house the old garden is still defined by concrete edgings, a galvanised pipe rose frame to the west and south of the building and some original, old fashioned roses. To the north of the house is a meat house on stumps and with a hipped and gabled corrugated iron roof. The sides are gauzed and the original mechanism for hanging meat remains. there is also a small store. and complex contains numerous other outbuildings.

(https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=1220008)

The CMP (Jill Sheppard Heritage Consultants, 2013) states that the Toorale Homestead and the associated McCaughey era outbuildings complex meet the criteria for listing on the State Heritage Register, but currently it remains a locally listed item.

Regarding the dams, the Boera Dam & Floodwaters Scheme is recognised in the CMP (Jill Sheppard Heritage Consultants, 2013) as meeting the criteria for listing on the State Heritage Register for its historical, social, research and particularly technological values. The CMP includes the following observations:

> *'The success of McCaughey's c.1882 Boera Dam and Floodwaters Scheme at Toorale in particular is thought to have underpinned the then Governments decision to go ahead with the Burrunjuck Reservoir and the Northern Murrumbigee Canal Scheme in 1907.'*
>
> *'The construction of the Boera Dam and Floodwaters Scheme c.1882 by Samuel McCaughey is one of the most massive nineteenth century civil engineering and water management constructions known to be undertaken by a private individual on a remote property in New South Wales.'*
>
> *'The modified flow regimes associated with the Boera Dam have resulted in a tenfold increase in flood frequency across the Western Floodplain and the creation of a diverse wetland, which is an important breeding habitat for colonial water birds. Those wetlands have important research potential.'*

The CMP (Jill Sheppard Heritage Consultants, 2013) concludes that all the dams and water management at Toorale contribute to the potential State significance of the whole site as they constitute a significant technological achievement for the time. No dams are identified as individually significant. However, the CMP also states that the most significant phase of construction for the earthworks, which form the dams and divert water into the Western Floodplain, occurred when Samuel McCaughey took over in 1880. Homestead Dam was constructed prior to this time for specific purposes not associated with floodplain watering.

Homestead Dam is included in the listed Homestead and Outbuildings' heritage curtilage and in the CMP (Jill Sheppard Heritage Consultants, 2013), it is associated with the heritage significance of the standing Homestead site. The Dam was constructed for domestic use and is not noted in the CMP as a significant item on its own right, nor is it discussed as part of Toorale's heritage listing. The heritage curtilage of the Toorale Homestead and Outbuildings listing extends across much of Toorale National Park and the State Conservation Area and is not confined to the homestead and its immediate surroundings (Figure 5-29).

All of the dams associated with Toorale have a long history of construction and modification (Jill Sheppard Heritage Consultants 2013) and it appears they have regularly required repair since they were constructed. The CMP (Jill Sheppard Heritage Consultants, 2013) states that nature of construction involving logs covered by earth means that the structures are vulnerable to breaching during flood events. There have been breaches in recent times, including Homestead and Peebles Dams. Infrastructure associated with the dams includes overflow pipes, flow regulators such as ratchet and gate as well as boardwalk and wheel.

Due to continuous alteration over the years and documentation of dam construction, dams have little historical archaeological research potential and therefore have little or only local historical archaeological significance. NPWS has invested significant amount of money to conserve and repair the historic heritage in this precinct and the proposed works would enhance that investment. The Heritage Inventory sheet for Boera Dam states no historical archaeological oversight is required.

5.7.2 Potential impacts

The proposal comprises modification of the existing flow management infrastructure on Toorale to enable more effective management of water. Environmental assessment of Phase 2 – Modification works at Boera, Booka and Homestead Dams is required before further stages of the project can progress. The works at all three Dams include embankment modifications to allow for additional infrastructure.

Potential impacts are assessed in the Statement of Historic Impact (SoHI - Appendix K) and summarised below.

Boera Dam

The proposed works are to modify the existing water infrastructure to increase the capacity of water delivered to Warrego River in circumstances that require maximum delivery of flows to the Darling River. These works will involve modification to the embankment at the main Warrego River site of Boera Dam, the installation of lay flat gates, regulator gates to provide controlled discharge, and a bridge to provide access across the structure. The existing pipes will be removed during the works. A vertical slot fishway will also be installed to allow fish passage independent of the regulator gates.

- The existing full supply of Boera Dam will be retained, thereby continuing to support the wetlands ecosystem that has been created;
- Allowing Warrego River flows to pass through to the Darling River (when required) is a positive ecological outcome; and
- There will be limited archaeological impact as the embankment has little archaeological significance.
- The existing pipes will be removed during the works, however, as they were installed in the latter half of the 20th century, they have limited heritage value.
- If additional materials are required for management of the banks, it can be sourced from the remaining spoil from Peebles Dam or local materials.
- Existing roads and tracks will be used for access.
- All works and stored materials will be located within areas covered by an AHIP.
- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

Booka Dam

The proposed works are to lower the spillway elevation approximately 500 mm and install a rock ramp fishway into the lowered embankment.

- There will be no archaeological impact as the embankments have little archaeological research potential and therefore little archaeological significance.
- The existing pipes will be retained for maintenance purposes (if required), but not used.
- If additional materials are required for management of the banks, it can be sourced from the remaining spoil from Peebles Dam or local materials.
- Existing roads and tracks will be used for access.
- All works and stored materials will be located within areas covered by an AHIP.
- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

Homestead Dam

The proposed works are to repair the previously breached dam wall consistent with the existing works approval and to reinstate Homestead Dam to a state that is consistent with its recognised heritage values. Material from Peebles Dam may be used to fill the breach at Homestead Dam. The spillway elevation

will be lowered approximately 1 m from pre-breach condition and a culvert or bridge will be installed at the spillway to allow for safe vehicle access. A rock ramp fishway will be installed to allow fish passage.

- There are no potential direct impacts to heritage values associated with Toorale Homestead Precinct posed by the proposed reinstatement of Homestead Dam.
- Establishment of 98.5 m AHD water levels in Homestead Dam will enhance the significance of the Homestead precinct by reinstating the storage capacity of the dam for high volume events and thereby retaining a reasonably constant water level. Re-establishment of existing historic water management infrastructure is a positive heritage outcome for the historic Toorale Homestead setting and the local ecosystem.
- There will be no archaeological impact as the embankments have little archaeological research potential and therefore little archaeological significance.
- Local materials will be added to fill the breach.
- The existing pipes will be retained for maintenance purposes (if required) but will not be used.
- The works area is 1 km to the west of the Homestead.
- Existing roads and tracks will be used for access.
- All works and stored materials will be located within areas covered by an AHIP.
- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

Legislative compliance

For the historic heritage of Toorale, NPWS's statutory responsibilities for cultural heritage come under the following legislation:

- Heritage Act for historical archaeological sites and items listed on the State Heritage Register;
- NP&W Act (excluding pre-contact Aboriginal cultural heritage);
- EP&A Act for locally listed items under Part 5 of the Act;
- Bourke LEP 2012;
- Bourke DCP 2012; and
- State Environmental Planning Policy (Infrastructure) 2007.

The proposed works are addressed in relation to the requirements and the relevant clauses and controls of the above legislation, if relevant, the *NPWS Guidelines for historic heritage approvals* (2016) and the management policy contained in the CMP.

Heritage Act 1977

Toorale and its dams are not listed on the State Heritage Register. Archaeological relics are unlikely to be present within the dam embankments and therefore an excavation permit under s140 of the *Heritage Act* is not required.

The NPWS Guidelines for historic heritage approvals (2016)

The NPWS Guidelines state that for places on reserved lands that are of state significance but have not yet been added to the State Heritage Register;

i. No application is required to the Heritage Council of NSW unless a project involves excavation.
ii. Written notification is required to the Heritage Council of NSW for demolition.
iii. An Aboriginal Heritage Impact Permit (AHIP) may also be required if work has the potential to harm an Aboriginal object or place.

The proposed works for Boera, Booka and Homestead Dams have been assessed under Part 5 of the EP&A Act. This Part applies for infrastructure projects approved by the local Council or a State agency undertaking the project. No excavation permit is required from the Heritage Council.

Development consent from Council is not required, however for a locally listed heritage item, written notice to the Local Council is required to carry out a development, including demolition, with consideration of any response received within 21 days. To comply with this, DPIE shall provide a copy of the REF and any specific CMP, heritage assessment or impact assessment to the Bourke Shire Council. Consultation with the local community and local stakeholders is also recommended.

Infrastructure SEPP 2007

The ISEPP states that certain categories of development which are of no more than minimal environmental impact are 'exempt development'. There will be positive and negative impacts. This project will result in minimal heritage impact and a positive environmental effect. The activity is permitted without Development Consent from Council, however written notice to the Local Council is required under Clause 14 of the ISEPP, to carry out demolition affecting a locally listed heritage item with consideration of any response within 21 days.

Bourke LEP 2012

The objectives of Heritage conservation in the Bourke LEP 2012 are to conserve the environmental heritage of Bourke including the fabric, settings, views and heritage significance of heritage items and heritage conservation areas, archaeological sites, Aboriginal objects and Aboriginal places of heritage significance (Table 5-25).

Table 5-25: Relevant Bourke LEP 2012 Clauses

Clause	Discussion
2) **Requirement for consent** Development consent is required for any of the following: (a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance): (i) a heritage item, (ii) an Aboriginal object, (iii) a building, work, relic or tree within a heritage conservation area, (b) altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item, (c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed, (d) disturbing or excavating an Aboriginal place of heritage significance, (e) erecting a building on land: (i) on which a heritage item is located or that is within a heritage conservation area, or (ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance,	The Homestead Dam Development Footprint is located within the curtilage of a listed local heritage item. Pursuant to clause 127(m) of the ISEPP, the activity is permitted without Development Consent.

Clause	Discussion
(f) subdividing land: (i) on which a heritage item is located or that is within a heritage conservation area, or (ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.	
(5) **Heritage assessment** The consent authority may, before granting consent to any development: (a) on land on which a heritage item is located, or (b) on land that is within a heritage conservation area, or (c) on land that is within the vicinity of land referred to in paragraph (a) or (b), require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.	Pursuant to clause 127(m) of the ISEPP, the activity is permitted without Development Consent. This REF and Heritage Impact Assessment fulfils this clause as the proposed development is within the curtilage of a heritage item.

Bourke Development Control Plan 2012 (DCP)

The general heritage provisions set out in the Bourke DCP are applicable to all Heritage Items, Heritage Conservations Areas, Potential Heritage Items (Built Environments, Cultural and Visual Landscapes, European Archaeological Sites) and for development in the vicinity of Heritage Places. However, it principally concerns buildings, alterations, additions and fencing and therefore does not directly apply to the proposed works associated with this project. The conservation objectives of the DCP include retention and conservation of heritage items and their significant elements and settings. The proposed development is not contrary to the heritage provisions of the Bourke DCP 2012.

Toorale National Park & State Conservation Area CMP (Jill Sheppard Heritage Consultants, 2013)

The CMP recommended that the procedures for managing the site be consistent with the management of the site as a State Heritage item, however this contradicts the *NPWS Guidelines for historic heritage approvals* which states no application is required to the Heritage Council of NSW unless a project involves excavation. In this case there is no archaeological potential and therefore an excavation permit from DPIE is not necessary. Policy relevant to dams and water management in the CMP is as follows:

CMP Policy	Response
7.5.2 Fabric Management of Water Infrastructure Partial decommissioning of historic water infrastructure where necessary will where possible be carried out in a sensitive manner so that the majority of the Dam or tank remains to identify its location, size and shape and evidence the construction techniques used. As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials.	While the proposal will result in the modification of the embankments of the Boera, Booka and Homestead Dams to lower the spillway levels and introduce fishway, none of the directly impacted infrastructure has been assessed as individually significant and/or dates to the 20th century. The embankments have no archaeological potential. The embankment at Homestead Dam has been breached since 2012.

Conclusions

Based on the information provided above, it is concluded that the proposed works will result a positive impact on historic heritage values associated with the Toorale Homestead Precinct, and there will be no significant impact to other historic precincts associated with the site. The potential impacts are minor and considered acceptable considering the positive environmental outcomes. Due to continuous alteration over the years and documentation of dam construction, dams have little historical research potential and therefore have little or only local historical archaeological significance.

The sympathetic alteration of Boera Dam to increase capacity to deliver water down the Warrego River for circumstances when maximum delivery of flows to the Darling River are required is a positive ecological outcome, as is the installation of a fishway. When additional flows to the Darling River are not required, Boera Dam will retain its existing full supply level, aiding to maintain the condition of the wetland's ecosystem. The lowering of the current spillway elevation will have negligible heritage impacts. The Heritage Inventory sheet for Boera Dam states no historical archaeological oversight is required.

The installation of a fishway in the Booka Dam embankment is a positive ecological outcome. The lowering of the current spillway elevation will have negligible heritage impacts.

The non-repair of Homestead Dam was noted within the CMP as potentially contravening 'Minimum Standards of Maintenance' provisions under the *Heritage A* Jill Sheppard Heritage Consultants, 2013). Therefore, the works to repair the Homestead Dam site will enhance the heritage significance of the area as it will reinstate an element of the modified landscape to better reflect its previous state, helping to restore the historic Toorale Homestead setting and the local ecosystem.

The overarching context of the larger Toorale Water Infrastructure Project aligns with this objective, seeking to retain and enhance environmental outcomes associated with the ongoing operation of the Boera Dam and Floodwaters Scheme. Actions associated with the Toorale Water Infrastructure Project include retention and sympathetic modification to Boera Dam and Booka Dam and reinstatement of Homestead Dam. Implementation of these actions (as a whole) demonstrates concurrence with the objects of the CMP.

5.7.3 Mitigation measures

The CEMP will detail mitigation measures for historic heritage impacts including the following:

- Heritage inductions are to be undertaken for all site workers and contractors in order to prevent any unintentional damage to water infrastructure or unknown archaeological sites. Induction to address relevant legislation, identified heritage sites, basic identification skills for Aboriginal and non-Aboriginal artefacts, penalties and non-compliance. Brief project team on unexpected finds protocol and discovery of human remains process at induction.

- Prior to the commencement of on-ground works, pre and post works archival photographic recording of each dam be compiled (that meets DPIE requirements for such recording [consistent with the guidelines of the former OEH Heritage Division]) must be completed to ensure that a continuous record of the Boera Dam and Floodwaters Scheme is maintained.

- As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials' (Jill Sheppard Heritage Consultants, 2013).

- Reuse or interpretation of any existing pipes or water management infrastructure that require removal shall be considered. Historic features and landscapes within and beyond the heritage precincts will, where practical, be interpreted.
- Implement ongoing surveillance and monitoring of water levels within the Dams. Maintain and protect remaining components of Boera Precinct, including Duncan's Wall.
- As far as is practical, maintain and protect remaining significant historic fabric of Homestead Dam Wall.
- Mark up the site before construction, to highlight 'no go' areas – make these areas very clear in the field.
    - Laydown areas or site office areas must be kept within the area covered by the AHIP.
    - Vehicles to keep to existing tracks outside of areas covered by AHIP.

5.8 Waste and Resource Use

5.8.1 Existing Environment

Natural resources relating to the proposed works include the surrounding environment (such as the water resources of the Warrego River) as well as the resources and materials to be used during the construction stage of the proposed works.

Materials within all of the dams that are currently in place include the bank spoil material, concrete pipes and metal gates and platforms. Materials from the Phase 1 works, such as bank spoil from the Peebles Dam embankment, will be reused in the works (such as for fill at Homestead Dam) or will be stored and reused or sold later by NPWS.

5.8.2 Potential impacts

The proposal is not likely to involve the use, wastage, destruction or depletion of natural resources including water, fuels, timber or extractive materials. Furthermore, the proposal provides for the sustainable and efficient use of water resources.

Construction

The proposed activity ensures the efficient use of natural resources with the aim of reusing as much spoil material from Peebles Dam (Phase 1) or from the Bourke Area irrigation channels for the construction of coffer dams and embankments. Existing tracks will be utilised for construction activities to ensure minimal impact

Changes to operating strategy

The activity is likely to positively affect the quantity and use of water resources of the Warrego River within the immediate vicinity of the works.

5.8.3 Mitigation measures

Mitigation measures for resources, waste and emission impacts are outlined below.

- Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. Machines will be maintained as per manufacturers specifications.
- Selection of appropriate machinery for construction works.
- Where possible, reuse spoil material at Homestead Dam
- Felled trees to be removed and stored for use as firewood, traffic barriers or placed in situ as woody habitat.
- To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with NSW EPA guidelines.
- All hazardous materials will be stored in accordance with existing or agreed NPWS procedures. All contractors and staff will be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills.
- Spill response procedures will follow existing or agreed NPWS procedures.
- If suspected soil contamination is encountered, the suspected materials should be segregated and placed in a designated bunded stockpile covered in plastic sheeting to prevent rainfall infiltration and/or soil migration during windy conditions. Pending disposal at a licenced waste facility, suspected contaminated should be tested to determine waste classification. Records of waste analysis, classification and disposal dockets would be recorded and maintained.
- Spent oils and liquids from construction plant and equipment will be disposed of appropriately in a properly licenced facility.

6 Environmental Management

6.1 Residual environmental risk and impacts

Following consideration of the proposed construction and operational safeguards, controls and mitigation measures to be implemented by DPIE as part of the project design, Table 6-1 is used to reassess the risks associated with each of the potential impacts identified in Section 5.

Table 6-1: Risk Assessment Matrix

Risk Assessment Matrix		Consequence				
Likelihood		Minor	Major	Severe	Critical	Catastrophic
		A	B	C	D	E
Very Unlikely	1	Low	Low	Medium	Medium	Medium
Unlikely	2	Low	Low	Medium	Medium	High
Possible	3	Low	Medium	High	High	High
Likely	4	Medium	Medium	High	High	Extreme
Almost Certain	5	Medium	High	High	Extreme	Extreme

6.2 Key risks

There are a number of environmental risks related to the project identified through this REF. Mitigation measures have been outlined for each of the risks identified. The following section brings these mitigation measures together, augments them where additional actions are required and outlines a framework for their management during construction and/or operation. Residual risk levels are then assessed.

Modification to the three storages and changed flow arrangements will improve water quality and connectivity and fish passage along the Warrego and Darling Rivers. It may however, reduce the flow of water into the Western Floodplain, in turn reducing its value as an aquatic habitat/refuge for fauna, and impacting on the condition of riparian vegetation communities within the Floodplain including endangered ecological communities. These impacts become the key environmental risks for the proposed works at Boera Dam.

To manage these risks, the following documents and supporting processes will be in place (further details are provided in Section 6.3):

- A Construction Environmental Management Plan (CEMP) will be developed for the project. The CEMP will include the following sub plans:
    - **Erosion and sediment control plan–** this sub plan must outline erosion and sediment risks and reference the Erosion and Sediment Control Plan (ESCP) which will outline the process to be put in place to manage these risks. The ESCP needs to be developed by a suitably qualified person.
    - **Incident and emergency management plan –** this sub plan must outline the processes for managing a pollution event or other environmental incident. This would include spill response requirements (spill kits etc), incident notification process

and roles and responsibilities for managing and reporting any incidents. Also incorporate a fire management strategy.

- **Heritage management –** There are no anticipated significant impacts to historic heritage. Obtained AHIPs cover the maximum areas that may be disturbed, and all conditions associated with the AHIP shall be observed. Staff induction shall outline how any unexpected finds (both Aboriginal or non-Aboriginal) will be managed. This must include requirements around stopping work and notifying appropriate people in the event of an unexpected find.
- **Waste management and storage of hazardous materials –** this sub plan needs to outline how waste will be minimised and managed, how hazardous materials will be stored, refuelling procedures etc. Working in and around a waterway increases the risks associated with hazardous materials and refuelling.
- **Biodiversity management plan –** this sub plan needs to outline measures to prevent direct impacts to native fauna and minimise any impacts on areas of native vegetation or existing habitat, including weed management plan.
- **Public amenity plan –** this sub plan needs to clearly outline management measures that will be in place to ensure impacts to park visitors and other residents are minimised, including traffic management plan.

- Other items to be included in the CEMP and sub-plans:
  - **Induction and pre-start –** this sub item needs to outline the induction process for workers coming onto the project as well as any toolbox talks required and the process for undertaking pre-start checks of machinery for damage and wear and tear (in particular hydraulic hoses, fuel tanks etc) before the start of work each day.
  - **Environmental Control Maps (ECMs)** will be developed for the full length of the project. These are maps that have all areas of environmental significance clearly identified along the route. Hard copies of these will be on-site at all times and displayed where they can be seen by the project team. They should be discussed as part of the pre-start before works commence.

6.3 Environmental Controls and Residual Risk

A summary of the environmental controls and residual risks of the Phase 2 works are outlined in Table 6-2.

Table 6-2: Summary of environmental controls and residual risk relevant to proposed works

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
Soils and sedimentation	• Laydown and stockpile areas are to be placed, secured and managed if flooding or weather conditions suggest the likelihood of high water flows and therefore sedimentation risks. • The plan should identify areas requiring management control, include inspection and checklist and be reviewed by a suitably qualified professional prior to any works commencing. These controls must be suitably maintained and monitored to ensure the measures and controls in place are effective. Controls can be removed once soils are stabilised. • Account for climatic events during construction; • If heavy rainfall is predicted the site should be stabilised and works modified to prevent erosion for the duration of the wet period; and • Works methods shall be modified during high wind conditions if excessive dust is generated. • Visual monitoring for dust will be implemented during the works. Water cart to regularly wet down haul roads and laydown areas, particularly adjacent to the Akuna homestead where water will be sourced. • Schedule works when there is no/low flow through the Warrego River. If this is not possible, water diversion works	• An Erosion and Sedimentation Control Plan (ESCP) will be developed and included as part of the Construction Environmental Management Plan (CEMP) that will be developed prior to construction. Site management will incorporate best management erosion and sediment control practices such as those found in the 'Blue Book' Soils and Construction, Managing Urban Stormwater (Landcom, 2004). Such erosion and sediment control measures are not to be removed until the works are completed, and areas are stabilised. • Detail erosion and sediment controls on ECMs for each area. • The CEMP will include measures to mitigate the risk of fuel and hydraulic oil spills/leaks including use of designated refuelling and	CEMP ESCP ECM Induction	MEDIUM

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	shall be implemented to minimise the risk of water erosion whilst construction works are undertaken. • The area of disturbance should be limited to the smallest practicable footprint possible. • Limit duration of disturbance – e.g. only excavate immediately prior to scheduled activities. • To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with NSW EPA guidelines. Spent oils and liquids from construction plant and equipment will be disposed of appropriately in a properly licenced facility. • All hazardous materials will be stored in accordance with existing or agreed NPWS procedures. • All contractors and staff will be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills. • Spill response procedures will follow existing or agreed NPWS procedures. • Onsite refuelling shall occur within the designated areas and located more than 100m from the waterway and within an impervious bund. • Daily inspections of contractor's machinery will be undertaken to ensure no oil, fuel or fluids are leaking • If suspected soil contamination is encountered, the suspected materials should be segregated and placed in a designated bunded stockpile covered in plastic sheeting to prevent rainfall infiltration and/or soil migration during windy conditions. Pending disposal at a licenced waste facility,	bunding of maintenance areas. The CEMP will also include a Spill Response Plan to manage potential soil contamination by the implementation of a spill response procedure. • Make contractors aware of erosion and sediment and contamination issues and mitigation measures through project induction. • Brief on the erosion and sediment controls in the work area for that day in pre-start briefing each day.		

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	suspected contaminated should be tested to determine waste classification. Records of waste analysis, classification and disposal dockets would be recorded and maintained.			
Groundwater	• A CEMP, including site specific Erosion and Sediment Control Plans and a Spill Response Plan, is to be prepared prior to works commencing to guide the implementation of environmental impact mitigation measures as proposed in Section 5.1.3. • • A CEMP, including site specific Erosion and Sediment Control Plans, is to be prepared prior to works commencing to guide the implementation of environmental impact mitigation measures pertaining to groundwater and water quality. Site management will incorporate best management erosion and sediment control practices such as those found in the 'Blue Book' Soils and Construction, Managing Urban Stormwater (Landcom, 2004). Such erosion and sediment control measures are not to be removed until the works are completed, and areas are stabilised.	• Develop a CEMP including a section outlining groundwater and contamination risks of the project and linking to the ESCP and spill response plan. • Detail erosion and sediment controls on ECMs for each area. • Make project team aware of erosion and sediment and contamination issues and mitigation measures through project induction. • Brief on the erosion and sediment controls in the work area for that day in pre-start briefing each day	CEMP ESCP	LOW
Surface Water and Aquatic ecology	*Direct mitigation measures* • Sufficient measures should be included into a construction environmental management plan (CEMP) to control sedimentation and the introduction of hazardous material into the Warrego River adjacent the works sites. These risks would be minimised if construction was undertaken during a time when the storages were low or empty. If coffer dams are required and localised dewartering is required before construction takes place, then standard dewatering protocols should be followed including a pre-	• While no individuals of the endangered Darling River snail have been recorded at the site, inspection of the existing pipes should be carried out during removal to confirm the absence of any snails. Artificial structures such as these are the snails preferred habitat. If any individuals are found, then ideally the pipes would be placed within the	CEMP Induction LTIM	MEDIUM

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	dewatering survey and then removal of any affected fauna by a qualified ecologist during dewatering. *Mitigation measures for operational changes to the inundation regime* • To mitigate any potential impacts to the aquatic ecology from the proposed activities and changed water regime, monitoring of hydrology (including floodplain inundation), water quality and aquatic communities (fish, frogs, invertebrates, waterbirds) should continue in line with the current Monitoring, Evaluation and Research program being undertaken by the University of New England on behalf of CEWH. Additional monitoring of fishway use above and below the fishways is also recommended to confirm their effectiveness during periods of flow. If any significant changes to aquatic communities are noted, then the operating strategy should be adaptively managed to minimise or arrest these changes.	storage away from the works to continue to provide habitat.		
Flora and fauna impacts	*Mitigation measures for Construction impacts* Current development footprints have been designed as a worst-case scenario for impact areas. It is highly likely that not all areas within these areas will be impacted – and this provides an opportunity to select a contractor that is sensitive to the environmental and cultural constraints of the project who is willing to work with DPIE to minimise impacts within those footprints. DPIE staff will work with contractors to refine suitable impact areas and mark-up of the site before construction in an effort to further avoid vegetation (especially hollow-bearing trees) where feasible. The western access route at Booka currently incurs a relatively large impact area. Although not all vegetation within this area will be	• Undertake supplementary flora survey of increased impact areas including the access route at Booka. Document the location of hollow bearing trees and check if threatened plants are within the impact areas – this information will inform discussions with the site supervisor about whether any important areas can be avoided. Report will be provided to NW planning.	ECM CEMP Induction LTIM Vehicle wash down register if required	LOW to MEDIUM

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	removed, there may be an opportunity to reduce impacts if alternative access can be obtained through neighbouring properties. This will require negotiation with landholders before construction. Maintain native vegetation where possible and reduce impact by the following actions: • Clearly marking construction zone. • Minimise root disturbance or compacting in the drip zone of trees and shrubs. • Avoid removal of hollow-bearing trees where possible (as identified during pre-construction mark-up surveys with the contractors). • Should mature trees or habitat trees be required to be removed, the trees should be surveyed by a suitably qualified person and any hollows marked for supervised clearing and possible salvage or repurposing as habitat. • Should hollow bearing trees need to be removed, nest boxes should be installed adjacent to the impact area at a 1:1 ratio to offset the removal of habitat. • Any felled hollow bearing trees will be placed on the outskirts of the impact area to remain as on ground habitat. Where necessary the following biosecurity measures should be applied during completion of works: • All machinery and vehicles brought on site will be free of any soil, seed or plant material. • Restrict vehicle and personal access from areas of known weed infestation during the proposed works to prevent spread and reinfestation.	• A CEMP will be developed including a section outlining flora and fauna mitigation measures • Native vegetation should be clearly marked on the ECMs to identify approved vegetation removal (disturbance footprint) and then the exclusion areas should be marked up with flagging tape (or equivalent) before construction. • Develop a process for review and approval if additional vegetation not assessed in this REF needs to be removed. • Mitigation measures should be briefed to all project staff in a site induction and at toolbox talks. • Promote regeneration of disturbed areas with the same vegetation species that were there before clearing. •		

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	• Control African Boxthorn, Noogoora Burr and any other weed infestations prior to proposed works commencing to prevent the spread of infestations by machinery and in spoil. • Evidence of compliance with biosecurity requirements should be documented, e.g. a Vehicle wash down register. • Follow up monitoring of work sites post construction to assess the potential establishment of weed species. *Mitigation measures for operational changes to the inundation regime* To mitigate any potential impacts to the terrestrial ecology from the mitigate any potential impacts to the terrestrial ecology from the proposed activities and changed water regime, monitoring of vegetation communities should continue in line with the current Monitoring, Evaluation and Research program being undertaken by the CEWHCEWH. This includes assessments of vegetation cover, diversity and recruitment within four representative vegetation communities on the floodplain. Additional broader scale monitoring of vegetation condition either through remote sensing or photo points should be investigated to provide a fuller landscape understanding of temporal and spatial trends in vegetation condition over time on the Western Floodplain. Additional sites should be established within the upstream sections of Booka Dam, Homestead Dam and around Ross Billabong to monitor potential changes to vegetation community health, condition and composition in these locations with changes in water availability. If any significant changes to both the diversity and abundance of aquatic communities are noted, then the operating strategy should be adaptively managed to minimise or arrest these changes, within the constraints of licence conditions.			

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
Social and Community impacts	• Provide community information regarding potential impacts on amenity and increases in heavy traffic during construction, including potential noise impacts. • Public access should be excluded from the construction zone, including laydown and stockpile areas. • Signage to prevent access by non-construction related traffic to the construction zone. • Signage to indicate construction laydown areas and location of firefighting equipment. • Grade road and access tracks as necessary once works have ceased • Project information to be made available to parties that do have access to areas of Toorale to outline the need for the works, potential impacts, changes to access and the expected duration of the proposed works. Compliance with the Park's fire management strategy and State of NSW and OEH *Fire Management Manual* (2017) and associated strategy for emergency response actions in times of fire risk. Protocols to be used in the environmental management plans may include safety protocols such as: • Basic training of all staff in the use of firefighting equipment on site • Firefighting equipment lists will be detailed in the Work Method Statements; • Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and	• Develop a CEMP including a section outlining public and contractor safety impacts and mitigation measures. • Develop a CEMP including a section outlining sensitive receivers and noise mitigation measures (may be in the CNVMP). • Make project team aware of noise issues and mitigation measures through induction. • Site plans should indicate no go zones, site signage locations, firefighting equipment locations.	ECM CEMP CNVMP Induction OEH *Fire Management Manual* (2011)	MEDIUM

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	• Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors. • The impacts of modified flow management arrangements will continue to be monitored and adjusted to mitigate unanticipated impacts, pending amended *Water Management Act* approval conditions. • Implement an advisory process for stakeholders to have ongoing input to flow management on Toorale. • Undertaking additional modelling to refine understanding of different flow management scenarios to refine flow management arrangements.			
Aboriginal heritage	Develop a CEMP including a section outlining archeologically sensitive areas and any heritage areas. The CEMP will detail mitigation measures for Aboriginal cultural and historic heritage impacts including the following: • Carry out the project in accordance with the conditions under the AHIPs (AHIP number C0003079, permit ID 4175 and AHIP number C0004300, permit ID 4369). • Create clear maps of the site with areas in/out of the construction footprint to aid inductions and daily construction activities as well as highlighting 'no go' areas. Archeologically sensitive areas, boundaries of AHIP area and AHIMS sites are also to be marked on ECMs. • Mark up the site before construction, to highlight 'no go' areas – make these areas very clear in the field.	•	CEMP ECM	LOW

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	○ Avoid impact to modified trees by fencing off to prevent any unintentional impacts. ○ Avoid impact to archaeological sites not covered by the AHIP by fencing off to prevent any unintentional impacts. ○ Laydown areas or site office areas must be kept within the area covered by the AHIP. ○ Vehicles to keep to existing tracks outside of areas covered by AHIP. • Heritage inductions are to be undertaken for all site workers and contractors in order to prevent any unintentional harm to Aboriginal sites located within the study area and its surrounds. Induction to address elements related to relevant legislation, AHIP conditions, location of identified heritage sites, basic identification skills for Aboriginal and non-Aboriginal artefacts and human remains, penalties and non-compliance. ○ Brief project team on unexpected finds and discovery of human remains process at induction. ○ Point out sensitive sites and any AHIMS sites in the work area for that day in pre-start briefing 'tool box talks' before works commence each day • Ongoing Aboriginal consultation with members from the JMC. A Kurnu-Baakandji community member to act as a cultural officer on site for site monitoring when works are being undertaken. • If impacts on AHIMS Sites and areas of archaeological sensitivity cannot be avoided outside areas covered by an AHIP, a new AHIP will be required. • Stop work if any potential heritage sites or human remains have been identified during construction. Aboriginal objects are protected under the NPW Act regardless if they are registered on			

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	AHIMS or not. If suspected Aboriginal objects, such as stone artefacts or scarred trees are located during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, DPIE must be notified under section 89A of the NPW Act. Appropriate management and avoidance or an approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed. ○ In the event that human remains are found, works will immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, DPIE may also be contacted at this time to assist in determining appropriate management. ○ In consultation with JMC, collect surface artefacts, store in keeping place, put back in same location once works complete. Pending approval of the works, the remaining Aboriginal sites in the impact footprint will be subject to archaeological salvage to be catalogued and analysed to contribute to knowledge of Aboriginal archaeological site type and distribution through the Bourke region. • Complete any remaining conditions outlined in AHIP and submit to DPIE a report about harm to Aboriginal Objects at the completion of works under the AHIP. Complete Aboriginal site impact recording forms following completion of works.			
Historic Heritage	As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials (CMP 2013:129). It is also proposed to retain the cultural and historic features of the site through reuse or interpretation of any existing pipes or water	• Induction to address elements related to relevant legislation and CEMP requirements	CEMP Induction	LOW

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	management infrastructure that require removal. Furthermore, historic features and landscapes within and beyond the heritage precincts will, where practical, be interpreted. • Heritage inductions are to be undertaken for all site workers and contractors in order to prevent any unintentional damage to water infrastructure or unknown archaeological sites. Induction to address relevant legislation, identified heritage sites, basic identification skills for Aboriginal and non-Aboriginal artefacts, penalties and non-compliance. Brief project team on unexpected finds protocol and discovery of human remains process at induction. • Prior to the commencement of on-ground works, pre and post works archival photographic recording of each dam be compiled (that meets DPIE requirements for such recording [consistent with the guidelines of the former OEH Heritage Division]) must be completed to ensure that a continuous record of the Boera Dam and Floodwaters Scheme is maintained. • As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials' (Jill Sheppard Heritage Consultants, 2013:129). • Reuse or interpretation of any existing pipes or water management infrastructure that require removal shall be considered. Historic features and landscapes within and beyond the heritage precincts will, where practical, be interpreted. • Implement ongoing surveillance and monitoring of water levels within the Dams. Maintain and protect remaining components of Boera Precinct, including Duncan's Wall.	• Brief project team on unexpected finds and discovery of human remains process at induction		

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk

	• As far as is practical, maintain and protect remaining significant historic fabric of Homestead Dam Wall.
	• Mark up the site before construction, to highlight 'no go' areas – make these areas very clear in the field.
	  ○ Laydown areas or site office areas must be kept within the area covered by the AHIP.
	  ○ Vehicles to keep to existing tracks outside of areas covered by AHIP.			

Resources, emissions and waste	• Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. Machines will be maintained as per manufacturers specifications. • Selection of appropriate machinery for construction works. • Where possible, reuse spoil material at Homestead Dam • Store, sell or reuse the two steel pipes from Peebles Dam. • Felled trees to be removed and stored for use as firewood, traffic barriers or placed in situ as woody habitat. Dust generation from vehicle movements on access tracks will be controlled by the following measures on site: • All vehicles on-site should be confined to a designated route; • Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips; • Excessive dust to be managed by application of water using a water truck. • Manage stockpiles as per the ESCP.	• Develop a CEMP including a section outlining resources, emission and waste risks on project • Make project team aware of issues and mitigation measures through project induction • Emergency response training for all staff • Correct waste disposal techniques communicated to all staff	CEMP Induction Emergency response training	LOW

Risk	Mitigation measures	Additional mitigation measures	Documentation	Residual risk
	• Post-construction, ensure any deterioration of tracks is rehabilitated to the same or better standard than pre-construction.			

7 Ecologically Sustainable Development

The *National Strategy for Ecologically Sustainable Development 1992* defines Ecologically Sustainable Development (ESD) as:

> *"using, conserving and enhancing the community's resources so that ecologically processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased*."

Schedule 2 of the EP&A Reg outlines four principles of ESD that have been considered in this REF (Table 7-1).

Table 7-1: Consideration of ecologically sustainable development principles

ESD Principle	Comment
Precautionary principle The precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: i. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and ii. an assessment of the risk-weighted consequences of various options	The full proposal has been carefully considered and based around a set of objectives aimed at a conservative change to the existing water management arrangements on Toorale. The designs have been developed to enable flexible flow management that can prioritise delivery of water to either the western floodplain or downstream. Similarly, the discharge rates can be adjusted as required during each event and over time. This will support an adaptive approach to managing flows where the potential response is uncertain. Potential impacts associated with construction and operational processes have been considered, risks minimised through design and consultation. Mitigation measures nominated will reduce the likelihood or consequences of identified environmental impacts. These mitigation measures are subject to review throughout the entirety of the proposed works.
Inter-generational equity Inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations	The proposed works will contribute to improved long-term environmental outcomes both within Toorale and the downstream environment through improved water management and connectivity. The project has been designed to deliver multiple environmental objectives aimed at ensuring the health, diversity and productivity of the environment on Toorale and in the Darling River are maintained or enhanced. The proposed works ensure a valued public asset is maintained for future generations.

ESD Principle	Comment
	Mitigation measures nominated will reduce the likelihood or consequences of identified environmental impacts.
Conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration	The Project aims to enhance environmental flows and ecosystem health in the Warrego and Darling Rivers without compromising the important biodiversity of Toorale. Improved connectivity within and between these rivers, along with reduction of fish barriers will contribute to ecological integrity.
Improved valuation, pricing and incentive mechanisms Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as: i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, ii. the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, **iii.** environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.	Proposal was developed and refined after extensive consultation, technical investigations and planning to ensure that the most cost-effective, environmentally acceptable option has been adopted DPIE has conducted extensive consultation with the local community and government departments to gauge community views and values to develop a proposal that delivers on multiple social, economic, cultural and environmental objectives.

8 Conclusion

Phase 2 of the Toorale Water Infrastructure Project is being undertaken to maximise the environmental outcomes from the purchase of Toorale and its water entitlements.

The Project has been planned and assessed with a degree of uncertainty about the baseline conditions of a highly complex and variable system. For this reason, the works and operating arrangements proposed for Phase 2 have been planned and designed to be flexible and adaptive as understanding of the system and its response to flows delivered improves. The Project as proposed is the result of extensive studies, consultation and planning and delivers the required aims whilst minimising or mitigating impacts to other Park values and water users to the extent possible.

The proposed changes to the water infrastructure at Toorale are subject to consideration by DPIE under Part 5 of the EP&A Act. This REF considers the statutory requirements relating to, and the potential environmental impacts resulting from, Phase 2 of the proposed Toorale Water Infrastructure Project.

Environmental impacts have been assessed in accordance with clause 228(2) of the EP&A Act and are presented in Section 5 of this REF. When considering the likely environmental significance of the impacts associated with the proposed activity, aspects are assessed to be low or medium.

Table 8-1: Compliance with clause 228(2) of the EP&A Reg

Clause 228(2) Factors	Impact	Section of REF
Any environmental impact on a community?		
The proposed modifications have a net improvement to environmental flows from the Warrego to the Darling River. Temporary and/or ongoing impacts to neighbouring landholders are likely, but shall be managed and minimised where possible through ongoing consultation and adaptive water management strategies. Downstream communities will benefit from improved flows in the Darling River, which will contribute to better river health, water quality and water supply for critical human needs. The magnitude of these benefits will vary depending on the prevailing conditions and the size and duration of inflows to Toorale. . Works are in a remote location away from residents and towns. Short term and minimal adverse impacts to air quality, traffic and access will be limited to the construction stage and will be managed through the preparation and implementation of a Construction Environmental Management Plan (CEMP) and environmental safeguards.	Medium	Section 5.5
Any transformation of a locality?		
The proposed modifications are to existing structures and therefore will not transform the locality. The dams will still function as water storages with upgraded regulating infrastructure and fishways	Low	Section **5.5**
Any environmental impact on the ecosystems of the locality?		

Clause 228(2) Factors	Impact	Section of REF
The proposed modifications and revised operating strategy have been developed to improve water management opportunities and outcomes throughout the lower Warrego Catchment and the downstream Darling River. The Project is anticipated to result in environmental improvements in the Warrego and Darling Rivers, particularly in regard to ecological processes, riparian vegetation, fish movement and water quality. The 3 storages are to be retained in recognition of their ecosystem value. There will be an impact on the value of Booka Dam as well as Ross Billabong. However, the values will be retained at Homestead Dam and Booka Dam. The proposed modification to Boera Dam and the operating strategy have been developed to limit impacts to the western floodplain ecosystems. Any short-term ecosystem impacts resulting from construction works will be minimised by appropriate mitigation measures.	Medium	Section **5.3**, **5.4**
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?		
Phase 2 will result in aesthetic impacts at all three storages. Boera Dam – substantial increase is size of regulating structure. Located in site of existing infrastructure. Limited public visitation/recreation use of the site. Full storage level to be retained. Booka Dam – reduced full supply level will impact on aesthetics for neighbours. Site is not accessed or used by Park visitors. Some loss of environmental quality. Homestead Dam – large new structure within river channel will change aesthetics. Visually prominent structure. Design of rock-like ridges to reduce aesthetic impact while being hydraulically effective for fish passage. Limited public visitation but may increase with improved ability to cross the river. Western Floodplain – limited impact to visitation. Access will be improved with proposed bridge at Homestead. Aesthetic impact likely to be low due to highly variable nature of this part of the park. Some potential loss of environmental quality under proposed flow arrangements but mitigation measures in place. Warrego and Darling Rivers – aesthetic, recreation and environmental improvements from increased and more frequent flows. There is not expected to be any reduction in scientific value of the locality. Survey and monitoring of the Park has provided a sound benchmark upon which further studies can build and feed into adaptive management response.	Low-Medium	Section 5.4
Any effect in a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?		
• Adoption and implementation of the mitigation measures will allow for any impacts to Aboriginal heritage items to be acceptable and managed – and in line with the approved AHIPs. • The proposed reinstatement of Homestead Dam will result in improved cultural outcomes for Aboriginal community that wants the storage reinstated. This will support future aspirations of the Kurnu-Baarkanji to hold cultural water in this storage and utilise the area for cultural purposes.	Low	Section **5.6**, **5.7**

Clause 228(2) Factors	Impact	Section of REF
• The designs have had regard to archaeological, cultural and historic significance. While there will be some effect, this has been mitigated in consultation with the JMC • No direct impacts from the proposed modifications to non-indigenous heritage are anticipated at the locally-listed Homestead Dam. Reinstating water levels in Homestead Dam is consistent with enhanced historic, social, cultural and aesthetic outcomes that are consistent with cultural and historic values. The works a Booka Dam will be a diminishment of aesthetic values, at least in the short-medium term. The longer-term impact when the new arrangements stabilise are less clear. • The proposed development involves direct impacts to Boera Dam and Floodwaters Scheme however these impacts will be minimised by being modifying, and not removing, these dams, and, by appropriate mitigation measures. • The proposal will not impact on the scientific significance now or in the future • Increased flows in the Warrego and Darling Rivers are likely to contribute to improved river health over the longer term, but will not on its own result in more sustainable aquatic and riparian systems. The capacity to be adaptive improves capacity to refine arrangements over time. • The proposal seeks to ensure that the values of the western floodplain are maintained into the future		
Any impact on habitat of any protected animals (within the meaning of the *Biodiversity Conservation Act 2016*)?		
Over the longer term, there will be some diminution of habitat quality, extent and availability for a range of protected species in Boera and Booka Dams as well as the western floodplain relative to the current situation There will be an improvement to habitat in Homestead Dam Increased flows and improved connectivity in the Warrego and Darling Rivers will have a mostly beneficial impact on habitat There may be some reduction in habitat quality and availability in Ross Billabong. There will be localised, short-term impacts to habitat during construction. These impacts will be mitigated through a CEMP Potential impacts associated with changed water management practices can be minimised through adaptive water management and ongoing environmental monitoring.	Medium	Section **5.3**, **5.4**
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?		
The proposed works would not likely result in the endangering of any species of animal, plant or other form of life.	Low	Section **5**

Clause 228(2) Factors	Impact	Section of REF
Any long-term effects on the environment?		
All construction works associated with the proposed modifications would have short-term impacts on the environment and will be rehabilitated following completion of activities. The Warrego and Darling Rivers are expected to benefit in the long-term as a result of the new structures and operating arrangements. The degree that these benefits are realised will be at least partially influenced by broader river management arrangements operating outside of Toorale. Management of the new arrangements is intended to be adaptive, and in this regard, will be positioned to respond to any unacceptable or unintended impacts on the environment in the future.	Low	Section 5.3, 5.4.
Any degradation on the quality of the environment?		
The new structures are sited in or near existing infrastructure in previously highly disturbed locations. The embankments have been subject to modifications since they were initially constructed, and periodically breach and are subsequently repaired. All construction works associated with the proposed modifications will have short-term impacts on the environment and will be rehabilitated following completion of construction activities. New water management arrangements have been planned to benefit the river systems and not result in degradation to the quality of the environment, Potential impacts associated with changed water management practices can be minimised through adaptive water management and ongoing environmental monitoring.	Low	Section **5.1**, **Error! Reference source not found.**
Any risk to the safety of the environment?		
Risks would be limited to the construction stage and can be managed through the preparation and implementation of a CEMP. New structures will comply with the relevant safety standards	Low	Section **6.3**
Any reduction in the range of beneficial uses of the environment?		
There will be some loss of benefit to landholders adjoining Boera and Booka Dams as a result of potential decrease in water security and pasture productivity, reduced recreation opportunities and loss of amenity.	Low-Medium	Section **5.3**
Any pollution of the environment?		
Risks of pollution to the environmental will be minimal. The potential for water pollution, erosion and contamination to land exist but would be minimal and avoided with the safeguards and mitigation measures in the REF and CEMP.	Low	Section **5.1**,
Any environmental problems associated with the disposal of waste?		
No environmental problems are identified associated with the disposal of waste.	Low	Section **5.8**

Clause 228(2) Factors	Impact	Section of REF
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?		
All materials required for the proposed works are available and are not currently or likely to be in short supply. Potential impacts associated with changed water management practices can be minimised through adaptive water management and ongoing environmental monitoring.	Low	Section **5.8**
Any cumulative environmental effect with other existing or likely future activities?		
The proposed modifications and revised water management arrangements are expected to have impacts beyond the immediate Project area. The cumulative effect of reduction of flows into Ross Billabong is considered to be offset by improvements that will arise from improved flow delivery and connectivity of habitats in the Warrego and Darling Rivers.	Low-Medium	Section **5**

The proposed development is unlikely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a SIS or EIS is not required. Furthermore, the proposed development is unlikely to affect Commonwealth land or have an impact on MNES and does not require referral to the Federal Minister for the Environment.

Potential negative environmental impacts associated with building the new structures are short term and associated with the construction phase of the project. The Project will result in positive impacts from improved environmental flows management, cultural outcomes and fish passage in the Warrego River and the Darling River. These come at a cost to storage capacity and security, and changes to the flooding regime of the western floodplain.

Mitigation measures as detailed in this REF will ameliorate or minimise any expected impacts to generally acceptable levels. Mitigation measures are detailed in Table 6-2 of Section 6.3. The remaining residual risks are considered low-medium.

This REF concludes that construction and operation of Phase 2 of the Toorale Water Infrastructure Project is, on balance, unlikely to result in a significant adverse environmental impact. The proposal is not expected to in negative permanent change to the environment Construction-related impacts will be short term in nature and appropriately mitigated. The new structures and flow management arrangements proposed seek to deliver long-term environmental outcomes, and are able to be adapted in response to new information or changing priorities.

The proposed activity is not likely to result in the degradation of the Park or any other area reserved for conservation purposes. The direct impact area footprint has been specified and impacts assessed to ensure minimal to no degradation of the Park.

References

Alluvium Pty Ltd (Alluvium). (2016). *Toorale Environmental Water Delivery Business Case.* Prepared for NSW Office of Environment and Heritage.

Alluvium Pty Ltd (Alluvium). (2018). *Functional Design Report: Toorale water infrastructure project – survey and design.* Prepared for NSW Office of Environment and Heritage, Dubbo, NSW.

Alluvium Pty Ltd (Alluvium). (2019a). *Water Balance Modelling and Hydrologic Assessment Report.* Prepared for NSW Office of Environment and Heritage, Dubbo, NSW.

Alluvium Pty Ltd (Alluvium). (2019b). *Modelling Results for operation Strategy: Toorale Water Infrastructure Project – Survey and Design*. Memo for Department of Planning Industry and Environment, Dubbo NSW.

Atlas of Living Australia (ALA). (2019). *Spatial Portal. Interactive Map Tool*. Accessed from https://spatial.ala.org.au/

Aurecon. (2009). *Water Infrastructure Audit and Decommissioning Plan for Toorale Station*. Prepared for the Department of Environment, Water, Heritage and the Arts (DEWHA)

A.S. James Pty Ltd. (2018). *Proposed embankments Warrego River Toorale - Geotechnical Investigation,* March 2018. Report prepared for Alluvium Consulting Australia.

Bamford, M., Watkins, D., Bancroft, W., Tischler, G. & Wahl J. (2008). *Migratory Shorebirds of the East Asian - Australasian Flyway: Population Estimates and Internationally Important Sites*.

Biosis. (2016). *Toorale Environmental Water Delivery Project: Preliminary Assessment of ecological constraints.* Report prepared for Alluvium Consulting Australia.

Biosis. (2017). *Toorale Water Infrastructure Study: Aboriginal Cultural Heritage Assessment report*. Report for Office of Environment and Heritage. Authors: Atkinson, A. & Keats, S., Biosis Pty Ltd, Wollongong. Study no. 24144.

Biosis. (2018a). *Toorale Water Infrastructure Project: Archaeological Excavation Report*. Report for Office of Environment and Heritage. Authors: Atkinson, A., Keats, S. & Smith, M., Biosis Pty Ltd. Project no. 26280

Biosis. (2018b). *Toorale Water Infrastructure Study: Aboriginal Cultural Heritage Assessment report*. Report for Office of Environment and Heritage. Authors: Markham, A., Keevers-Eastman, A. & Smith, M., Biosis Pty Ltd, Wollongong. Study no. 26280.

Biosis. (2019). *Toorale Water Infrastructure Project: Excavation Report for Boera Dam 1*. Report for Office of Environment and Heritage. Authors: S Keats & M Smith, Biosis Pty Ltd, Wollongong. Project no. 29430

Briggs, J. & Leigh, J. (1996). *Rare or Threatened Australian Plants*. CSIRO Publications, Melbourne.

Bureau of Meteorology (BoM). (2016). *Climate classification maps.* Retrieved from: http://www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp. Accessed 3 May 2018.

Bureau of Meteorology (BoM). (2017a). *Australian National Groundwater Explorer database*. Retrieved from http://www.bom.gov.au/water/groundwater/explorer/map.shtml. Accessed 14 January 2019.

Bureau of Meteorology (BoM). (2017b). *Groundwater Dependent Ecosystems Atlas*. Retrieved from http://www.bom.gov.au/water/groundwater/gde/index.shtml. Accessed 10 May 2019.

Bureau of Meteorology (BoM). (2017c). *Groundwater Dependent Ecosystems. Spatial Dataset.* Retrieved from http://www.bom.gov.au/water/groundwater/gde/index.shtml. Accessed 10 May 2019.

Bureau of Meteorology (BoM). (2019a). *Monthly climate statistics – Bourke Airport AWS*. Retrieved from: http://www.bom.gov.au/climate/averages/tables/cw_048245.shtml. Accessed 10 April 2019.

Bureau of Meteorology (BoM). (2019b). *Monthly climate statistics – Cobar Meteorological Office*. Retrieved from: http://www.bom.gov.au/climate/averages/tables/cw_048027.shtml. Accessed 10 April 2019.

Bureau of Meteorology (BoM). (2019c). *Monthly Rainfall – Fords Bridge (Delta).* Retrieved from: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=048194. Accessed 10 April 2019.

Bureau of Meteorology (BoM). (2019d). *Monthly Rainfall – Louth (Bloxham Street).* Retrieved from: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=048057. Accessed 10 April 2019.

Carlile, P. (2017). *Hydrological impacts of water management arrangements on low flows in the Barwon-Darling River system*. Advice to the Commonwealth Environmental Water Office.

Casanova, M.T. (2015). *Review of Water Requirements for Key Floodplain Vegetation for the Northern Basin: Literature review and expert knowledge assessment*. Report to the Murray–Darling Basin Authority, Charophyte Services, Lake Bolac.

Commonwealth Environmental Water Office (CEWHCEWH). (2019). *Commonwealth Environmental Water Portfolio Management Plan: Northern Intersecting Streams 2019–20*. Commonwealth of Australia.

Commonwealth of Australia. (2013). *Matters of National Environmental Significance - Significant impact guidelines 1.1 (Environment Protection and Biodiversity Conservation Act 1999)*. Retrieved from https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl. Accessed June 2019.

Commonwealth of Australia. (2015). *Commonwealth Water Office Long Term Intervention Monitoring Project Junction of the Warrego and Darling Rivers Selected Area – 2014-15 Evaluation Report.* Commonwealth of Australia, Canberra.

Commonwealth of Australia. (2017a). *Commonwealth Water Office Long Term Intervention Monitoring Project Junction of the Warrego and Darling Rivers Selected Area – 2015-16 Evaluation Report.* Commonwealth of Australia, Canberra.

Commonwealth of Australia. (2017b). *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Retrieved from https://www.environment.gov.au/epbc/publications/shorebirds-guidelines. Accessed June 2019.

Commonwealth of Australia. (2018). *Commonwealth Water Office Long Term Intervention Monitoring Project Junction of the Warrego and Darling Rivers Selected Area – 2016-17 Evaluation Report.* Commonwealth of Australia, Canberra.

Commonwealth of Australia. (2019). *Commonwealth Water Office Long Term Intervention Monitoring Project Junction of the Warrego and Darling Rivers Selected Area – 2018-19 Evaluation Report.* Commonwealth of Australia, Canberra.

Cox, S.J., Thomas, R.F. & Lu, Y. (2012). *Flooding Patterns of Toorale: the confluence of the Warrego and Darling rivers*, unpublished report to Office of Environment and Heritage, Sydney.

Department of the Environment (DoEE). (2014). *EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland)*. New South Wales and the Australian Capital Territory.

Department of the Environment and Energy (DoEE). (2017). *Commonwealth Environmental Water Office Long Term Intervention Monitoring Project junction of the Warrego and Darling rivers Selected area 2015-16 Evaluation Report*. Retrieved from: http://www.environment.gov.au/water/CEWHCEWH/publications/warrego-darling-ltim-report-2015-16. Accessed 7 January 2019.

Department of the Environment and Energy (DoEE). (2018). *EPBC Act policy statements.* Retrieved from: http://www.environment.gov.au/epbc/policy-statements. Accessed 7 January 2019.

Department of the Environment and Energy (DoEE). (2018a). *Matters of National Environmental Significance: Significant Impact Guidelines 1.1.* Retrieved from: http://www.environment.gov.au/epbc/policy-statements.

Department of the Environment and Energy (DoEE). (2019). *Protected Matters Search Tool.* Retrieved from: https://www.environment.gov.au/epbc/protected-matters-search-tool.

Eco Logical Australia (ELA). (2017). *Toorale Water Infrastructure Project – Biodiversity Status Report.*

Eco Logical Australia (ELA). (2019). *Toorale infrastructure Project (Phase 1) Review of Environmental Factors*. Prepared for the NSW Government Office for Environment and Heritage.

Eco Logical Australia (ELA). (2019a). *Fish Movement around Booka Dam, Toorale NP May 2019*. Prepared for the Commonwealth Environmental Water Office.

Eco Logical Australia (ELA). (2019b). *Report on the Warrego River flow into the Darling: April-June 2019*. Prepared for the Commonwealth Environmental Water Office.

Environment Protection Authority (EPA). (2000). *NSW Industrial Noise Policy.*

Fairfull, S.& Witheridge, G. (2003). *Why do Fish need to cross the road? Fish passage requirements for waterway crossings*. NSW Fisheries, Cronulla, 16 pp.

Fitzpatrick, R., Powell, B. & Marvanek, S. (2011). *Atlas of Australian Acid Sulfate Soils v2*. Retrieved from: http://doi.org/10.4225/08/512E79A0BC589. Accessed 27 August 2018.

Gowans, S., Milne, R., Westbrooke, M. & Palmer, G. (2012). *Survey of Vegetation and Vegetation Condition of Toorale*. Prepared for the NSW Government Office for Environment and Heritage. University of Ballarat, Mt Hellen. 199pp.

Holz, L., Barma, D & Wettin, P. (2008). *Warrego River Scoping Study: Final Report*. Western Catchment Management Authority

Humphries, P. & Walker, K.F. (2013). Introduction to the Ecology of Australian Freshwater Fishes. In: *Ecology of Australian Freshwater Fishes* (Humphries, P. and Walker, K.F. eds). CSIRO Publishing, Melbourne.

Isbell, R.F. (2016). *The Australian Soil Classification*. Retrieved from: http://www.clw.csiro.au/aclep/asc_re_on_line_V2/soilhome.htm. Accessed 10 January 2019.

Jill Sheppard Heritage Consultants. (2013). *Toorale National Park & State Conservation Area. Conservation Management Plan.* Prepared for Office of Environment and Heritage NSW National Parks & Wildlife Service Far West Region. Dated June 2013.

Kelly, L. (2004). '*Toorale' Wildlife Refuge: Results of a Biodiversity Assessment on the 'Toorale' Wildlife Refuge.* Prepared by Parks and Wildlife Division New South Wales Department of Environment and Conservation.

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction (Blue Book).* New South Wales Government.

Loudon, A.G., Menzies, I.A. & Wallis, G.R. (1965). *Louth 1:250 000 Geological Sheet SH/55-09, 1st edition.* Geological Survey of New South Wales, Sydney. Retrieved from https://resourcesandgeoscience.nsw.gov.au/miners-and-explorers/geoscience-information/products-and-data/maps/geological-maps/1-250-000

Mackay, S. & James, C. (2016). Aquatic vascular macrophytes of Australia's riverine systems. In: *Vegetation of Australian Riverine Landscapes: Biology, Ecology and Management* (Capon, S., James, C. & Reid, M. eds). CSIRO Publishing, Melbourne.

Martin, S. (2010). *Preliminary Aboriginal Cultural Heritage Assessment of Toorale Station*. Prepared for the Kurnu Paakantyi Elders and the NSW Department of Environment, Climate Change and Water.

Martin S. (2012). *Toorale Boundary Fence Line & Fire Trail Archaeological & Cultural Heritage Survey*. Unpublished report prepared for Bourke Area, National Parks Division, Office of Environment and Heritage.

Martin S. (2013a). *Summary Report on Cultural Heritage Survey of Hell's Gate Tourist Campsite Area and Talowla Hill Road, Carpark & Walktrail*. Unpublished report prepared for Bourke Area, NPWS, Office of Environment and Heritage.

Martin S. & the Kurnu-Baakandji Elders. (2013b). *Ngayi, Kiira Kiir-inana Toorale Kurnu Baakandji Discovery Tours Manual*. Unpublished report compiled by Sarah Martin and the Kurnu-Baakandji Elders for National Parks and Wildlife Service.

Mitchell, P. (2002). *Descriptions of NSW (Mitchell) Landscapes Version 2.*

Mitrovic *et al*. (2010). Use of flow management to mitigate cyanobacterial blooms in the Lower Darling River, Australia. *Journal of Plankton Research 33*(2), 229–241

Murray Darling Basin Authority (MDBA). (2009). *Acid Sulfate Soils in the Murray Darling Basin*. MDBA Publication No. 147/11.

Murray Darling Basin Authority (MDBA). (2016). *Warrego*. Retrieved from: https://www.mdba.gov.au/discover-basin/catchments/warrego. Accessed 8 January 2019.

National Native Title Tribunal. (2018). *Register of Native Title Claims Details.* Retrieved from: http://www.nntt.gov.au/searchRegApps/NativeTitleRegisters/Pages/RNTC_details.aspx?NNTT_Fileno=NC2012/001. Accessed 10 October 2018.

NSW Department of Environment Climate Change and Water (DECCW). (2006a). *Barwon-Darling and Far Western Water Quality and River Flow Objectives*. Retrieved from https://www. https://www.environment.nsw.gov.au/ieo/FarWest/report-02.htm

NSW Department of Environment and Climate Change and Water (DECCW). (2010a). *Aboriginal cultural heritage consultation requirements for proponents (Part 6 National Parks and Wildlife Act 1974).*

NSW Department of Environment and Climate Change and Water (DECCW). (2010b). *Due diligence code of practice for the protection of Aboriginal Objects in New South Wales.*

NSW Department of Environment, Climate Change, and Water (DECCW). (2010c). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*.

NSW Department of Environment, Climate Change, and Water (DECCW). (2011). *NSW Road Noise Policy.*

NSW Department of Primary Industries (DPI). (2017). Darling Alluvium Water Resource Plan (GW7), Status and Issues Paper. DPI Water.

NSW Government. (2018). *NSW Planning Portal.* Retrieved from: https://www.planningportal.nsw.gov.au/find-a-property/3788962_Toorale_Road_3896_Gumbalie_DP766369. Accessed 23 October 2018.

NSW National Parks and Wildlife Service (NPWS). (2012). *Toorale and Gundabooka Nature Tourism Action Plan*. Retrieved from https://www.environment.nsw.gov.au/research-and-publications/publications-search/toorale-and-gundabooka-nature-tourism-action-plan

NSW Office of Water (NOW). (2011). *Water Sharing Plan for the Intersecting Streams Unregulated and Alluvial Water Sources – Background Document.*

NSW Office of Water (NOW). (2012). *Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources – Background Document.*

NSW Office of Environment and Heritage (OEH). (2012). *The land and soil capability assessment scheme – A general rural land evaluation system for New South Wales.* October 2012.

NSW Office of Environment and Heritage (OEH). (2016). *Guidelines for preparing a Review of Environmental Factors – How to assess the environmental impacts of activities within national parks and other reserves.*

NSW Office of Environment and Heritage (OEH). (2016a). *A Vertebrate Fauna Survey of Toorale State Conservation Area and Toorale National Park*. NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2017a). *Digital soil maps for key soil properties over New South Wales.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2017b). *Hydrologic Groups of Soils in NSW.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2018a). *Toorale National Park and Toorale State Conservation Area Draft Plan of Management (PoM)*. February 2018.

NSW Office of Environment and Heritage (OEH). (2018b). *Toorale Water Infrastructure Project – Stakeholder Briefing Notes May 2018.*

NSW Office of Environment and Heritage (OEH). (2018c). *Koala habitat and feed trees*. Retrieved from

NSW Office of Environment and Heritage (OEH). (2019a). *BioNet Atlas. Database of flora and fauna records* [online]. Retrieved from: www.BioNet.nsw.gov.au. Accessed January 2019.

NSW Office of Environment and Heritage (OEH). (2019b). *Threatened Species Profiles* [online]. Retrieved from https://www.environment.nsw.gov.au/threatenedspeciesapp/ . Accessed December 2019.

Polychrest Pty Ltd. (2013). *Toorale Station – Historic heritage inventory recording.*

Roberts, J. & Marston, F. (2011). *Water regime for wetland and floodplain plants: A source book for the Murray-Darling Basin*. National Water Commission, Canberra.

Shelly, D., Baun, R., Beretta, M., Mazzer, T., Kidd, S. & Shelly, C. (2003). *Fauna Survey 'Toorale' Bourke NSW.*

State of NSW and Office of Environment and Heritage. (2017). *Fire Management Manual 2017 – 2018. Policy and Procedures for Fire Management.*

Suzanne R. Hudson Consulting. (2009). Toorale Heritage.

Terrill, P. (2009). *Work required to inform Toorale decommissioning options*. Unpublished draft report.

Threatened Species Scientific Committee (TSSC). (2010). *Listing advice for the Coolibah – Black Box woodlands of the Darling Riverine Plains and the Brigalow Belt South bioregions ecological community*. Threatened species scientific committee.

WaterNSW. (2019). *Real-time data – All Groundwater*. Retrieved from https://realtimedata.waternsw.com.au/

Walker, P.J. (1991). *Land systems of Western New South Wales, Technical Report no. 25*, Soil Conservation Service of New South Wales, Sydney.

Western Local Land Services (LLS). (2017). *Western Regional Strategic Weed Management Plan 2017-2022.*

Appendix A : Alluvium Engineering Plans for Boera, Booka and Homestead Dams (Detailed Designs and Technical Specifications)

Due to size constraints, these have not been included in the public exhibition version of the REF.

For a copy of the design reports, please contact toorale.project@environment.nsw.gov.au

Appendix B : Toorale Joint Management Committee Consultation Log

2016

19 March – teleconference

Purpose

Introduction to Project

Seek feedback from the JMC about out when and how the consultants can meet with the JMC members in that time (late April/Early May) to talk about issues, and what they wanted considered as part of designing the project, and what information they wanted beforehand.

JMC Feedback

- which dams in the Warrego are being decommissioned and there are concerns of Aboriginal artefacts being held within the dam walls
- don't want dams to be decommissioned if the dam walls contain Aboriginal sites.
- want to know what the actual plan for decommissioning entails.
- Don't see any problem with decommissioning the Irrigation channels that Clyde Agriculture built, but any of the earlier dams within the Warrego River should be preserved.
- Is there any capacity to employ an Aboriginal Consultant to survey and map Aboriginal artefacts associated with the dams, as well as provide for Aboriginal involvement and employment to assist with dam archaeological surveys?
- should be looking at the cultural aspects of the water, e.g. cultural water to be used for cultural purposes.
- want an outline of what is involved with every dam to be decommissioned and they want an Aboriginal Consultant to survey and map the dams to identify Aboriginal sites that could be impacted by the decommissioning.
- Any future water requirements need to include Aboriginal local people and provide training and employment opportunities for Aboriginal people and should not only benefit the environment
- The Western Floodplain is to maintain flows
- What is the projection of water flow would be achieved with the decommissioning?
- the Commonwealth's access to water rights can't be at the cost to the Baakandji community.
- contractors carrying out the decommissioning project to do everything by the book and everything is to be considered prior to any dams being decommissioned.

Project Response

JMC feedback was noted and carried forward into project planning and design

7-8 May – on-site workshop/meeting

Purpose

This meeting included a tour of the key project sites with project team staff and a half day meeting in Bourke to discuss the JMC concerns and values of the Toorale in relation to the project.

JMC Feedback

Major values, concerns or recommendations relating to the project recorded at the JMC meeting include:

- Natural resources in the area important, bush tucker
- Concerns regarding tourism, and the potential for tourists to steal artefacts
- Dam walls contain Aboriginal sites
- Homestead Dam to be repaired for fish passage and also cultural water storage for potential jetty/pontoon access
- Ross Billabong area of high cultural significance. Junction of the Darling and Warrego is location of a dreamtime story.
- Stone artefacts are contained within dam walls
- Greater concern over the potential for additional flows to impact on sites
- Minimal impacts to dam walls lessened concerns
- All dams to be considered in the site options
- Indigenous training and employment opportunities in the project works be recommended
- Flows to the Western Floodplain to be maintained
- Access to cultural flows
- Management of flow regime to achieve cultural objectives. *Project Response*

Project Response

The JMC feedback was considered and incorporated into the business case concept plan

26 August – on-site JMC meeting

Purpose

Presentation of the draft Toorale Water Delivery Project Business Case for comment

JMC Feedback

- Supported Option B (gates at Boera dam) as the preferred arrangement but they were not happy with Option A.
- Asked that more employment opportunities for Aboriginal people be made available during this project.

Project Response

JMC feedback noted

2017

9 March 2017 - AHIP consultation

Purpose

Consultants Biosis provided each Registered Aboriginal Parties, or "RAPs", (including the JMC) with a copy of the study methodology pack outlining the proposed Aboriginal cultural heritage assessment process and methodology for this study. RAPs were given 28 days to review and prepare feedback on the proposed methodology.

JMC/RAP feedback

No comments from RAPs were received at this stage of consultation.

13 May – on-site JMC meeting

Purpose

At the completion of fieldwork undertaken to support the Aboriginal Cultural Heritage Assessment, a meeting was held with the Toorale JMC to discuss the management of cultural heritage sites which may be impacted as part of the construction.

JMC Feedback

As shown in ACHA report

Project Response

The feedback of the JMC has been incorporated into the AHIP conditions

26 August – on-site meeting

Purpose

To update the JMC on progress with the Toorale Environmental Water Infrastructure project and explain that the application for the AHIP had been lodged. Also, to seek advice on who to contract as site monitors to be engaged to salvage artefacts and to monitor proposed survey and geotechnical investigations.

JMC Feedback

The JMC provided feedback on appropriate site monitors to engage. Requested copy of AHIP when issued.

Project Response

Site monitors have been sought and engaged based on JMC advice. Copy of AHIP has been provided to JMC.

25 November – on-site JMC meeting

Purpose

Provide project update, specifically the upcoming salvage of Aboriginal artefacts, and marking out the no go areas, and to table the Project AHIP.

JMC Feedback

The JMC noted the new information

Project Response

n/a

2018

12-13 May 2018 - meeting

Purpose

Presentation of results of text excavations at Boera and Homestead. Consult JMC on analysis of samples and artefacts.

Project update. Discuss design issues

JMC Feedback

- The JMC approved Biosis taking samples from pits for OSL dating.
- Do not want prefabricated “tombstone” ridges used in rock ramp due to maintenance, visual impact, employment, safety and longevity. Want natural rock used at all 3 sites where a rock ramp is proposed
- Want employment opportunities for Bourke
- Want Alluvium to review the need for number/width of culverts/gates required at Boera
- Use Peebles soil to fill holes at Homestead and Boera
- Prefer box culverts to a bridge at Homestead
- Responsibility for management should be shared between the Australian Government and State

Project Response

Samples collected and sent for analysis

JMC feedback noted and considered in design process.

14-15 July – meeting

Purpose

To provide project update, to discuss fishway design issues and canvass reprioritisation of works to start with Peebles and partial rebuild of Homestead Dam within 18/18 FY

JMC Feedback

- Still want a rock-ramp style fishway at Homestead
- Don't want 100s of tons of rock transported across country
- Will support a prefab style made to look more like rocks for dams under 2m
- For barriers over 2m prefer a vertical slot fishway because less impact, but need access over both sides
- Don't want impact to cultural trees on banks of Homestead Dam
- Would like prefabricated structure to be made on-park if possible
- Want the project to lean more towards ACH side of things
- Want Matt Gordos to speak to some of committee in the interim by telecon about what the options are that can be put together. Also to come and speak at the next JMC meeting.
- Don't want Peebles (and Homestead partial) commenced in 18/19

Project Response

JMC recommendations carried forward in design process to make prefabricated ridges more rock-like in appearance. Revise fish passage to a vertical slot structure at Boera to minimise footprint. Arrangement made for DPI Fisheries to attend next JMC meeting. Prefabricated ridges will reduce volume of rock needed to be transported on park.

12 October

Purpose

For DPI Fisheries to attend and present on fish passage matters, and to advise the JMC about developments with the dating of the sample taken from the test pit at Boera Dam.

JMC Feedback

- The JMC is happy that the project has now addressed all the issues they have raised
- They now have a better understanding of fishways and why they are important
- They support a VS fishway at Boera and rock ramp fishways at Booka and Homestead as long as ridges are made to resemble rocks as described on the day
- Believe that transporting soil from Peebles to Homestead will have too great an impact
- Want the fishways to be prefabricated in Bourke or contracted/made on site.

Project Response

Could not guarantee that construction materials will be sourced from/made in Bourke since it will be subject to procurement guidelines as well as providers of services of such a specialised nature being available in Bourke. Can try to write documentation in a way that will encourage this outcome. Also advised JMC members to alert people in Bourke community that this work is potentially coming so that they can skill/gear up and be positioned to apply for it.

Appendix C : EPA Advice

NSW EPA

Our reference SF17/67665; DOC17/816381
Contact Matthew Prince, 02 6883 5354
Date 15 December 2017

Sonya Ardill
Senior Environmental Water Planner
Regional Operations Division
Office of Environment and Heritage
48- 52 Wingewarra Street Dubbo
NSW 2830

Dear Sonya,

I refer to your email dated 8 December 2017 to the Environment Protection Authority ("EPA") requesting input from the EPA in relation to the proposed modification to the existing earth bank weirs across the lower Warrego River on Toorale National Park via Bourke NSW (the project).

With reference to the information supplied within the email, the EPA understands that the project involves minor modifications to existing earth bank weirs across the Lower Warrego River to enable more frequent passing of small to moderate flow events that come down the River. Base on this advice the EPA would like to advise that the project is not Integrated Development from the EPA's perspective and will not require an Environment Protection Licence.

The EPA recommends that the Environmental Assessment for the project should consider the following general matters.

- **Water quality Impacts** - identification of appropriate pollution control systems to protect surface and ground water resources such as sediment and erosion controls during construction and operational stages and inclusion of permanent sediment and erosion and stormwater controls where required.
- **Noise** – identify potential impacts and mitigation strategies to be incorporated during construction and operation to minimise noise and comply with NSW policies and legislation on noise control.
- **Odour and Dust** – identify impacts from odour and dust during the construction and operational periods and identify mitigative measures.
- **Storage of chemicals/ fuels** - ensure adequate control measures are in place for storages to reduce risk of spills contaminating waterways and land.
- **Waste management** – options and strategies for waste minimisation, reuse and recycling should be assessed as appropriate.

It is recommended that in achieving a high standard of sediment and erosion controls and general site management the proponent, or any contractor engaged by the proponent, develop and implement the

PO Box 2111 Dubbo NSW 2830
Level 1, 52 Wingewarra Street, Dubbo NSW 2830
Tel: (02) 6883 5330 Fax: (02) 6884 8675
ABN 43 692 285 758
www.epa.nsw.gov.au
central.west@epa.nsw.gov.au

proposal in accordance with relevant guidelines such as the EPA endorsed publication "*Soils and Construction, Volume 1, 4th Edition,*" March 2004 by Landcom.

It should be noted that this information are guidelines only and it is up to the proponent (and later the consent/determining authority after appropriate consultation) to determine the detail and comprehensiveness of the surveys and level of assessment required to form legally defensible conclusions regarding the impact of the proposal.

The scale and intensity of the proposed development should dictate the level of investigation. It is important that all conclusions are supported by adequate data.

If you have any questions, or wish to discuss this matter further please contact Mr Matthew Prince at the EPA's Central West Dubbo office by telephoning 02 6883 5354 or by email at central.west@epa.nsw.gov.au.

Yours sincerely

BRAD TANSWELL
Head Central West Operations - Dubbo
Environment Protection Authority

Appendix D : Flora Species List

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Acanthaceae	*Rostellularia adscendens*	Pink Tongues				BioNet,
Aizoaceae	*Geijera parviflora*	Hairy Carpet-weed				BioNet, Fauna 2003,
Aizoaceae	*Tetragonia eremaea*					BioNet,
Aizoaceae	*Tetragonia tetragonioides*	New Zealand Spinach				BioNet, Fauna 2003, ELA LTIM
Aizoaceae	*Trianthema triquetra*	Small Hogweed				BioNet,
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed				BioNet, Fauna 2003, ELA LTIM
Amaranthaceae	*Alternanthera nodiflora*	Common Joyweed				BioNet, Fauna 2003, ELA LTIM
Amaranthaceae	*Amaranthus macrocarpus*	Dwarf Amaranth				BioNet,
Amaranthaceae	*Amaranthus mitchellii*	Boggabri Weed				BioNet,
Amaranthaceae	*Ptilotus atriplicifolius* var. *atriplicifolius*	Crimson Foxtails				Fauna 2003
Amaranthaceae	*Ptilotus exaltatus* var. *exaltatus*	Tall Mulla Mulla	P			BioNet,
Amaranthaceae	*Ptilotus gaudichaudii* var. *gaudichaudii*	Paper Foxtail				Fauna 2003
Amaranthaceae	*Ptilotus leucocomus*	Small Purple Foxtail				BioNet,
Amaranthaceae	*Ptilotus obovatus* var. *obovatus*	Silver Tails	P			BioNet,
Amaranthaceae	*Ptilotus polystachyus* var. *polystachyus*	Long Tails				BioNet,
Amaranthaceae	*Ptilotus sessilifolius* var. *sessilifolius*					BioNet,
Amaranthaceae	*Ptilotus spathulatus* f. *spathulatus*	Pussy-tails				BioNet,
Amaryllidaceae	*Crinum flaccidum*	Darling Lily				BioNet, ELA LTIM
Apiaceae	*Ammi majus*	Bishops Weed			I	Fauna 2003

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Apiaceae	*Daucus glochidiatus*	Australian Carrot				BioNet, Fauna 2003, ELA LTIM
Apiaceae	*Daucus* sp.					ELA LTIM
Apiaceae	*Eryngium paludosum*					BioNet, Fauna 2003, ELA LTIM
Apiaceae	*Trachymene ochracea*	White Parsnip				BioNet,
Apocynaceae	*Alstonia constricta*	Quinine Bush				BioNet,
Apocynaceae	*Marsdenia australis*	Doubah				BioNet,
Apocynaceae	*Rhyncharrhena linearis*	Purple Pentatrope				BioNet,
Asphodelaceae	*Bulbine bulbosa*	Bulbine Lily				ELA LTIM
Asphodelaceae	*Bulbine* sp.	Native Leek				Fauna 2003
Asteraceae	*Angianthus brachypappus*	Spreading Cup-flower				BioNet,
Asteraceae	*Aster subulatus*	Wild Aster			I	BioNet, ELA LTIM
Asteraceae	*Asteraceae* sp.					ELA LTIM
Asteraceae	*Brachyscome ciliaris*	Variable Daisy				BioNet,
Asteraceae	*Brachyscome curvicarpa*					BioNet,
Asteraceae	*Brachyscome dentata*					ELA LTIM
Asteraceae	*Brachyscome lineariloba*	Hard-Headed daisy				BioNet,
Asteraceae	*Brachyscome melanocarpa*	Black-Seeded daisy				ELA LTIM
Asteraceae	*Brachyscome* sp.					BioNet, ELA LTIM
Asteraceae	*Calotis cuneata*	Mountain Burr-daisy				Fauna 2003, ELA LTIM
Asteraceae	*Calotis cuneifolia*	Purple Burr-daisy				BioNet, ELA LTIM
Asteraceae	*Calotis erinacea*	Tangled Burr-daisy				Fauna 2003
Asteraceae	*Calotis hispidula*	Bogan Flea				BioNet, ELA LTIM,
Asteraceae	*Calotis inermis*	Fluffy Burr-daisy				BioNet
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy				ELA LTIM
Asteraceae	*Calotis latiuscula*					ELA LTIM
Asteraceae	*Calotis plumulifera*	Woolly-headed Burr-daisy				BioNet,
Asteraceae	*Calotis scabiosifolia*	Rough Burr-daisy				ELA LTIM
Asteraceae	*Carthamus lanatus*	Saffron Thistle			I	BioNet, Fauna 2003, ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Asteraceae	*Centaurea melitensis*	Maltese Cockspur			I	BioNet, Fauna 2003, ELA LTIM
Asteraceae	*Centipeda cunninghamii*	Common Sneezeweed				BioNet, Fauna 2003
Asteraceae	*Centipeda minima* subsp. *minima*					BioNet, ELA LTIM
Asteraceae	*Centipeda* sp.					ELA LTIM
Asteraceae	*Centipeda thespidioides*	Desert Sneezeweed				ELA LTIM
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting				ELA LTIM
Asteraceae	*Chthonocephalus pseudevax*	Ground-heads				Fauna 2003
Asteraceae	*Cichorium intybus*	Chicory				ELA LTIM
Asteraceae	*Cirsium vulgare*	Spear Thistle				ELA LTIM
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane			I	BioNet, ELA LTIM
Asteraceae	*Conyza* sp.	A Fleabane				ELA LTIM
Asteraceae	*Craspedia uniflora*			P		BioNet
Asteraceae	*Cymbonotus maidenii*					BioNet,
Asteraceae	*Eclipta platyglossa*	Yellow Twin-heads				ELA LTIM
Asteraceae	*Eriochlamys cupularis*					BioNet
Asteraceae	*Eucalyptus vicina*	Star Cudweed				BioNet
Asteraceae	*Glinus lotoides*	Cobbler's Tack				BioNet, ELA LTIM
Asteraceae	*Glycine tabacina*	Erect Yellow Heads				ELA LTIM
Asteraceae	*Harmsiodoxa blennodioides*					BioNet
Asteraceae	*Hypericum gramineum*	Catsear				ELA LTIM
Asteraceae	*Iseilema vaginiflorum*	Grass Cushions				BioNet,
Asteraceae	*Isotropis wheeleri*					BioNet,
Asteraceae	*Lactuca saligna*	Willow-leaved Lettuce				ELA LTIM
Asteraceae	*Lactuca serriola*	Prickly Lettuce				ELA LTIM
Asteraceae	*Leiocarpa brevicompta*	Flat Billy-buttons				BioNet
Asteraceae	*Leiocarpa leptolepis*	Pale Plover-daisy				BioNet
Asteraceae	*Leiocarpa panaetioides*	Wooly Buttons				BioNet
Asteraceae	*Leiocarpa* sp.					ELA LTIM
Asteraceae	*Leptorhynchos baileyi*	Woolly Buttons				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Asteraceae	*Minuria integerrima*	Smooth Minuria				BioNet, ELA LTIM
Asteraceae	*Myriocephalus rhizocephalus*	Woolly-heads				BioNet
Asteraceae	*Olearia pimeleoides*					BioNet,
Asteraceae	*Podolepis capillaris*	Invisible Plant				BioNet,
Asteraceae	*Pseudognaphalium luteoalbum*	Jersey Cudweed				BioNet, Fauna 2003, ELA LTIM
Asteraceae	*Pterocaulon sphacelatum*	Applebush				BioNet
Asteraceae	*Pycnosorus chrysanthes*	Golden Billy-buttons	P			BioNet, Fauna 2003
Asteraceae	*Rhodanthe floribunda*	Common White Sunray				BioNet, ELA LTIM
Asteraceae	*Rhodanthe* sp.	Slender Sunray				Fauna 2003
Asteraceae	*Rhodanthe stricta*					ELA LTIM
Asteraceae	*Rutidosis helichrysoides*	Grey Wrinklewort				BioNet, Fauna 2003
Asteraceae	*Senecio glossanthus*					ELA LTIM
Asteraceae	*Senecio quadridentatus*					ELA LTIM
Asteraceae	*Senecio runcinifolius*					ELA LTIM
Asteraceae	*Senecio* sp.	Groundsel, Fireweed				ELA LTIM
Asteraceae	*Silybum marianum*	Variegated Thistle			I	BioNet, Fauna 2003
Asteraceae	*Sonchus asper*	Prickly Sowthistle			I	Fauna 2003,
Asteraceae	*Sonchus oleraceus*	Common Sowthistle			I	BioNet, Fauna 2003, ELA LTIM
Asteraceae	*Sonchus* sp.					ELA LTIM
Asteraceae	*Taraxacum officinale*	Dandelion				ELA LTIM
Asteraceae	*Verbesina encelioides* subsp. *encelioides*	Crownbeard			I	BioNet, ELA LTIM
Asteraceae	*Vittadinia cervicularis* var. *cervicularis*	A Fuzzweed				BioNet
Asteraceae	*Vittadinia cuneata*	A Fuzzweed				BioNet, ELA LTIM
Asteraceae	*Vittadinia eremaea*					BioNet
Asteraceae	*Vittadinia quadridentatus*					ELA LTIM
Asteraceae	*Vittadinia* sp.	Fuzzweed				Fauna 2003, ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Asteraceae	*Vittadinia sulcata*					BioNet
Asteraceae	*Xanthium occidentale*	Noogoora Burr			I	BioNet
Asteraceae	*Xanthium spinosum*	Bathurst Burr			I	BioNet, ELA LTIM
Asteraceae	*Xerochrysom* sp.					ELA LTIM
Asteraceae	*Zaleya galericulata*	Hogweed				ELA LTIM
Azollaceae	*Azolla filiculoides*	Pacific Azolla				BioNet
Boraginaceae	*Cynoglossum australe*					ELA LTIM
Boraginaceae	*Cynoglossum* sp.					ELA LTIM
Boraginaceae	*Echium marginale*					ELA LTIM
Boraginaceae	*Echium plantagineum*	Patterson's Curse			I	BioNet, ELA LTIM
Boraginaceae	*Hedypnois rhagadioloides*	Common Heliotrope			I	ELA LTIM
Boraginaceae	*Heliotropium europaeum*	Prostrate Heliotrope				BioNet, Fauna 2003, ELA LTIM
Brassicaceae	*Alyssum linifolium*	Flax-leaf Alyssum			I	BioNet, Fauna 2003
Brassicaceae	*Brassica* sp.	Brassica				ELA LTIM
Brassicaceae	*Brassica tournefortii*	Mediterranean Turnip			I	BioNet, ELA LTIM
Brassicaceae	*Brassicaceae* sp.	Mustards				ELA LTIM
Brassicaceae	*Haloragis* sp.					BioNet, ELA LTIM
Brassicaceae	*Lepidium africanum*	Peppercress			I	Fauna 2003
Brassicaceae	*Lepidium bonariense*	Argentine Peppercress				ELA LTIM
Brassicaceae	*Lepidium campastre*					ELA LTIM
Brassicaceae	*Lepidium campestre*					ELA LTIM
Brassicaceae	*Lepidium leptopetalum*					BioNet
Brassicaceae	*Lepidium monoplocoides*	Winged pepper-cress [9190]	E			PMST 2017
Brassicaceae	*Lepidium papillosum*	Warty peppercress				BioNet
Brassicaceae	*Lepidium pseudohyssopifolium*	Peppercress				BioNet, ELA LTIM
Brassicaceae	*Lepidium* spp.	A peppercress			I	BioNet, ELA LTIM
Brassicaceae	*Phlegmatospermum cochlearinum*	Oval-podded cress				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Brassicaceae	*Sisymbrium erysimoides*	Smooth mustard			I	BioNet, Fauna 2003
Brassicaceae	*Sisymbrium irio*					ELA LTIM
Brassicaceae	*Sisymbrium officinale*					ELA LTIM
Brassicaceae	*Sisymbrium orientale*	Indian hedge mustard			I	BioNet
Brassicaceae	*Sisymbrium* sp.					ELA LTIM
Campanulaceae	*Wahlenbergia communis*	Tufted bluebell				BioNet, ELA LTIM
Campanulaceae	*Wahlenbergia fluminalis*	River bluebell				BioNet
Campanulaceae	*Wahlenbergia gracilenta*	Annual bluebell				BioNet, ELA LTIM
Campanulaceae	*Wahlenbergia gracilis*	Sprawling bluebell				BioNet
Campanulaceae	*Wahlenbergia* sp.	Native bluebell				Fauna 2003, ELA LTIM
Campanulaceae	*Wahlenbergia* spp.	Bluebell				BioNet
Campanulaceae	*Wahlenbergia stricta*	Tall bluebell				BioNet
Campanulaceae	*Walwhalleya proluta*					BioNet, ELA LTIM
Campanulaceae	*Whalenbergia gracillis*					ELA LTIM
Campanulaceae	*Whalenbergia* sp.	Noogoora burr				ELA LTIM
Capparaceae	*Apophyllum anomalum*	Warrior bush				BioNet, Fauna 2003
Capparaceae	*Capparis mitchellii*	Native orange				BioNet
Caryophyllaceae	*Petrorhagia nanteulii*					ELA LTIM
Caryophyllaceae	*Silene* sp.					ELA LTIM
Caryophyllaceae	*Stellaria angustifolia*	Swamp starwort				BioNet, ELA LTIM
Caryophyllaceae	*Stellaria media*	Common chickweed			I	BioNet, ELA LTIM
Caryophyllaceae	Unknown *Caryophyllaceae*					ELA LTIM
Casuarinaceae	*Casuarina cristata*	Belah				Fauna 2003
Casuarinaceae	*Casuarina pauper*	Black oak				BioNet
Chenopodiaceae	*Atriplex angulata*	Fan saltbush				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Atriplex conduplicata*					BioNet
Chenopodiaceae	*Atriplex eardleyae*	Small saltbush				BioNet
Chenopodiaceae	*Atriplex holocarpa*	Pop saltbush				BioNet, Fauna 2003

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Chenopodiaceae	*Atriplex infrequens*	A saltbush	V,P	V		BioNet
Chenopodiaceae	*Atriplex leptocarpa*	Slender-fruit saltbush				BioNet, ELA LTIM
Chenopodiaceae	*Atriplex limbata*					BioNet,
Chenopodiaceae	*Atriplex lindleyi*	Eastern flat-top saltbush				BioNet
Chenopodiaceae	*Atriplex muelleri*	Mueller's saltbush				BioNet, ELA LTIM
Chenopodiaceae	*Atriplex pseudocampanulata*					BioNet
Chenopodiaceae	*Atriplex* sp.	A saltbush				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Atriplex spongiosa*	Pop saltbush				BioNet
Chenopodiaceae	*Atriplex stipitata*	Mallee saltbush				BioNet
Chenopodiaceae	*Atriplex suberecta*					ELA LTIM
Chenopodiaceae	*Chenopodium auricomum*	Queensland bluebush				BioNet
Chenopodiaceae	*Chenopodium cristatum*	Crested goosefoot				BioNet
Chenopodiaceae	*Chenopodium curvispicatum*					BioNet
Chenopodiaceae	*Chenopodium desertorum*	Desert goosefoot				BioNet
Chenopodiaceae	*Chenopodium melanocarpum*	Black crumbweed				BioNet, ELA LTIM
Chenopodiaceae	*Chenopodium nitrariaceum*	Nitre goosefoot				BioNet, ELA LTIM
Chenopodiaceae	*Chenopodium* sp.	Crumbweed				Fauna 2003, ELA LTIM
Chenopodiaceae	*Dissocarpus biflorus* var. *biflorus*					BioNet
Chenopodiaceae	*Dissocarpus biflorus* var. *cephalocarpus*	Many-horned cpperburr				BioNet
Chenopodiaceae	*Dissocarpus paradoxus*	Cannonball				BioNet, Fauna 2003
Chenopodiaceae	*Dysphania pumilio*	Small crumbweed				BioNet
Chenopodiaceae	*Dysphania* sp.					ELA LTIM
Chenopodiaceae	*Einadia hastata*	Berry saltbush				ELA LTIM
Chenopodiaceae	*Einadia nutans*	Climbing saltbush				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Einadia nutans* subsp. *eremaea*	Climbing saltbush				Fauna 2003

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Chenopodiaceae	*Einadia nutans* subsp. *nutans*	Climbing saltbush				BioNet
Chenopodiaceae	*Einadia polygonoides*	Knotweed goosefoot				ELA LTIM
Chenopodiaceae	*Einadia trigonos*					ELA LTIM
Chenopodiaceae	*Enchylaena tomentosa*	Ruby saltbush				BioNet, ELA LTIM
Chenopodiaceae	*Maireana aphylla*	Cotton bush				BioNet
Chenopodiaceae	*Maireana brevifolia*					BioNet
Chenopodiaceae	*Maireana coronata*	Crown fissure-weed				BioNet
Chenopodiaceae	*Maireana decalvans*	Black cotton bush				BioNet
Chenopodiaceae	*Maireana enchylaenoides*	Wingless fissure-weed				BioNet
Chenopodiaceae	*Maireana georgei*	Slit-wing bluebush				BioNet
Chenopodiaceae	*Maireana microcarpa*					BioNet
Chenopodiaceae	*Maireana sclerolaenoides*					BioNet
Chenopodiaceae	*Maireana* spp.	Cotton bush, bluebush, fissure-weed				BioNet
Chenopodiaceae	*Maireana triptera*	Three-wing bluebush				BioNet
Chenopodiaceae	*Maireana villosa*	Silky bluebush				BioNet
Chenopodiaceae	*Malacocera tricornis*	Soft horns				BioNet
Chenopodiaceae	*Osteocarpum acropterum*	Water weed				BioNet
Chenopodiaceae	*Osteocarpum acropterum* var. *acropterum*					BioNet
Chenopodiaceae	*Osteocarpum scleropterum*	Squash bush	E1,P			BioNet
Chenopodiaceae	*Rhagodia spinescens*	Thorny saltbush				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Salsola australis*					ELA LTIM
Chenopodiaceae	*Salsola kali* var. *kali*	Buckbush				BioNet, ELA LTIM
Chenopodiaceae	*Salsola tragus*	Buckbush				BioNet, Fauna 2003
Chenopodiaceae	*Scleroblitum atriplicinum*	Purple goosefoot				ELA LTIM
Chenopodiaceae	*Sclerolaena anisacanthoides*	Yellow burr				BioNet
Chenopodiaceae	*Sclerolaena articulata*					BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Chenopodiaceae	*Sclerolaena bicornis*	Goathead burr				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena bicornis* var. *bicornis*					BioNet
Chenopodiaceae	*Sclerolaena bicornis* var. *horrida*	Goathead burr				BioNet
Chenopodiaceae	*Sclerolaena birchii*	Galvanised burr				Fauna 2003, ELA LTIM
Chenopodiaceae	*Sclerolaena brachyptera*	Short-winged copperburr				BioNet
Chenopodiaceae	*Sclerolaena calcarata*	Redburr				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena convexula*	Tall copperburr				BioNet, Fauna 2003
Chenopodiaceae	*Sclerolaena cuneata*					ELA LTIM
Chenopodiaceae	*Sclerolaena decurrens*	Green copperburr				BioNet
Chenopodiaceae	*Sclerolaena diacantha*	Grey copperburr				BioNet
Chenopodiaceae	*Sclerolaena divaricata*	Tangled Copperburr				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena eriacantha*	Silky Copperburr				BioNet, Fauna 2003,
Chenopodiaceae	*Sclerolaena intricata*	Poverty Bush				BioNet
Chenopodiaceae	*Sclerolaena lanicuspis*	Woolly Copperburr				BioNet
Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena muricata* var. *muricata*	Black Rolypoly				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena muricata* var. *semiglabra*	Black Rolypoly				BioNet
Chenopodiaceae	*Sclerolaena muricata* var. *villosa*	Black Rolypoly				BioNet, ELA LTIM
Chenopodiaceae	*Sclerolaena obliquicuspis*					BioNet
Chenopodiaceae	*Sclerolaena parallelicuspis*					BioNet
Chenopodiaceae	*Sclerolaena patenticuspis*					BioNet
Chenopodiaceae	*Sclerolaena* sp.	Copperburr species				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Sclerolaena stelligera*	Star copperburr				BioNet
Chenopodiaceae	*Sclerolaena tetracuspis*	Brigalow burr				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Chenopodiaceae	*Sclerolaena tricuspis*	Giant redburr				BioNet, Fauna 2003, ELA LTIM
Chenopodiaceae	*Sclerolaena ventricosa*	Salt copperburr				BioNet
Chenopodiaceae	*Tecticornia pergranulata*					BioNet
Chenopodiaceae	*Tecticornia pergranulata* subsp. *pergranulata*					BioNet
Chenopodiaceae	*Tecticornia triandra*	Desert glasswort				ELA LTIM
Convolvulaceae	*Convolvulus clementii*	Desert bindweed				BioNet
Convolvulaceae	*Convolvulus erubescens*	Australian bindweed				BioNet, Fauna 2003
Convolvulaceae	*Convolvulus graminetinus*					ELA LTIM
Convolvulaceae	*Convolvulus remotus*					BioNet
Convolvulaceae	*Convolvulus* spp.	A bindweed			I	BioNet
Convolvulaceae	*Cuscuta campestris*	Golden Dodder			I	BioNet
Convolvulaceae	*Hypochaeris radicata*					ELA LTIM
Cucurbitaceae	*Citrullus lanatus* var. *lanatus*	Wild Melon			I	BioNet
Cucurbitaceae	*Cucumis melo* subsp. *agrestis*	Ulcardo Melon				ELA LTIM
Cucurbitaceae	*Cucumis myriocarpus*					ELA LTIM
Cucurbitaceae	*Cucumis myriocarpus* subsp. *leptodermis*	Paddy Melon			I	BioNet, ELA LTIM
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine				BioNet
Cyperaceae	*Cyperus difformis*	Dirty Dora				BioNet
Cyperaceae	*Cyperus fulvus*	Sticky Sedge				BioNet
Cyperaceae	*Cyperus* sp.					ELA LTIM
Cyperaceae	*Eleocharis pallens*	Pale Spike Sedge				BioNet, ELA LTIM
Cyperaceae	*Eleocharis pusilla*					ELA LTIM
Cyperaceae	*Eleocharis* sp.	Spike-rush				ELA LTIM
Elatinaceae	*Bergia trimera*	Small Water-fire				ELA LTIM
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed				BioNet, Fauna 2003, ELA LTIM
Euphorbiaceae	*Chamaesyce* sp.					ELA LTIM
Euphorbiaceae	*Euchiton sphaericus*	Plains Spurge				BioNet
Euphorbiaceae	*Euphorbia planiticola*					BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Fabaceae	*Exocarpos aphyllus*					Fauna 2003
Fabaceae	*Parkinsonia aculeata*	Parkinsonia			I	PMST 2017
Fabaceae	*Prosopis* spp.	Mesquite, Algaroba [68407]			I	PMST 2017
Fabaceae	*Trifolium glomeratum*					ELA LTIM
Fabaceae	*Trifolium* sp.					ELA LTIM
Fabaceae (Caesalpinioideae)	*Senna circinnata*					BioNet
Fabaceae (Caesalpinioideae)	Senna form taxon *'petiolaris'*	Woody Cassia				BioNet
Fabaceae (Faboideae)	*Aeschynomene indica*	Budda Pea				BioNet, ELA LTIM
Fabaceae (Faboideae)	*Glossocardia bidens*	Silky Glycine				BioNet
Fabaceae (Faboideae)	*Glycine canescens*	Twining Glycine				BioNet
Fabaceae (Faboideae)	*Glycine clandestina*	Variable Glycine				BioNet
Fabaceae (Faboideae)	*Isoetopsis graminifolia*	Wheeler's Lamb-poison				Fauna 2003
Fabaceae (Faboideae)	*Medicago laciniata*	Cut-leaf Medic			I	BioNet, Fauna 2003
Fabaceae (Faboideae)	*Medicago minima*	Woolly Burr Medic			I	BioNet
Fabaceae (Faboideae)	*Medicago polymorpha*	Burr Medic			I	BioNet, ELA LTIM
Fabaceae (Faboideae)	*Medicago* sp.					ELA LTIM
Fabaceae (Faboideae)	*Sesbania cannabina* var. *cannabina*	Sesbania Pea				BioNet, ELA LTIM
Fabaceae (Faboideae)	*Swainsona bracteata*					BioNet
Fabaceae (Faboideae)	*Swainsona greyana*	Darling Pea				BioNet
Fabaceae (Faboideae)	*Swainsona phacoides*	Dwarf Swainson-pea				BioNet
Fabaceae (Faboideae)	*Swainsona procumbens*	Broughton Pea				BioNet, ELA LTIM
Fabaceae (Faboideae)	*Swainsona* sp.					BioNet, ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Fabaceae (Faboideae)	*Templetonia aculeata*	Spiny Mallee Pea				BioNet
Fabaceae (Faboideae)	*Trigonella suavissima*	Coopers Clover				BioNet, ELA LTIM
Fabaceae (Mimosoideae)	*Acacia aneura*	Mulga				BioNet, Fauna 2003
Fabaceae (Mimosoideae)	*Acacia cambagei*	Gidgee				BioNet, Fauna 2003
Fabaceae (Mimosoideae)	*Acacia excelsa*	Ironwood				BioNet
Fabaceae (Mimosoideae)	*Acacia excelsa* subsp. *excelsa*	Ironwood				Fauna 2003
Fabaceae (Mimosoideae)	*Acacia oswaldii*	Miljee				BioNet
Fabaceae (Mimosoideae)	*Acacia salicina*	Cooba				BioNet
Fabaceae (Mimosoideae)	*Acacia* spp.	Wattle				BioNet
Fabaceae (Mimosoideae)	*Acacia stenophylla*	River Cooba				BioNet, ELA LTIM
Fabaceae (Mimosoideae)	*Acacia tetragonophylla*	Dead Finish				BioNet
Fabaceae (Mimosoideae)	*Acacia victoriae*					BioNet, Fauna 2003, ELA LTIM
Fabaceae (Mimosoideae)	*Acacia victoriae* subsp. *victoriae*	Elegant Wattle				BioNet
Frankeniaceae	*Flindersia maculosa*					BioNet, Fauna 2003
Gentianaceae	*Centaurium spicatum*	Spike Centaury				Fauna 2003
Geraniaceae	*Erodium crinitum*	Blue Crowfoot				BioNet
Goodeniaceae	*Gnephosis arachnoidea*	Cut-leaf Goodenia				BioNet, Fauna 2003
Goodeniaceae	*Goodenia cycloptera*	Mallee Goodenia				BioNet
Goodeniaceae	*Goodenia fascicularis*	Pale Goodenia				BioNet, ELA LTIM
Goodeniaceae	*Goodenia glauca*					BioNet
Goodeniaceae	*Goodenia heteromera*	Scrambles Eggs				BioNet, ELA LTIM
Goodeniaceae	*Goodenia pinnatifida*	Goodenia Species				BioNet, ELA LTIM
Goodeniaceae	*Velleia paradoxa*					ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Haloragaceae	*Hakea tephrosperma*	Rough Raspwort				BioNet
Haloragaceae	*Haloragis aspera*					ELA LTIM
Haloragaceae	*Haloragis glauca* f. *glauca*	Variable Raspwort				BioNet
Haloragaceae	*Haloragis heterophylla*	A Raspwort				BioNet, ELA LTIM
Hydrocharitaceae	*Ottelia ovalifolia* subsp. *ovalifolia*	Swamp Lily				BioNet
Hypericaceae	*Hibiscus trionum*					BioNet, ELA LTIM
Juncaceae	*Jasminum lineare*	Tussock Rush				BioNet
Juncaceae	*Juncus aridicola*	A Rush				BioNet
Juncaceae	*Juncus* sp.	A Rush				BioNet, ELA LTIM
Juncaceae	*Juncus subglaucus*	Rush				BioNet
Juncaceae	*Juncus usitatus*					ELA LTIM
Lamiaceae	*Mentha australis*	River Mint				BioNet, ELA LTIM
Lamiaceae	*Mentha* sp.					ELA LTIM
Lamiaceae	*Prostanthera striatiflora*	Jockey's Cap				BioNet
Lamiaceae	*Salvia verbenaca*	Vervain			I	BioNet, ELA LTIM
Lamiaceae	*Teucrium racemosum*	Grey Germander				BioNet
Lobeliaceae	*Lobelia darlingensis*	Darling Pratia				BioNet
Lobeliaceae	*Lobelia purpurascens*					ELA LTIM
Lobeliaceae	*Pratia concolor*	Poison Pratia				ELA LTIM
Loranthaceae	*Amyema maidenii* subsp. *maidenii*					BioNet
Loranthaceae	*Amyema miraculosum subsp. boormanii*					BioNet
Loranthaceae	*Amyema quandang*	Grey Mistletoe				BioNet
Loranthaceae	*Amyema quandang* var. *quandang*	Grey Mistletoe				BioNet
Loranthaceae	*Amyema* sp.	Mistletoe				BioNet, ELA LTIM
Loranthaceae	*Lysiana exocarpi*					BioNet
Loranthaceae	*Lysiana exocarpi* subsp. *exocarpi*					BioNet, ELA LTIM
Loranthaceae	*Lysiana* spp.					BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Loranthaceae	*Lysiana subfalcata*					ELA LTIM
Lythraceae	*Ammannia multiflora*	Jerry-Jerry				BioNet, ELA LTIM
Malvaceae	*Abutilon leucopetalum*					BioNet
Malvaceae	*Abutilon malvifolium*					ELA LTIM
Malvaceae	*Abutilon otocarpum*	Desert Chinese-Lantern				BioNet, Fauna 2003, ELA LTIM
Malvaceae	*Abutilon oxycarpum*	Straggly Lantern-Bush				ELA LTIM
Malvaceae	*Abutilon sp.*	Lantern-Bush				ELA LTIM
Malvaceae	*Heliotropium supinum*	Velvet-Leaf Hibiscus				ELA LTIM
Malvaceae	*Hibiscus krichauffianus*	Flower-Of-An-Hour				BioNet
Malvaceae	*Malva parviflora*	Small-Flowered Mallow			I	BioNet, ELA LTIM
Malvaceae	*Malva sp.*	Mallow				ELA LTIM
Malvaceae	*Malvastrum americanum*	Spiked Malvastrum			I	BioNet, ELA LTIM
Malvaceae	*Sida corrugata*	Corrugated Sida				BioNet, ELA LTIM
Malvaceae	*Sida cunninghamii*	Ridge Sida				BioNet, ELA LTIM
Malvaceae	*Sida fibulifera*	Pin Sida				BioNet, ELA LTIM
Malvaceae	*Sida filiformis*					BioNet
Malvaceae	*Sida glauca*					ELA LTIM
Malvaceae	*Sida intricata*					BioNet
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne				ELA LTIM
Malvaceae	*Sida sp.*	Sida Species				Fauna 2003, ELA LTIM
Malvaceae	*Sida trichopoda*	High Sida				BioNet, ELA LTIM,
Marsileaceae	*Marsilea drummondii*	Common Nardoo				BioNet, Fauna 2003, ELA LTIM
Marsileaceae	*Marsilea sp.*	A Nardoo				ELA LTIM
Myoporaceae	*Eremophila bignoniiflora*	Eurah				BioNet
Myoporaceae	*Eremophila deserti*	Turkeybush				BioNet, ELA LTIM
Myoporaceae	*Eremophila glabra*	Tar Bush				BioNet
Myoporaceae	*Eremophila longifolia*	Emubush				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Myoporaceae	*Eremophila mitchellii*	Budda				BioNet, Fauna 2003
Myoporaceae	*Eremophila polyclada*	Flowering Lignum				BioNet, Fauna 2003
Myoporaceae	*Eremophila serrulata*	Green Fuchsia Bush				BioNet
Myoporaceae	*Eremophila* spp.					BioNet
Myoporaceae	*Eremophila sturtii*	Turpentine				BioNet, Fauna 2003
Myoporaceae	*Myoporum montanum*	Western Boobialla				BioNet, ELA LTIM
Myoporaceae	*Myoporum platycarpum*	Sugarwood				BioNet
Myrtaceae	*Corymbia tumescens*					BioNet
Myrtaceae	*Eryngium rostratum*	River Red Gum				ELA LTIM
Myrtaceae	*Eucalyptus camaldulensis*	Coolibah				BioNet
Myrtaceae	*Eucalyptus coolabah*					BioNet, Fauna 2003, ELA LTIM
Myrtaceae	*Eucalyptus coolabah* subsp. *coolabah*	Gum Coolibah				BioNet
Myrtaceae	*Eucalyptus intertexta*	Black Box				BioNet
Myrtaceae	*Eucalyptus largiflorens*	Bimble Box				BioNet, ELA LTIM
Myrtaceae	*Eucalyptus populnea*	Bimble Box				Fauna 2003
Myrtaceae	*Eucalyptus populnea* subsp. *bimbil*					BioNet, ELA LTIM
Nitrariaceae	*Nitraria billardierei*	Dillon Bush				BioNet
Nitrariaceae	*Nitraria* spp.					BioNet
Nyctaginaceae	*Boerhavia dominii*	Tarvine				BioNet, ELA LTIM
Oleaceae	*Ixiolaena* sp.	Desert Jasmine				ELA LTIM
Onagraceae	*Frankenia serpyllifolia*					BioNet
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose				ELA LTIM
Oxalidaceae	*Oxalis perennans*					BioNet, ELA LTIM
Oxalidaceae	*Oxalis* sp.					BioNet, ELA LTIM
Papaveraceae	*Argemone ochroleuca* subsp. *ochroleuca*	Mexican Poppy			I	Fauna 2003, BioNet, ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Phormiaceae	*Dianella longifolia*	Blueberry Lily				BioNet
Phormiaceae	*Dianella* spp.					BioNet
Phyllanthaceae	*Phyllanthus fuernrohrii*					BioNet
Phyllanthaceae	*Phyllanthus lacunarius*					BioNet
Phyllanthaceae	*Phyllanthus lacunellus*					BioNet
Phyllanthaceae	*Phyllanthus* spp.				I	BioNet, ELA LTIM
Phyllanthaceae	*Sauropus trachyspermus*					BioNet
Pittosporaceae	*Pittosporum angustifolium*	Butterbush				BioNet
Plantaginacea	*Stemodia florulenta*					ELA LTIM
Plantaginaceae	*Plantago cunninghamii*	Sago-weed				BioNet, ELA LTIM
Plantaginaceae	*Plantago debilis*					ELA LTIM
Plantaginaceae	*Plantago* sp.	Plantain				Fauna 2003, ELA LTIM
Poaceae	*Arista* sp.	Wiregrass				Fauna 2003
Poaceae	*Aristida anthoxanthoides*					BioNet
Poaceae	*Aristida contorta*	Bunched Kerosene Grass				BioNet
Poaceae	*Aristida holathera* var. *holathera*	Erect Kerosene Grass				BioNet
Poaceae	*Aristida jerichoensis*	Jericho Wiregrass				BioNet
Poaceae	*Aristida jerichoensis* var. *jerichoensis*	Jericho Wiregrass				BioNet
Poaceae	*Aristida obscura*	Small Brush Wiregrass				Fauna 2003
Poaceae	*Aristida* spp.	A Wiregrass				BioNet
Poaceae	*Asperula gemella*	Twin-leaved Bedstraw				ELA LTIM
Poaceae	*Asperula geminifolia*					ELA LTIM
Poaceae	*Astrebla lappacea*	Curly Mitchell Grass				BioNet
Poaceae	*Astrebla pectinata*	Barley Mitchell Grass				BioNet
Poaceae	*Austrostipa acrociliata*					BioNet
Poaceae	*Austrostipa metatoris*			V		PMST 2017
Poaceae	*Austrostipa nitida*					BioNet
Poaceae	*Austrostipa nodosa*	A Speargrass				BioNet
Poaceae	*Austrostipa scabra*	Rough Speargrass				Fauna 2003
Poaceae	*Austrostipa scabra* subsp. *scabra*	Rough Speargrass				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Poaceae	*Austrostipa* sp.	A Speargrass				Fauna 2003, ELA LTIM
Poaceae	*Austrostipa* spp.	A Speargrass				BioNet
Poaceae	*Bothriochloa macra*	Red Grass				BioNet,
Poaceae	*Cenchrus ciliaris*	Buffel Grass			I	BioNet, Fauna 2003, ELA LTIM, PMST 2017
Poaceae	*Chloris pectinata*	Comb Chloris				BioNet
Poaceae	*Chloris* spp.				I	BioNet
Poaceae	*Chloris truncata*	Windmill Grass				BioNet, Fauna 2003
Poaceae	*Chrysopogon fallax*					BioNet
Poaceae	*Cymbopogon obtectus*	Silky Heads				BioNet
Poaceae	*Cynodon dactylon*	Common Couch				Fauna 2003, ELA LTIM
Poaceae	*Dactyloctenium radulans*	Button Grass				BioNet
Poaceae	*Deyeuxia* sp.					ELA LTIM
Poaceae	*Dichanthium sericeum*	Queensland Bluegrass				BioNet
Poaceae	*Dichanthium sericeum* subsp. *humilius*					BioNet
Poaceae	*Digitaria brownii*	Cotton Panic Grass				BioNet
Poaceae	*Digitaria ciliaris*	Summer Grass			I	BioNet
Poaceae	*Digitaria* sp.					ELA LTIM
Poaceae	*Diplachne fusca*	Brown Beetle Grass				BioNet, ELA LTIM
Poaceae	*Echinochloa colona*	Awnless Barnyard Grass				BioNet, ELA LTIM
Poaceae	*Echinochloa crus-galli*	Barnyard Grass			I	BioNet
Poaceae	*Echinochloa inundata*	Marsh Millet				BioNet, ELA LTIM
Poaceae	*Echinochloa* spp.				I	BioNet
Poaceae	*Enneapogon avenaceus*	Bottle Washers				BioNet
Poaceae	*Enneapogon cylindricus*	Jointed Nineawn				BioNet
Poaceae	*Enneapogon gracilis*	Slender Nineawn				BioNet
Poaceae	*Enneapogon intermedius*					BioNet
Poaceae	*Enneapogon nigricans*	Niggerheads				BioNet
Poaceae	*Enteropogon acicularis*	Curly Windmill Grass				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Poaceae	*Eragrostis australasica*	Canegrass				BioNet, ELA LTIM
Poaceae	*Eragrostis cilianensis*	Stinkgrass			I	BioNet
Poaceae	*Eragrostis dielsii*	Mallee Lovegrass				BioNet
Poaceae	*Eragrostis elongata*	Clustered Lovegrass				BioNet
Poaceae	*Eragrostis eriopoda*	Woollybutt				BioNet
Poaceae	*Eragrostis lacunaria*	Purple Lovegrass				BioNet
Poaceae	*Eragrostis laniflora*	Woollybutt				BioNet
Poaceae	*Eragrostis microcarpa*					BioNet
Poaceae	*Eragrostis parviflora*	Weeping Lovegrass				BioNet
Poaceae	*Eragrostis pergracilis*					BioNet
Poaceae	*Eragrostis setifolia*	Neverfail				BioNet
Poaceae	*Eragrostis* spp.	A Lovegrass			I	BioNet, Fauna 2003, ELA LTIM
Poaceae	*Eriachne mucronata*	Mountain Wanderrie Grass				BioNet
Poaceae	*Eriochloa crebra*	Cup Grass				BioNet, ELA LTIM
Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass				BioNet
Poaceae	*Ipomoea lonchophylla*	Small Flinders Grass				BioNet
Poaceae	*Iseilema membranaceum*	Red Flinders Grass				BioNet
Poaceae	*Lachnagrostis filiformis*					BioNet, ELA LTIM
Poaceae	*Monachather paradoxus*	Bandicoot Grass				BioNet
Poaceae	*Panicum decompositum*	Native Millet				BioNet
Poaceae	*Panicum decompositum* var. *tenuius*					ELA LTIM
Poaceae	*Panicum queenslandicum*	Yadbila Grass				BioNet
Poaceae	*Panicum* sp.	Panicum				ELA LTIM
Poaceae	*Paspalidium constrictum*	Knottybutt Grass				BioNet, ELA LTIM
Poaceae	*Paspalidium jubiflorum*	Warrego Grass				BioNet, ELA LTIM
Poaceae	*Paspalidium* sp.					BioNet, ELA LTIM

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Poaceae	*Paspalum distichum*	Water Couch				ELA LTIM
Poaceae	*Perotis rara*	Comet Grass				BioNet
Poaceae	*Phragmites australis*	Common Reed				BioNet
Poaceae	*Poaceae* sp.					ELA LTIM
Poaceae	*Rytidosperma* spp.					BioNet
Poaceae	*Setaria paspalidioides*					BioNet
Poaceae	*Sorghum halepense*	Johnson Grass			I	BioNet
Poaceae	*Sorghum* spp.				I	BioNet
Poaceae	*Sporobolus actinocladus*	Katoora Grass				BioNet
Poaceae	*Sporobolus caroli*	Fairy Grass				BioNet, ELA LTIM
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass				BioNet, ELA LTIM
Poaceae	*Sporobolus mitchellii*	Rat's Tail Couch				BioNet, ELA LTIM
Poaceae	*Thellungia advena simile*					ELA LTIM
Poaceae	*Thyridolepis mitchelliana*	Mulga Mitchell Grass				BioNet
Poaceae	*Tragus australianus*	Small Burrgrass				BioNet, ELA LTIM
Poaceae	*Tripogon loliiformis*	Fiveminute Grass				BioNet
Poaceae	*Triraphis mollis*	Purple Needlegrass				BioNet
Poaceae	*Urochloa gilesii*					BioNet
Poaceae	*Urochloa praetervisa*					BioNet
Poaceae	*Urochloa subquadripara*	Green Summer Grass				BioNet
Poaceae	*Urochloa texana*	Texas Millet			I	BioNet
Polygonaceae	*Duma florulenta*	Lignum				BioNet, ELA LTIM
Polygonaceae	*Muehlenbeckia florulenta*	Lignum				Fauna 2003
Polygonaceae	*Persicaria lapathifolia*	Pale Knotweed				BioNet
Polygonaceae	*Persicaria prostrata*	Creeping Knotweed				ELA LTIM
Polygonaceae	*Persicaria* sp.	Knotweed				ELA LTIM
Polygonaceae	*Polygonum arenastrum*	Wireweed			I	Fauna 2003
Polygonaceae	*Polygonum aviculare*	Wireweed			I	BioNet
Polygonaceae	*Polygonum plebeium*	Small Knotweed				BioNet
Polygonaceae	*Polygonum* spp.				I	BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Polygonaceae	*Rumex brownii*	Swamp Dock				BioNet, ELA LTIM
Polygonaceae	*Rumex* sp.	Dock				Fauna 2003, ELA LTIM
Polygonaceae	*Rumex tenax*	Shiny Dock				BioNet
Portulacaceae	*Portulaca oleracea*	Pigweed				BioNet, Fauna 2003
Primulaceae	*Anagallis arvensis*	Scarlet Pimpernel				ELA LTIM
Proteaceae	*Goodenia* spp.	Beefwood				BioNet, Fauna 2003, ELA LTIM
Proteaceae	*Grevillea striata*					BioNet
Proteaceae	*Hakea ivoryi*	Needlewood				BioNet
Proteaceae	*Hakea leucoptera*	Hooked Needlewood				BioNet
Ranunculaceae	*Ranunculus pumilio*					ELA LTIM
Ranunculaceae	*Ranunculus* sp.					ELA LTIM
Rhamnaceae	*Ventilago viminalis*	Supple Jack				BioNet, Fauna 2003
Rubiaceae	*Dentella minutissima*		E1,P			BioNet, ELA LTIM
Rubiaceae	*Synaptantha tillaeacea* var. *tillaeacea*					BioNet
Rubiaceae	*Synostemon trachyspermus*	Slender Spurge				
Rutaceae	*Fabaceae* sp.	Leopardwood				ELA LTIM
Rutaceae	*Gaura* sp.	Wilga				ELA LTIM
Rutaceae	*Phebalium glandulosum* subsp. *glandulosum*					BioNet
Santalaceae	*Euphorbia tannensis* subsp. *eremophila*	Leafless Cherry				BioNet
Sapindaceae	*Alectryon oleifolius*	Western Rosewood				BioNet
Sapindaceae	*Alectryon oleifolius subsp. elongatus*					BioNet
Sapindaceae	*Atalaya hemiglauca*	Whitewood				BioNet
Sapindaceae	*Dodonaea viscosa*					BioNet, ELA LTIM
Sapindaceae	*Dodonaea viscosa subsp. angustissima*	Narrow-Leaf Hop-Bush				BioNet, Fauna 2003, ELA LTIM
Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein				ELA LTIM
Solanaceae	*Duboisia hopwoodii*	Pituri				BioNet

Family	Scientific Name	Common Name	Status		Exotic	Sources
			NSW	Cth		
Solanaceae	*Lycium ferocissimum*	African Boxthorn			I	BioNet, Fauna 2003, ELA LTIM
Solanaceae	*Nicotiana simulans*					BioNet
Solanaceae	*Nicotiana suaveolens*	Native Tobacco				BioNet
Solanaceae	*Nicotiana velutina*					BioNet, Fauna 2003, ELA LTIM
Solanaceae	*Physalis lanceifolia*				I	BioNet
Solanaceae	*Physalis* spp.				I	BioNet
Solanaceae	*Solanum ellipticum*	Velvet Potato Bush				BioNet
Solanaceae	*Solanum esuriale*	Quena				BioNet, ELA LTIM
Solanaceae	*Solanum ferocissimum*	Spiny Potato-Bush				BioNet
Solanaceae	*Solanum jucundum*					BioNet
Solanaceae	*Solanum nigrum*	Black-Berry Nightshade			I	BioNet, ELA LTIM
Solanaceae	*Solanum sturtianum*	Thargomindah Nightshade				BioNet
Tamaricaceae	*Tamarix aphylla*	Athel Pine			I	PMST 2017
Thymelaeaceae	*Pimelea microcephala* subsp. *microcephala*	Shrubby Rice-flower				BioNet
Thymelaeaceae	*Pimelea penicillaris*	Sandhill Rice-flower				Fauna 2003
Thymelaeaceae	*Pimelea trichostachya*	Spiked Rice-flower				BioNet, Fauna 2003
Verbenaceae	*Phyla canescens*	Lippia				ELA LTIM
Verbenaceae	*Phyla nodiflora*	Carpet Weed				ELA LTIM
Verbenaceae	*Verbena gaudichaudii*	Verbena				ELA LTIM
Verbenaceae	*Verbena officinalis*	Common Verbena			I	BioNet, ELA LTIM
Verbenaceae	*Verbena* sp.					ELA LTIM
Verbenaceae	*Verbena supina*	Trailing Verbena			I	BioNet, ELA LTIM
Zygophyllaceae	*Tribulus micrococcus*	Spineless Caltrop				BioNet
Zygophyllaceae	*Tribulus terrestris*	Cat-head				ELA LTIM
Zygophyllaceae	*Zygophyllum ammophilum*	Sand Twinleaf				BioNet
Zygophyllaceae	*Zygophyllum iodocarpum*	Violet Twinleaf				BioNet

Appendix E : Fauna Species List

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Crustacea						
Parastacidae	*Cherax destructor*	Yabby			Likely	ELA LTIM
Gastropoda						
Viviparidae	*Notopala sublineata*	Darling River Snail	CE		Potential	Biosis 2016
Actinopterygii						
Ambassidae	*Ambassis agasizzii*	Olive Perchlet	EP			Capon 2009, WMA 2008 (Balcombe et al 2006)
Ambassidae	*Ambassis mulleri*	Western Chanda Perch				Capon 2009
Terapontidae	*Bidyanus bidyanus*	Silver Perch	V		Potential	Capon 2009, WMA 2008 (Balcombe et al 2006)
Cyprinidae	*Carassius auratus*	Goldfish			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Atherinidae	*Craterocephalus stercusmuscarum fulvus*	Unspeckled Hardyhead				Capon 2009, WMA 2008 (Motell, 1998)
Cyprinidae	*Cyprinus carpio*	Common Carp			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Percichthyidae	*Gadopsis marmoratus*	River Black Fish				Capon 2009
Galaxiidae	*Galaxias* spp.	Mountain Galaxias				Capon 2009
Poeciliidae	*Gambusia holbrooki*	Mosquitofish			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Eleotridae	*Hypseleotris* spp.	Carp Gudgeons			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006), WMA 2008 (Motell, 1998)

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Terapontidae	*Leiopotherapon unicolor*	Spangled Perch			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Percichthyidae	*Maccullochella peelii*	Murray Cod		V	Potential	Capon 2009, PMST 2017
Percichthyidae	*Macquaria ambigua*	Golden Perch			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Melanotaeniidae	*Melanotaenia fluviatilis*	Crimson-spotted Rainbow Fish			Likely	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Polycentridae	*Morgurnda adspersa*	Purple-spotted gudgeon	E		Likely	Capon 2009
Clupeidae	*Nematalosa erebi*	Bony Herring			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Plotsidae	*Neosilurus hyrtlii*	Hyrtl's Catfish			Known	Capon 2009, ELA LTIM, WMA 2008 (Balcombe et al 2006)
Retropinnidae	*Retropinna semoni*	Australian Smelt				Capon 2009, WMA 2008 (Balcombe et al 2006)
Plotosidae	*Tandanus tandanus*	Eel-tailed Catfish	EP		Likely	Capon 2009, WMA 2008 (Balcombe et al 2006)
Ampihbia						
Myobatrachidae	*Crinia deserticola*	Desert Froglet			Potential	BioNet, ELA LTIM, Fauna 2003, Capon 2009, OEH 2015
Myobatrachidae	*Crinia parinsignifera*	Eastern Sign-bearing Froglet			Potential	BioNet, ELA LTIM, OEH 2015
Hylidae	*Cyclorana novaehollandiae*	New Holland Frog, Wide-mouthed Frog			Likely	ELA LTIM
Hylidae	*Cyclorana platycephala*	Water-holding Frog				BioNet, Fauna 2003, Capon 2009, OEH 2015
Hylidae	Cyclorana sp.					BioNet, OEH 2015
Hylidae	Cyclorana verrucosa	Rough Frog				BioNet, OEH 2015
Myobatrachidae	Limnodynastes fletcheri	Barking Frog, Long-thumbed Frog, Marsh Frog			Likely	BioNet, ELA LTIM, Fauna 2003, Capon 2009, OEH 2015

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Myobatrachidae	Limnodynastes salmini	Salmon Striped Frog				BioNet
Myobatrachidae	Limnodynastes tasmaniensis	Spotted Grass Frog, Spotted Marsh Frog				BioNet
Hylidae	Litoria caerulea	Green Tree Frog			Likely	BioNet, ELA LTIM, Fauna 2003, Capon 2009, OEH 2015
Hylidae	Litoria latopalmata	Broad-palmed Frog				OEH 2015
Hylidae	Litoria peronii	Peron's Tree Frog			Likely	BioNet, ELA LTIM, Fauna 2003, Capon 2009, OEH 2015
Hylidae	Litoria rubella	Desert Tree Frog			Likely	BioNet, ELA LTIM, Fauna 2003, Capon 2009, OEH 2015
Myobatrachidae	Neobatrachus sudelli	Sudell's Frog			Likely	ELA LTIM
Myobatrachidae	Notaden bennettii	Crucifix Frog				OEH 2015
Myobatrachidae	Uperoleia capitulata	Small-headed Toadlet			Likely	ELA LTIM
Myobatrachidae	Uperoleia rugosa	Wrinkled toadlet				BioNet
Aves						
Meliphagidae	Acanthagenys rufogularis	Spiny-cheeked Honeyeater				BioNet
Acanthizidae	Acanthiza apicalis	Inland thornbill				BioNet
Acanthizidae	Acanthiza chrysorrhoa	Yellow-rumped Thornbill				BioNet
Acanthizidae	Acanthiza nana	Yellow Thornbill				BioNet
Acanthizidae	Acanthiza uropygialis	Chestnut-rumped Thornbill				BioNet
Accipitridae	Accipiter cirrocephalus	Collared Sparrowhawk				OEH 2015
Accipitridae	Accipiter fasciatus	Brown Goshawk			Likely	ELA LTIM
Acrocephalidae	Acrocephalus australis	Australian Reed-warbler			Likely	ELA LTIM

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Acrocephalidae	Acrocephalus stenoteoreus	Clamorous Reed-warbler				Capon 2009
Scolopacidae	Actitis hypoleucos	Common Sandpiper			Likely	ELA LTIM
Aegothelidae	Aegotheles cristatus	Australian Owlet-nightjar			Likely	Capon 2009, ELA LTIM
Maluridae	Amytornis modestus	Thick-billed Grasswren	CE	CE	Unlikely	PMST 2017
Anatidae	Anas castanea	Chestnut Teal				BioNet
Anatidae	Anas gracilis	Australian Grey Teal				Capon 2009
Anatidae	Anas rhynchotis	Australasian Shoveler				BioNet
Anatidae	Anas superciliosa	Pacific Black Duck				BioNet
Anhingidae	Anhinga melanogaster	Australian Darter			Known	Capon 2009
Anhingidae	Anhinga novaehollandiae	Australasian Darter				BioNet
Motacillidae	Anthus australis	Australian Pipit				Fauna 2003
Motacillidae	Anthus novaeseelandiae	Australasian Pipit Australian Pipit			Likely	ELA LTIM
Acanthizidae	Aphelocephala leucopsis	Southern Whiteface				BioNet
Psittacidae	Aprosmictus erythropterus	Red-winged Parrot				BioNet
Apodidae	Apus pacificus	Fork-tailed Swift			Likely	ELA LTIM
Accipitridae	Aquila audax	Wedge-tailed Eagle				BioNet
Ardeidae	Ardea alba	Great Egret				Fauna 2003
Ardeidae	Ardea ibis	Cattle Egret		M, Ma	Unlikely	PMST 2017
Ardeidae	Ardea intermedia	Intermediate Egret				Field Nats 2012
Ardeidae	Ardea modesta	Eastern Great Egret		Ma		BioNet
Ardeidae	Ardea novaehollandiae	White-faced Heron				Capon 2009
Ardeidae	Ardea pacifica	White-necked Heron				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Otididae	Ardeotis australis	Australian Bustard	E		Potential	BioNet
Artamidae	Artamus cinereus	Black-faced Woodswallow				BioNet
Artamidae	Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		Potential	BioNet
Artamidae	Artamus leucorynchus	White-breasted Woodswallow			Likely	ELA LTIM
Artamidae	Artamus minor	Little Woodswallow			Likely	ELA LTIM
Artamidae	Artamus personatus	Masked Woodswallow				BioNet
Artamidae	Artamus superciliosus	White-browed Woodswallow			Likely	ELA LTIM
Anatidae	Aythya australis	Hardhead				BioNet
Psittacidae	Barnardius zonarius	Australian Ringneck				BioNet
Psittacidae	Barnardius zonarius barnardi	Mallee Ringneck				BioNet
Anatidae	Biziura lobata	Musk Duck				BioNet
Ardeidae	Botaurus poiciloptilus	Australasian Bittern	V		Potential	Biosis 2016
Cacatuidae	Cacatua leadbeateri	Major Mitchell's Cockatoo				Fauna 2003
Cacatuidae	Cacatua sanguinea	Little Corella			Likely	ELA LTIM
Cuculidae	Cacomantis flabelliformis	Fan-tailed Cuckoo				Fauna 2003
Cuculidae	Cacomantis pallidus	Pallid Cuckoo				BioNet
Scolopacidae	Calidris ferruginea	Curlew Sandpiper	E	CE, M	Unlikely	OEH 2015
Cacatuidae	Calyptorhynchus banksii	Red-tailed Black Cockatoo			Likely	ELA LTIM
Cacatuidae	Calyptorhynchus banksii samueli	Red-tailed Black-cockatoo (inland subspecies)	V		Potential	BioNet
Meliphagidae	Certhionyx variegatus	Pied Honeyeater	V		Unlikely	OEH 2015
Cuculidae	Chalcites basalis	Horsfield’s Bronze-cuckoo				Capon 2009

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Cuculidae	Chalcites osculans	Black-eared Cuckoo				BioNet
Charadriidae	Charadrius australis	Inland Dotterel			Known	BioNet
Charadriidae	Charadrius melanops	Black-fronted Plover				Capon 2009
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover				BioNet
Anatidae	*Chenonetta jubata*	Australian Wood Duck				Aerial Bird 2010
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow				OEH 2015
Laridae	*Chlidonias hybrida*	Whiskered Tern				BioNet
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull				BioNet
Laridae	*Chrysococcyx basalis*	Horsfield's Bronze-cuckoo			Likely	ELA LTIM
Laridae	*Chrysococcyx osculans*	Black-eared Cuckoo			Likely	ELA LTIM
Megaluridae	*Cincloramphus cruralis*	Brown Songlark				BioNet
Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark			Likely	ELA LTIM
Megaluridae	*Cinclosoma castanotum*	Chestnut Quail-thrush	V		Potential	OEH 2015
Accipitridae	*Circus assimilis*	Spotted Harrier	V		Likely	Fauna 2003
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola			Likely	ELA LTIM
Climacteridae	*Climacteris affinis*	White-browed Treecreeper				BioNet
Climacteridae	*Climacteris picumnus*	Brown Treecreeper			Likely	ELA LTIM
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (Eastern Subspecies)	V		Potential	BioNet
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush				BioNet
Columbidae	*Columba livia*	Rock Pigeon, Rock Dove, Domestic Pigeon				PMST 2017
Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike				OEH 2015

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			Likely	ELA LTIM
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike			Likely	ELA LTIM
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough				BioNet
Corvidae	*Corvus bennetti*	Little Crow				BioNet
Corvidae	*Corvus coronoides*	Australian Raven				BioNet
Corvidae	*Corvus mellori*	Little Raven				BioNet
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird				BioNet
Artamidae	*Cracticus tibicen*	Australian Magpie				BioNet
Artamidae	*Cracticus torquatus*	Grey Butcherbird				BioNet
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo				Fauna 2003
Anatidae	*Cygnus atratus*	Black Swan			Likely	ELA LTIM
Anatidae	*Cyngnus atratus*	Australian Black Duck				Capon 2009
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra				BioNet
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		Potential	BioNet
Anatidae	*Dendrocygna eytoni*	Plumed Whistling-duck				OEH 2015
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird				BioNet
Casuariidae	*Dromaius novaehollandiae*	Emu				BioNet
Ardeidae	*Egretta garzetta*	Little Egret				OEH 2015
Ardeidae	*Egretta novaehollandiae*	White-faced Heron				BioNet
Accipitridae	*Elanus axillaris*	Black-Shouldered Kite				BioNet
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel				BioNet
Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Cacatuidae	*Eolophus roseicapillus*	Galah				BioNet
Meliphagidae	*Epthianura albifrons*	White-Fronted Chat	V		Potential	BioNet
Meliphagidae	*Epthianura aurifrons*	Orange Chat				BioNet
Meliphagidae	*Epthianura tricolor*	Crimson Chat				BioNet
Charadriidae	*Erythrogonys cinctus*	Red-kneed Dotterel				BioNet
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar				BioNet
Falconidae	*Falco berigora*	Brown Falcon				BioNet
Falconidae	*Falco cenchroides*	Nankeen Kestrel				BioNet
Falconidae	*Falco hypoleucos*	Grey Falcon	E		Potential	BioNet
Falconidae	*Falco longipennis*	Australian Hobby				Fauna 2003
Falconidae	*Falco subniger*	Black Falcon	V		Potential	BioNet
Rallidae	*Fulica atra*	Eurasian Coot			Likely	ELA LTIM
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe		M, Ma		PMST 2017
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen				Fauna 2003
Rallidae	*Gallinula ventralis*	Black-tailed Native-hen				Fauna 2003
Meliphagidae	*Gavicalis virescens*	Singing Honeyeater				BioNet
Columbidae	*Geopelia cuneata*	Diamond Dove				BioNet
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove				Fauna 2003
Columbidae	*Geopelia placida*	Peaceful Dove				Fauna 2003
Columbidae	*Geopelia striata*	Zebra Dove				BioNet
Columbidae	*Gerygone fusca*	Western Gerygone				OEH 2015
Glareolidae	*Glareola maldivarum*	Oriental Pratincole		M, Ma		BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				BioNet
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V	Unlikely	OEH 2015
Gruidae	*Grus rubicunda*	Brolga	V			BioNet
Artamidae	*Gymnorhina tibicen*	Australian Magpie				Fauna 2003
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	V	M	Unlikely	PMST 2017
Accipitridae	*Haliastur sphenurus*	Whistling Kite				BioNet
Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard	V		Potential	OEH 2015
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		Potential	BioNet
Recurvirostridae	*Himantopus himantopus*	Black-Winged Stilt				BioNet
Hirundinidae	*Hirundo neoxena*	Welcome Swallow			Likely	ELA LTIM
Campephagidae	*Lalage sueurii*	White-winged Triller				BioNet
Campephagidae	*Lalage tricolor*	White-winged Triller				Fauna 2003
Laridae	*Larus novaehollandiae*	Silver Gull				Capon 2009
Megapodiidae	*Leipoa ocellata*	Malleefowl	E	V	Unlikely	PMST 2017
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater				Fauna 2003
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater				Fauna 2003
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater			Likely	ELA LTIM
Cacatuidae	*Lophochroa leadbeateri*	Major Mitchell's Cockatoo	V		Potential	BioNet
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		Unlikely	OEH 2015
Anatidae	*Malacorhynchus membranaceus*	Pink-eared Duck				OEH 2015
Maluridae	*Malurus cyaneus*	Superb Fairy-wren			Likely	ELA LTIM
Maluridae	*Malurus lamberti*	Variegated Fairy-wren				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Maluridae	*Malurus leucopterus*	White-winged Fairy-wren				BioNet
Maluridae	*Malurus splendens*	Splendid Fairy-wren				BioNet
Meliphagidae	*Manorina flavigula*	Yellow-throated Miner				BioNet
Meliphagidae	*Manorina melanocephala*	Noisy Miner				BioNet
Maluridae	*Megalurus gramineus*	Little Grassbird				Capon 2009
Petroicidae	*Melanodryas cucullata cucullata*	Hooded Robin (South-Eastern form)	V		Unlikely	OEH 2015
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater				OEH 2015
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (Eastern Subspecies)	V		Unlikely	OEH 2015
Psittacidae	*Melopsittacus undulatus*	Budgerigar				BioNet
Meropidae	*Merops ornatus*	Rainbow Bee-eater		Ma	Likely	ELA LTIM
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant				BioNet
Petroicidae	*Microeca fascinans*	Jacky Winter				BioNet
Accipitridae	*Milvus migrans*	Black Kite				BioNet
Alaudidae	*Mirafra javanica*	Horsfield's Bush Lark				OEH 2015
Motacillidae	*Motacilla flava*	Yellow Wagtail		M, Ma		PMST 2017
Monarchidae	*Myiagra inquieta*	Restless Flycatcher			Likely	ELA LTIM
Estrildidae	*Neochmia modesta*	Plum-headed Finch			Likely	ELA LTIM
Psittacidae	*Neopsephotus bourkii*	Bourke’s Parrot				Capon 2009
Strigidae	*Ninox connivens*	Barking Owl	V		Potential	OEH 2015
Strigidae	*Ninox novaeseelandiae*	Southern Boobook				BioNet
Psittacidae	*Northiella haematogaster*	Blue Bonnet				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron				BioNet
Cacatuidae	*Nymphicus hollandicus*	Cockatiel				BioNet
Columbidae	*Ocyphaps lophotes*	Crested Pigeon				BioNet
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird				BioNet
Pachycephalidae	*Oriolus sagittatus*	Olive-Backed Oriole				Fauna 2003
Anatidae	*Oxyura australis*	Blue-billed Duck	V		Potential	BioNet
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler				BioNet
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote				BioNet
Pardalotidae	*Pardalotus striatus*	Striated Pardalote				BioNet
Passeridae	*Passer domesticus*	House Sparrow				PMST 2017
Phasianidae	*Pavo cristatus*	Indian Peafowl				BioNet
Pedionomidae	*Pedionomus torquatus*	Plains-wanderer	E	CE	Unlikely	PMST 2017
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican				BioNet
Hirundinidae	*Petrochelidon ariel*	Fairy Martin				BioNet
Hirundinidae	*Petrochelidon nigricans*	Tree Martin				BioNet
Petroicidae	*Petroica goodenovii*	Red-capped Robin				BioNet
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant				BioNet
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant				Fauna 2003
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant				BioNet
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant				BioNet
Columbidae	*Phaps chalcoptera*	Common Bronzewing				BioNet
Meliphagidae	*Philemon citreogularis*	Little Friarbird				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird			Likely	ELA LTIM
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill				BioNet
Threskiornithidae	*Platalea regia*	Royal Spoonbill			Known	BioNet
Psittacidae	*Platycercus adscitus*	Pale-Headed Rosella				BioNet
Meliphagidae	*Plectorhyncha lanceolata*	Striped Honeyeater				BioNet
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis		C	Potential	BioNet
Podargidae	*Podargus strigoides*	Tawny Frogmouth				BioNet
Podargidae	*Podiceps cristatus*	Great Crested Grebe			Likely	ELA LTIM
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe				BioNet
Psittaculidae	*Polytelis swainsonii*	Superb Parrot	V	V	Unlikely	OEH 2015
Pomatostomidae	*Pomatostomus halli*	Hall's Babbler	V		Potential	OEH 2015
Pomatostomidae	*Pomatostomus ruficeps*	Chestnut-crowned Babbler				BioNet
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		Potential	OEH 2015
Rallidae	*Porphyrio porphyrio*	Purple Swamphen			Likely	ELA LTIM
Rallidae	*Porzana tabuensis*	Spotless Crake			Likely	ELA LTIM
Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot			Likely	ELA LTIM
Psittacidae	*Psephotus varius*	Mulga Parrot				BioNet
Ptilonorhynchidae	*Ptilonorhynchus maculatus*	Spotted Bowerbird				BioNet
Meliphagidae	*Ptilotula penicillatus*	White-plumed Honeyeater				OEH 2015
Recurvirostridae	*Recurvirostra novaehollandiae*	Red-necked Avocet				BioNet
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail				OEH 2015

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail				BioNet
Rostratulidae	*Rostratula australis*	Australian Painted Snipe		E	Unlikely	PMST 2017
Rostratulidae	*Rostratula benghalensis*	Painted Snipe	E	E	Unlikely	PMST 2017
Acanthizidae	*Smicrornis brevirostris*	Weebill				BioNet
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V		Potential	BioNet
Laridae	*Sterna hybrida*	Whiskered Tern				Capon 2009
Anatidae	*Stictonetta naevosa*	Freckled Duck	V		Known	OEH 2015
Glareolidae	*Stiltia isabella*	Australian Pratincole				BioNet
Artamidae	*Strepera graculina*	Pied Currawong				ELA LTIM
Corcoracidae	*Struthidea cinerea*	Apostlebird				BioNet
Sturnidae	*Sturnus vulgaris*	Common Starling				OEH 2015
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe				BioNet
Anatidae	*Tadorna tadornoides*	Australian Shelduck				BioNet
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch				BioNet
Estrildidae	*Taeniopygia guttata*	Zebra Finch				BioNet
Threskiornithidae	*Threskiornis aethiopica*	White Ibis				Capon 2009
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis				BioNet
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis				BioNet
Alcedinidae	*Todiramphus pyrrhopygius*	Red-backed Kingfisher				Fauna 2003
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher			Likely	ELA LTIM
Rallidae	*Tribonyx ventralis*	Black-tailed Native-hen				BioNet
Rallidae	*Tringa glareola*	Wood Sandpiper			Likely	ELA LTIM

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Rallidae	*Tringa nebularia*	Common Greenshank		M	Potential	OEH 2015
Rallidae	*Tringa stagnatilis*	Marsh Sandpiper				Fauna 2003
Turdidae	*Turdus merula*	Common Blackbird				PMST 2017
Tytonidae	*Tyto javanica*	Eastern Barn Owl				BioNet
Charadriidae	*Vanellus miles*	Masked Lapwing				BioNet
Charadriidae	*Vanellus tricolor*	Banded Lapwing				BioNet
Mammalia						
Dasyuridae	*Antechinomys laniger*	Kultarr	E		Potential	BioNet
Molossidae	*Austronomus australis*	White-striped Freetail-bat				BioNet
Bovidae	*Bos taurus*	Domestic Cattle				PMST 2017
Canidae	*Canis lupus familiaris*	Dog				PMST 2017
Bovidae	*Capra hircus*	Feral Goat				Fauna 2003
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat				BioNet
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat			Likely	ELA
Vespertilionidae	*Chalinolobus picatus*	Little Pied Bat	V		Potential	BioNet
Felidae	*Felis catus*	Cat				BioNet
Leporidae	*Lepus capensis*	Brown Hare				BioNet
Leporidae	*Lepus europaeus*	Hare			Likely	ELA LTIM
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo				BioNet
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo				BioNet
Macropodidae	*Macropus robustus*	Common Wallaroo				BioNet
Macropodidae	*Macropus rufus*	Red Kangaroo				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Molossidae	*Mormopterus eleryi*	Bristle-faced Free-tailed Bat	E		Unlikely	OEH 2015
Molossidae	*Mormopterus petersi*	Inland Free-tailed Bat				OEH 2015
Molossidae	*Mormopterus planiceps*	Southern Freetail Bat				Fauna 2003
Muridae	*Mus musculus*	House Mouse				BioNet
Vespertilionidae	*Myotis macropus*	Southern Myotis	V		Unlikely	OEH 2015
Vespertilionidae	*Nyctophilus corbeni*	Corben's Long-eared Bat	V	V	Unlikely	PMST 2017
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-Eared Bat				BioNet
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat			Likely	ELA
Leporidae	*Oryctolagus cuniculus*	European Rabbit				Fauna 2003
Bovidae	*Ovis aries*	Sheep			Likely	ELA LTIM
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	Potential	OEH 2015
Dasyuridae	*Planigale gilesi*	Paucident Planigale				BioNet
Muridae	*Rattus* sp.	Rat				BioNet
Muridae	*Rattus villosissimus*	Long-Haried Rat	V		Unlikely	OEH 2015
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		Potential	BioNet
Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat				BioNet
Vespertilionidae	*Scotorepens greyii*	Little Broad-nosed Bat				BioNet
Dasyuridae	*Sminthopsis crassicaudata*	Fat-tailed Dunnart				BioNet
Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart	V		Unlikely	OEH 2015
Dasyuridae	*Sminthopsis murina*	Common Dunnart				BioNet
Suidae	*Sus scrofa*	Feral Pig				Fauna 2003
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			Likely	ELA LTIM

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Vespertilionidae	*Vespadelus baverstocki*	Inland Forest Bat	V		Potential	OEH 2015
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat			Likely	ELA
Canidae	*Vulpes vulpes*	European Fox				Fauna 2003
Macropodidae	*Wallabia bicolor*	Swamp Wallaby				Fauna 2003
Reptilia						
Typhlopidae	*Anilios bituberculatus*	Prong-snouted Blind Snake				BioNet
Typhlopidae	*Anilios endoterus*	Interior Blind Snake	E		Potential	BioNet
Typhlopidae	*Anilios ligatus*	Robust Blind Snake				BioNet
Boidae	*Antaresia stimsoni*	Stimson's Python	V			OEH 2015
Chelidae	*Chelodina expansa*	Broad-shelled Turtle			Likely	ELA LTIM
Chelidae	*Chelodina longicollis*	Eastern Long-necked Turtle			Likely	ELA LTIM
Scincidae	*Cryptoblepharus australis*	Inland Snake-eyed Skink				BioNet
Scincidae	*Cryptoblepharus carnabyi*	Carnaby's Wall Skink				Fauna 2003
Scincidae	*Cryptoblepharus pannosus*	Ragged Snake-eyed Skink				BioNet
Scincidae	*Cryptoblepharus* sp.					BioNet
Scincidae	*Cryptoblephaurs carnabyi*	Carnaby's Wall Skink				Capon 2009
Scincidae	*Ctenophorus nuchalis*	Central Netted Dragon				Fauna 2003
Scincidae	*Ctenotus leonhardii*	Leonhardi's Ctenotus				BioNet
Scincidae	*Ctenotus olympicus*					BioNet
Scincidae	*Ctenotus pantherinus ocellifer*	Leopard Ctenotus	E			BioNet
Scincidae	*Ctenotus regius*	Pale-Rumped Ctenotus				BioNet
Scincidae	*Ctenotus schomburgkii*	Barred Wedgesnout Ctenotus				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Pygopodidae	*Delma inornata*	Inornate Delma				Fauna 2003
Elapidae	*Denisonia devisi*	De Vis' Banded Snake				BioNet
Gekkonidae	*Diplodactylus steindachneri*	Box-Patterned Gecko				Fauna 2003
Gekkonidae	*Diplodactylus tessellatus*	Tessellated Gecko				BioNet
Gekkonidae	*Diplodactylus vittatus*	Wood Gecko				BioNet
Gekkonidae	*Dlema inornata*	Inornate Delma				Capon 2009
Scincidae	*Egernia striolata*	Tree Skink				BioNet
Chelidae	*Emydura macquarii*	Macquarie Turtle				BioNet
Elapidae	*Furina diadema*	Red-Naped Snake				BioNet
Gekkonidae	*Gehyra variegata*	Tree Dtella				BioNet
Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko				BioNet
Scincidae	*Lerista labialis*	Southern Sandslider				BioNet
Scincidae	*Lerista muelleri*	Wood Mulch-slider				BioNet
Scincidae	*Lerista punctatovittata*	Eastern Robust Slider				BioNet
Scincidae	*Lerista timida*	Timid Slider				BioNet
Pygopodidae	*Lialis burtonis*	Burton's Snake-lizard				BioNet
Agamidae	*Lophognathus burnsi*	Burns' Dragon				BioNet
Gekkonidae	*Lucasium damaeum*	Beaded Gecko				BioNet
Gekkonidae	*Lucasium steindachneri*	Box-patterned Gecko				BioNet
Scincidae	*Menetia greyii*	Common Dwarf Skink				BioNet
Scincidae	*Morethia boulengeri*	Boulenger’s Skink				Capon 2009
Gekkonidae	*Nephrurus levis*	Three-lined Knob-tail				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Gekkonidae	*Oedura marmorata*	Marbled Velvet Gecko				BioNet
Elapidae	*Parasuta dwyeri*	Dwyer's Snake				BioNet
Elapidae	*Parasuta nigriceps*	Mitchell's Short-tailed Snake				OEH 2015
Agamidae	*Pogona barbata*	Bearded Dragon				BioNet
Agamidae	*Pogona vitticeps*	Central Bearded Dragon				BioNet
Elapidae	*Pseudechis australis*	King Brown Snake				BioNet
Elapidae	*Pseudonaja aspidorhyncha*	Strap-snouted Brown Snake				BioNet
Elapidae	*Pseudonaja modesta*	Ringed Brown Snake	E		Potential	OEH 2015
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake				BioNet
Typhlopidae	*Ramphotyphlops bituberculatus*	Prong-snouted Blind Snake				OEH 2015
Typhlopidae	*Ramphotyphlops endoterus*	Interior Blind Snake	E			OEH 2015
Typhlopidae	*Ramphotyphlops ligatus*	Robust Blind Snake				OEH 2015
Typhlopidae	*Ramphotyphlops* sp.	Unidentified Blind Snake				OEH 2015
Diplodactylidae	*Rhynchoedura angusta*	Border Beaked Gecko				BioNet
Diplodactylidae	*Rhynchoedura ormsbyi*	Eastern Beaked Gecko				BioNet
Diplodactylidae	*Rhynchoedura ornata*	Beaked Gecko				Fauna 2003
Elapidae	*Suta suta*	Curl Snake				BioNet
Scincidae	*Tiliqua rugosa*	Shingle-back				BioNet
Scincidae	*Tiliqua scincoides*	Common Blue-tongue				Fauna 2003
Scincidae	*Trachydosaurus rugosus*	Shingleback Lizard				Capon 2009
Agamidae	*Tympanocryptis tetraporophora*	Eyrean Earless Dragon				BioNet
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed Gecko				BioNet

Family	Scientific Name	Common Name	Status*		Breeding	Sources
			NSW	Cth		
Varanidae	*Varanus gouldii*	Gould's Goanna				BioNet
Varanidae	*Varanus* sp.	Unidentified Goanna				BioNet
Varanidae	*Varanus tristis*	Black-headed Monitor				BioNet
Varanidae	*Varanus varius*	Lace Monitor				OEH 2015
Elapidae	*Vermicella annulata*	Bandy-Bandy				BioNet
Chelidae	*Emydura macquarii macquarii*	Murray Turtle			Likely	ELA LTIM

* CE – Critically Endangered, E – Endangered, EP – Endangered Population, V – Vulnerable, M- Migratory (EPBC Act only).

Appendix F : Likelihood of Occurrence

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. This assessment applies to the impact assessment area only, not to the entire subject site. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposed development site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Species, populations and communities considered to have the potential, are likely or are known to occur are highlighted blue.

Key to the table:

- BC Act = Listing under the *NSW Biodiversity Conservation Act 2016*
- EPBC Act = Listing under the *Environment Protection and Biodiversity Conservation Act 1999*
- CE = Critically Endangered
- E = Endangered
- EP = Endangered Population
- E4 = Extinct (BC Act)
- V = Vulnerable
- M = Migratory (EPBC Act)
- Mar = Marine (EPBC Act)

Table A 1: Threatened ecological communities likelihood table

Community Name	Conservation Status			Habitat	BC Act listing equivalent	Habitat present (good, marginal, none)	Community known to occur in region (yes/no)	Community known to occur on site (yes/no)	Likelihood of occurrence	Impact Assessment Required
	BC Act	EPBC Act	FM Act							
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchments of the Darling River			E	All native fish and aquatic invertebrates in natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions and floodplains of the Darling River in NSW		Good	Yes	Yes	Yes	Yes
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	E		Found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, stream levees, drainage depressions and gilgais.	Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions	Good	Yes	Yes	Yes	Yes

Table A 2: Threatened flora likelihood table

Scientific Name	Common Name	Conservation Status		Habitat	Habitat quality present (good, marginal, none)	Likelihood of occurrence	Impact Assessment Required
		BC Act	EPBC Act				
Atriplex infrequens	A saltbush	V	V	Broad drainage tracts, clay flats and possibly occasionally inundated habitats.	Good	Potential	Yes
Austrostipa metatoris	A spear-grass	V	V	Sandhills, sandridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils.	Marginal	Potential	Yes
Dentella minutissima		E		Mud flats, edges of drainage lines and waterholes, riparian sandy banks, white sandy-clay soil in damp areas and grey cracking clays.	Good	Potential	Yes
Lepidium monoplocoides	Winged Peppercress	E	E	Open woodland dominated by *Allocasuarina luehmannii* and/or eucalypts, wetland-grassland, or *Maireana pyramidata* shrubland. Occurs on seasonally moist to waterlogged sites, with heavy fertile soils.	Marginal	Potential	Yes
Osteocarpum sclerocarpum	Squash Bush	E		Low-lying habitats such as creek channels, with poorly draining clay soils.	Marginal	Potential	Yes
Sida rohlenae	Shrub Sida	E		Floodout areas, creek banks, roadsides and at the base of rocky hills.	Marginal	Potential	Yes

Table A 3: Threatened fauna likelihood table

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Molluscs	*Notopala sublineata*	Darling River Snail		CE		The species is now restricted to the Darling River and its tributaries.	Artificially introduced hard surfaces now provide habitat for the species with populations being recorded as surviving in irrigation pipelines near Bourke, Brewarrina and Walgett.	The Darling River Snail feeds on the bacteria and microflora associated with detritus	Good	No	Unlikely	Excluded as no previous records occur within the Warrego River at Toorale. Species is now only known from irrigation pipelines in Southern NSW (DPI, 2018).	No
Fish	*Ambassis agassizii*	Western population of Olive Perchlet		EP		This population is now found only at a few sites in the Darling River drainage.	Rivers, creeks, ponds and swamps. They are usually found in slow-flowing or still waters, often near overhanging vegetation or amongst logs, dead branches and boulders	Often congregate around large woody debris (snags) and vegetation during the day but disperse during the night to feed on micro-crustaceans and insects, including larvae. Males and females reach sexual maturity in one year. Spawning occurs in November and December, when water temperatures reach about 23°C. Females release adhesive eggs about 0.7mm in diameter amongst aquatic vegetation."	Good	No	Potential	Habitat may potentially provide refuge for this species.	Yes
Fish	*Bidyanus bidyanus*	Silver Perch		V		Murray-Darling basin; now mostly stocked fish which generally have not established reproducing populations. The most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries. Other self-sustaining populations reported from the Macintyre and Macquarie Rivers in northern NSW.	Fast-flowing, open waters, especially where there are rapids and races; however, will also inhabit warm, sluggish water with cover provided by large woody debris and reeds.	"They are omnivorous, feeding on small aquatic insects, molluscs, earthworms and green algae. Males reach sexual maturity at three years of age, when around 25 cm in length, and females at five years, when around 29 cm. Adults migrate upstream in spring and summer to spawn. Juveniles also sometimes move upstream in response to rising water temperatures and levels. Females can shed 300,000 or more semi-buoyant eggs of about 2.75 mm in diameter. The eggs develop in a few days to become feeding larvae that drift downstream."	Good	Yes	Likely	Indicative distributions overlap with the study area. Occurrence record retrieved within the lower reaches of the Warrego River in 2004 (ALA, 2019)	Yes
Fish	*Maccullochella peelii*	Murray Cod			V	Throughout most of the Murray Darling Basin with the exception of some localised extinctions. Some translocated populations exist outside the species' natural distribution in impoundments and waterways (Cataract Dam and the Nepean River system in NSW).	Clear rocky streams to slow flowing, turbid rivers and billabongs. Frequently found in the main river channel and larger tributaries; also in floodplain channels when they contain water.	"The Murray Cod reaches sexual maturity at 4 to 5 years of age and at 2 to 3 kg in weight. The species migrates upstream prior to spawning in late spring and early summer when the water reaches a temperature of between 16-21°C. The Murray Cod is the top predator of Australia's inland rivers. Cod are carnivorous, typically feeding on spiny crayfish, yabbies and shrimps."	Good	No	Potential	Species may occur within the lower reaches of the Warrego River.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Fish	*Morgurnda adspersa*	Purple Spotted Gudgeon		E		The population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment (DPI, 2017).	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 (DPI, 2017)	They feed mainly on terrestrial insects and their larvae, worms, small fish, tadpoles, and some plant matter (DPI, 2017).	Good	No	Unlikely	Indicative distributions do not include the Warrego River	No
Fish	*Tandanus tandanus*	Murray-Darling Basin population of Eel Tailed Catfish		EP		Eel Tailed Catfish are naturally distributed throughout the Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle.	Rivers, creeks, lakes, dams, billabongs and lagoons; prefers sluggish or still waters.	Eel tailed catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary, and adults typically only move within a 5 km range. Individuals are more active at night compared with during the day.	Good	No	Unlikely	Species not known from Toorale, despite extensive surveys	No
Birds	*Actitis hypoleucos*	Common Sandpiper			M	Summer migrant. In NSW, widespread along coastline and also occurs in many areas inland.	Coastal wetlands and some inland wetlands, especially muddy margins or rocky shores. Also, estuaries and deltas, lakes, pools, billabongs, reservoirs, dams and claypans, mangroves.	Breeds in Eurasia, uncommon summer migrant to Australia (August to May). Some overwinter.	Good	No	Likely	Direct impacts from construction/earthworks altering bank/water level followed by indirect impacts from flow regime changes and temporary impacts at dams due to construction activities.	Yes
Birds	*Amytornis modestus*	Thick-billed Grasswren (eastern subspecies)	CE		V	In NSW, known only from the Packsaddle area. May still occur at other locations in Upper Western Region.	Saltbush, cottonbush, bluebush and nitre-bush areas on sandy plains or depressions in gibber; also along watercourses in clumps of Canegrass.	The nest is deep and loosely-made, shaped either like a cup, half-dome or dome; located on or near the ground in a clump of Canegrass, within the foliage of low shrub or in flood debris, and constructed of dead grasses, twigs and dry bark strips. Forages on the ground and under or around bushes for a wide variety of seeds, berries and invertebrates.	Marginal	No	No	Excluded on the basis of no overlap in distribution	No
Birds	*Apus pacificus*	Fork-tailed Swift			M	Recorded in all regions of NSW.	Riparian woodland., swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	Non-breeding visitor to all states and territories of Australia, arriving from its breeding grounds in Siberia around October, and departing in April. The species is thought to be highly mobile within Australia, moving across the country in search of food. They probably roost aerially.	Good	No	Likely	Riparian habitat will be directly impacted by works. Dam modifications are likely to cause flow regime changes that could alter riparian vegetation on a relatively small scale. Disruption may occur during activity related to construction/remediation around the site.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Ardea alba*	Great Egret			M	Widespread, occurring across all states/territories. Also a vagrant on Lord Howe and Norfolk Island.	Swamps and marshes, grasslands, margins of rivers and lakes, salt pans, estuarine mudflats and other wetland habitats.	Mostly forages in shallow to moderately deep water for fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals. In NSW, most breeding colonies are located in the Darling Riverine Plains region and the Riverina region. Breeding sites are located in wooded and shrubby swamp. The breeding season generally extends from November to April.	Good	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Impacts may occur and are likely to be indirect through changes in flow regimes and temporary impacts at dams due to construction activities.	Yes
Birds	*Ardea ibis*	Cattle Egret			M	Widespread and common across NSW.	Grasslands, wooded lands and terrestrial wetlands.	Uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. The Cattle Egret often forages away from water on low lying grasslands, improved pastures and croplands. It is commonly found amongst livestock.	Marginal	No	Potential	Included based on marginal habitat and presence in the region. Impacts may occur and are likely to be indirect through changes in flow regimes and temporary impacts at dams due to construction activities.	Yes
Birds	*Ardeotis australis*	Australian Bustard	E			In NSW, mainly found in the north-west corner and less often in the lower western and central west plains regions. Occasional vagrants as far east as the western slopes and Riverine plain.	Tussock and hummock grasslands, low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.	Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees. Forages on insects, young birds, lizards, mice, leaves, seeds and fruit. Dispersive, with irregular widespread movements over long distances.	Marginal	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Impacts likely related to temporary impacts to some foraging habitat in set down areas and disturbance due to construction activities.	Yes
Birds	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V			Widespread in NSW from coast to inland including the western slopes of the Great Dividing Range and farther west. Species have also been recorded in southern and southwestern Australia.	Woodlands and dry open sclerophyll forest, usually eucalypts and mallee associations. Also have recordings in shrub and heathlands and various modified habitats, including regenerating forests. In western NSW, this species is primarily associated with River Red Gum/Black Box/Coolabah open forest/woodland and associated with larger river/creek systems.	Breeding more commonly occurs on the western slopes of the Great Dividing Range. Nesting occurs between Sept and Jan in open shallow untidy cups in an open hollow, crevice or stump. Clutch size is one to four with pairs possibly nesting twice per season. Diet consists mainly of invertebrates with occasional nectar, fruit and seed being consumed.	Marginal	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Potential temporary impacts to some foraging habitat in set down areas and disturbance due to construction activities.	Yes
Birds	*Botaurus poiciloptilus*	Australasian Bittern	E		E	Found over most of NSW except for the far north-west.	Permanent freshwater wetlands with tall, dense vegetation, particularly *Typha* spp. (bullrushes) and *Eleocharis* spp. (spikerushes).	Feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	Marginal	No	Potential	Included based on marginal potential foraging habitat present. Impacts likely limited to changes in flow regimes. Potential temporary impacts related to construction activities at Homestead dam to restore previous environment prior to dam wall break.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Burhinus grallarius*	Bush Stone-curlew	E			In NSW, found sporadically in coastal areas, and west of the divide throughout the sheep-wheat belt.	In NSW, it occurs in lowland grassy woodland and open forest.	It forages nocturnally in irrigated paddocks, grasslands, woodlands, domestic gardens, saltmarsh, mangroves, and playing fields. Feeds on a wide variety of invertebrates, seeds, small fruit, crustaceans, molluscs, frogs, lizards, snakes and mice. It roosts during the day in or near woodland remnants amongst fallen timber or ground litter. The nest site is typically in or near the edge of open grassy woodland or within a cleared paddock, and the breeding season is between spring and early summer.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts limited to temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Calidris acuminata*	Sharp-tailed Sandpiper			M	Summer migrant. Widespread in most regions of NSW, especially in coastal areas, but sparse in the south-central Western Plain and east Lower Western Regions.	Shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Breeds Arctic Siberia, summer migrant to Australia August-April. Some overwinter. Forage in wetlands or intertidal mudflats, inundated vegetation of saltmarsh, grass or sedges, sewage ponds. Roosting occurs at the edges of wetlands, on sandy beaches, stony shores or on rocks in water.	Good	No	Likely	Included based on potential to occur throughout the sites. Potential habitat is good, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Calidris ferruginea*	Curlew Sandpiper	E		CE, M	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands in the Murray-Darling Basin.	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. Curlew Sandpipers are omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Calidris melanotos*	Pectoral Sandpiper			M	Summer migrant to Australia. Widespread but scattered in NSW. East of the Great Divide, recorded from Casino and Ballina, south to Ulladulla. West of the Great Divide, widespread in the Riverina and Lower Western regions.	Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Breeds in northern Russia and North America, migrates to non-breeding areas in South America. Recorded in Australia from September to June.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Calyptorhynchus banksii samueli*	Red-tailed Black-Cockatoo (inland subspecies)	V			Watercourses and overflows of the Darling, Paroo, Bogan, Macquarie and Barwon Rivers extending along the Darling River from Wentworth in the south to Bourke and thence through to Brewarrina in the north. It extends east to Walgett and perhaps Boggabilla on the Barwon and south through to the Macquarie Marshes.	*Eucalyptus* forest and woodlands, especially along watercourses. Also grasslands, scrublands, wetlands and vegetation on floodplains.		Good	Yes	Likely	Included based on potential to occur throughout the sites. Potential habitat is good, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Certhionyx variegatus*	Pied Honeyeater	V			Arid and semi-arid areas, and occasionally east to the slopes and plains and the Hunter Valley.	*Acacia aneura* (Mulga), mallee, spinifex and eucalypt woodlands.	Feeds on nectar from various species of *Eremophila* spp. (emu-bushes), mistletoes and various other shrubs; also eats saltbush fruit, berries, seed, flowers and insects. Highly nomadic, following the erratic flowering of shrubs; can be locally common at times. Constructs a relatively large cup-shaped nest, usually robust, although occasionally loose, constructed of grasses and fine twigs, bound with spider webs, in the fork of a shrub or tree up to 5 m above the ground.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts likely limited to temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Cinclosoma castanotum*	Chestnut Quail-thrush	V			In NSW it occurs in two main populations: in the central mallee centred on Round Hill and Nombinnie Nature Reserves; and in the south west corner of the state in the Scotia mallee and in areas east of the Darling River as far east as Balranald and north to near Menindee.	In NSW it seems to occur almost exclusively in mallee habitats; elsewhere known from *Acacia* scrubs, dry sclerophyll woodland, heath, and native pine.	Forage on the ground, often among spinifex clumps, on a wide range of invertebrates, seeds of both native and introduced species and, more rarely, fruits. Its nest is a depression in the ground lined with strips of bark, fine grass or sticks, placed near a mallee trunk, against a fallen branch, under a low bush or in a sparse tuft of grass.	Marginal	No	Unlikely	Excluded. Potential habitat preferences on site are considered too marginal for inclusion in assessment of significance.	No
Birds	*Circus assimilis*	Spotted Harrier	V			Found throughout the Australian mainland, except in densely forested or wooded habitats, and rarely in Tasmania.	Grassy open woodland, inland riparian woodland, grassland, shrub steppe, agricultural land and edges of inland wetlands.	Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (e.g. bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	Good	Yes	Yes	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V			The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. The western boundary of the range of *Climacteris picumnus victoriae* runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper *Climacteris picumnus picumnus* which then occupies the remaining parts of the state.	Eucalypt woodlands and dry open forest.	Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding.	Good	No	Unlikely	Excluded due to no known available records in Toorale.	No

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Daphoenositta chrysoptera*	Varied Sittella	V			Distribution in NSW is nearly continuous from the coast to the far west.	Inhabits eucalypt forests and woodlands, mallee and *Acacia* woodland.	Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Marginal	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Potential temporary impacts to some foraging habitat in set down areas and disturbance due to construction activities. Observed at Booka Dam during May 2018 field survey.	Yes
Birds	*Epthianura albifrons*	White-fronted Chat	V			Occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state.	Saltmarsh vegetation, open grasslands and sometimes low shrubs bordering wetland areas.	The species is insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation or mangroves.	Marginal	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Potential temporary impacts to some foraging habitat in set down areas and disturbance due to construction activities.	Yes
Birds	*Falco hypoleucos*	Grey Falcon	E			Arid and semi-arid zones. In NSW, found chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	Shrubland, grassland and wooded watercourses, occasionally in open woodlands near the coast, and near wetlands.	Preys primarily on birds, especially parrots and pigeons; reptiles and mammals are also taken. Utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring.	Good	Yes	Yes	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Falco subniger*	Black Falcon	V			Sparsely distributed in NSW, occurring mostly in inland regions.	Woodland, shrubland and grassland, especially riparian woodland and agricultural land. Often associated with streams or wetlands.	Black Falcons nest in winter to late spring in the old stick nests of corvids or sometimes other raptor species. These tend to be located at the top of emergent trees in woodland, particularly riparian woodland. Feeds mostly on other birds, especially ground-feeding granivores such as pigeons and parrots, but also small mammals, large insects and occasionally carrion.	Good	Yes	Yes	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Gallinago hardwickii*	Latham's Snipe			M	Migrant to east coast of Australia, extending inland west of the Great Dividing Range in NSW.	Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	Non-breeding migrant to Australia, arriving between July-November from its breeding grounds in Japan and far-eastern Russia, and departing by late February. It feeds in mud or in very shallow water with low, dense vegetation. Roosting occurs on the ground near or in foraging areas beside or under clumps of vegetation, among dense tea-tree, in forests, in drainage ditches or plough marks, among boulders, or in shallow water if cover is unavailable.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Geophaps scripta*	Squatter Pigeon	E		V	From north Qld to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo.	Grassy woodlands and plains, preferring sandy areas and usually close to water.	Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground.	Good	No	Likely	Included based on being likely to occur throughout the broader area. Potential habitat is good, impacts may include temporary disturbances related to setdown areas and construction activities.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Glareola maldivarum*	Oriental Pratincole			M	Occasional scattered records in NSW.	Plains, open bare wetlands, tidal mudflats, beaches.	Breeds Pakistan, India, south-east Asia, migrates to coastal northern Australia November-February. Nomadic within Australia with rainfall.	Good	Yes	Yes	Included based on potential to occur throughout the sites. Potential habitat is good, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Grantiella picta*	Painted Honeyeater	V		V	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas.	Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema.* Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Good	Yes	Yes	Included based on presence of eucalypt woodlands at both sites. Potential temporary impacts to some foraging habitat and disturbance during foraging and at possible roost/perch sites due to construction activities.	Yes
Birds	*Grus rubicunda*	Brolga	V			Sparsely distributed across the southern part of its range, which includes central NSW to western Victoria.	Open wetlands, grassy plains, coastal mudflats and irrigated croplands and, on the coast, mangrove-studded creeks and estuaries.	They primarily feed on sedge roots and tubers, but will also take large insects, crustaceans, molluscs and frogs. The nesting season is from winter to autumn. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water.	Marginal	Yes	Yes	Included based on marginal habitat and known occurrences within Toorale Park. Impacts may occur and are likely to be indirect through changes in flow regimes and temporary impacts at both dams due to construction activities.	Yes
Birds	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V			Distributed along the coastline of mainland Australia and Tasmania, extending inland along some of the larger waterways, especially in eastern Australia.	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	The breeding season extends from June to January (or sometimes February) in southern Australia. Breeding habitat is usually close to water, but may occur up to a kilometre away. Nests are mainly located in tall open forest or woodland, but sometimes in other habitats such as dense forest, closed scrub or in remnant trees on cleared land. The White-bellied Sea-Eagle feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal.	Good	No	Likely	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Hamirostra melanosternon*	Black-breasted Buzzard	V			Areas receiving less than 500 mm rainfall from north-western NSW and north-eastern SA to the east coast at about Rockhampton, then across northern Australia south almost to Perth.	Inland habitats, including timbered watercourses, grasslands and sparsely timbered woodlands.	Mostly preys on reptiles, small mammals, birds, including nestlings, carrion and large eggs. Breeds from August to October near water in a tall tree. The stick nest is large and flat and lined with green leaves. Normally two eggs are laid.	Good	No	Likely	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Hieraaetus morphnoides*	Little Eagle	V			Throughout the Australian mainland, with the exception of the most densely-forested parts of the Dividing Range escarpment.	Open eucalypt forest, woodland or open woodland, including she oak or *Acacia* woodlands and riparian woodlands of interior NSW.	Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Lays two or three eggs during spring, and young fledge in early summer. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.	Good	Yes	Yes	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Hylacola cautus*	Shy Heathwren	V			Occurs across southern Australia, from the wheatbelt in southern WA east to central NSW, including Kangaroo Island.	Mallee woodlands with a relatively dense understorey. In central NSW, also uses rocky hilltop vegetation with a thick shrub layer.	Feeds on the ground, almost entirely on insects (cockroaches, grasshoppers, bugs, lerps, beetles, caterpillars, moths, ants, spiders and insect eggs) and rarely on seeds, including those of saltbush. Breeds late winter to early summer and builds a dome-shaped nest in a concealed location on the ground, using a variety of plant materials.	None	Yes	Yes	Excluded on the basis of no habitat on site.	No
Birds	*Leipoa ocellata*	Malleefowl	E		V	Arid and semi-arid zones. In NSW, populations occur in the south west mallee centred on Mallee Cliffs NP and extending east to near Balranald; in the Scotia mallee west of the Darling River; and in the Goonoo forest near Dubbo. Recorded less recently in the Pilliga forests, around Cobar and Goulburn River NP.	Predominantly mallee communities. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands, or other woodlands dominated by Mulga or native Cypress Pine species.	A pair may occupy a range of between 50 and 500 ha. Mainly forage in open areas on seeds of Acacias and other native shrubs (*Cassia, Beyeria, Bossiaea*), buds, flowers and fruits, insects, and cereals if available. Incubate eggs in large mounds that contain considerable volumes of sandy soil. The male monitors the temperature within the egg chamber using its bill, and regularly works the mound during the breeding season to maintain a constant temperature around 34 degrees.	Marginal	No	Potential	Excluded. Potential habitat preferences on site are considered too marginal for inclusion in assessment of significance.	No
Birds	*Limosa limosa*	Black-tailed Godwit	V		M	Arrives in August and leaves in March. In NSW, most frequently recorded at Kooragang Island, with occasional records elsewhere along the coast, and inland in the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.	Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps.	Breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Lophochroa leadbeateri*	Major Mitchell's Cockatoo	V			In NSW, occurs across the arid and semi-arid inland, as far east as Bourke and Griffith, and sporadically even further east.	Wide range of treed and treeless inland habitats, always within easy reach of water.	Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.	Marginal	Yes	Yes	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Lophoictinia isura*	Square-tailed Kite	V			In NSW, it is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast.	Timbered habitats including dry woodlands and open forests, particularly timbered watercourses.	It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Marginal	No	Potential	Excluded based on the species ability to readily relocate over large distances and no impacts to any breeding habitat if present.	No
Birds	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	V			Found throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies *picata.*	Open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. May breed any time between July and November, often rearing several broods. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	Good	No	Likely	Included based on potential to occur throughout the sites. Potential habitat is good, impacts may include temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V			Widespread in NSW from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Also Richmond and Clarence River areas and a few scattered sites in the Hunter, Central Coast and Illawarra regions.	Open forests or woodlands dominated by box and ironbark eucalypts, or by smooth-barked gums, stringybarks, river sheoaks and tea-trees.	Nectar is taken from flowers, and honeydew is gleaned from foliage. Breeds solitarily or co-operatively, with up to five or six adults, from June to December. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage. It is a compact, suspended, cup-shaped nest.	Marginal	No	Potential	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include temporary disturbances related to setdown areas and construction activities.	Yes
Birds	*Merops ornatus*	Rainbow Bee-eater			M	Distributed across much of mainland Australia, including NSW.	Open forests and woodlands, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	The breeding season extends from August to January. The nest is constructed in an enlarged chamber at the end of long burrow that is excavated by both sexes. Populations that breed in southern Australia are migratory, birds moving north to northern Australia, Papua New Guinea and eastern Indonesia after breeding, and remaining there for the duration of the Australian winter. Its diet mainly consists of bees and wasps.	Good	Yes	Yes	Included based on the potential for this species to occur throughout Toorale and use habitat that may be affected by the proposal	Yes
Birds	*Motacilla flava*	Yellow Wagtail			M	Regular summer migrant to mostly coastal Australia. In NSW recorded Sydney to Newcastle, the Hawkesbury and inland in the Bogan LGA.	Swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land, lawns.	Breeds Europe to Siberia and west Alaska. Regular summer migrant to Australia (November-April).	Good	No	Likely	Included based on potential to occur throughout the sites. Potential habitat is marginal, impacts may include changes to flow regime and temporary disturbances related to setdown areas and construction activities.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Ninox connivens*	Barking Owl	V			Wide but sparse distribution in NSW, avoiding the most central arid regions. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests.	Woodland and open forest, including fragmented remnants and partly cleared farmland, wetland and riverine forest.	It roosts in dense shaded foliage in large trees. Nesting occurs in hollows in large, old eucalypts, either living or dead. The nesting season is during mid-winter and spring, but may vary between pairs and from year to year. The Barking Owl preferentially hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but also takes birds, invertebrates and terrestrial mammals.	Marginal	Yes	Yes	Excluded as required habitat features will not be impacted by the works.	No
Birds	*Oxyura australis*	Blue-billed Duck	V			Widespread in NSW, but is most concentrated in the southern Murray-Darling Basin area.	Coastal and inland wetlands and swamps.	Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies.	Good	Yes	Yes	Included as distribution overlaps and habitat occurs throughout Toorale.	Yes
Birds	*Pedionomus torquatus*	Plains-wanderer	E1		CE	Most recent records in NSW are from the western Riverina, in an area bounded by Hay and Narrandera in the north, the Cobb Highway in the west, the Billabong Creek in the south, and Urana in the east.	Semi-arid, lowland native grasslands that typically occur on hard red-brown soils.	Most of the grassland habitat of the Plains-wanderer is <5 cm high, but some vegetation up to a maximum of 30 cm is important for concealment. During prolonged drought, the denudation of preferred habitats may force birds into marginal denser and taller grassland habitats that become temporarily suitable. The average home range of a single bird is about 12 ha. Breeding pairs have overlapping home ranges that total approximately 18 ha.	None	No	No	Excluded: Species distribution does not overlap.	No
Birds	*Plegadis falcinellus*	Glossy Ibis			M	Recorded over much of NSW. Spring/summer breeding migrant to southern Murray-Darling region and Macquarie Marshes.	Edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Occasionally estuaries, deltas, saltmarshes and coastal lagoons.	Breeds spring-summer, nests in colonies in well-vegetated wetlands. Roost in trees or shrubs usually near water bodies. Forage in shallow water over a soft substrate or on grassy or muddy margins of wetlands.	Good	Yes	Yes	Included as distribution overlaps and habitat occurs throughout Toorale.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Polytelis swainsonii*	Superb Parrot	V		V	In NSW, occurs on inland slopes of the Great Divide and on adjacent plains, especially along the major river-systems.	Box-gum woodland, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	Nest in small colonies, often with more than one nest in a single tree. Breed between September and January. May forage up to 10 km from nesting sites, primarily in grassy box woodland. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain.	Good	No	Likely	Included based on the likelihood of this species to occur within Toorale and the potential for habitat to be affected	Yes
Birds	*Pomatostomus halli*	Hall's Babbler	V			Central-eastern Australia, from Cobar north into south-western Qld, particularly along or west of the Warrego River.	*Acacia* scrub (mainly Mulga), and occasionally open dry *Eucalyptus populnea* (Bimblebox) woodland, and mulga- or eucalypt-lined watercourses.	Construct neat spherical dome nests from twigs, within the outer branches of acacias, in the upright forks of mulgas and *Casuarina,* or in a horizontal eucalypt branch 3-10 m above the ground. Probably sedentary, maintaining home ranges of up to several hectares which contain a clump of roosting nests. Feed mostly on the ground in grassy areas, they also glean and probe on trunks and branches. Diet includes insects (especially beetle pupae and caterpillars), spiders and seeds	Good	Yes	Yes	Included based on distribution and the potential habitat of this species that may be affected by the proposal.	Yes
Birds	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V			In NSW, occurs on the western slopes of the Great Dividing Range, and as far as Louth and Balranald on the western plains. Also occurs in woodlands in the Hunter Valley and in some locations on the north coast	Open woodland habitats; favours Box-gum woodlands on the slopes and Box-cypress and open Box woodlands on alluvial plains.	The species is insectivorous and forages on trunks and branches of trees or on the ground. It builds conspicuous dome-shaped stick nests in shrubs or eucalypt saplings, which are also used for roosting each night. It breeds co-operatively in sedentary family groups of 2-13 birds. Breeding occurs between July and February.	Marginal	Yes	Yes	Included based on distribution overlap and habitat availability within Toorale and the disturbance footprint.	Yes
Birds	*Pyrrholaemus brunneus*	Redthroat	V			Southern mainland Australia in all States and the NT. In NSW, the species is confined to the far west.	In NSW recorded mainly in chenopod shrublands. Also found in dense vegetation along drainage lines, Canegrass and Lignum swamps and floodplain depressions.	Breeds in late winter to spring and builds a bulky dome-shaped nest with a side entrance from coarse strips of bark, grass and feathers. The nest is located in shrubs or small trees up to one metre above the ground and usually contains two to four eggs. Their diet consists of a wide variety of terrestrial invertebrates (beetles, ants, termites, earwigs, grasshoppers, bugs, caterpillars, butterflies, moths, wasps and spiders) and grass seeds gathered from the ground and amongst low foliage.	Marginal	No	Potential	Included. on the basis of the potential for this species to occur in Toorale and that potential habitat may be affected	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Rostratula australis*	Australian Painted Snipe	E		E	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	Swamps, dams and nearby marshy areas.	Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Good	No	Likely	Included species is considered likely to occur. Includes *Rostratula benghalensis*.	Yes
Birds	*Stagonopleura guttata*	Diamond Firetail	V			Widely distributed in NSW, mainly recorded in the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina, and less commonly found in coastal areas and further inland.	Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Marginal	Yes	Yes	Included based on presence of riparian habitat.	Yes
Birds	*Stictonetta naevosa*	Freckled Duck	V			Inland river systems, occurring as far as coastal NSW in times of drought.	Freshwater swamps and creeks, lakes, reservoirs, farm dams and sewage ponds.	Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. Nests are usually located in dense vegetation at or near water level.	Good	No	Likely	Included based on distribution and habitat availability within Toorale.	Yes
Birds	*Thinornis rubricollis*	Hooded Plover	CE		V	Occurs in coastal NSW north to Sussex Inlet. Occasional records from the Shoalhaven River, Comerong Beach and Lake Illawarra.	Sandy ocean beaches, tidal bays and estuaries, rock platforms, rocky or sand-covered reefs, and small beaches in lines of cliffs. Also use near-coastal saline and freshwater lakes and lagoons.	Forage in sand, rocks and coastal lagoons for marine worms, molluscs, crustaceans, insects, water plants and seeds. At night they favour the upper zones of beaches for roosting. In eastern Australia, Hooded Plovers usually breed from August to March on sandy ocean beaches, between the high-water mark and the base of the fore-dunes. The nest is a scrape in the sand near debris.	None	No	No	Excluded based on a lack of suitable habitat and distribution does not overlap	No

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Birds	*Tringa nebularia*	Common Greenshank			M	Summer migrant to Australia. Recorded in most coastal regions of NSW; also widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions.	Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).	Breeds Scotland to Siberia. Summer migrant to Australia September to April. Forages at edges of wetlands, mudflats, in channels, in shallows and on exposed seagrass beds. Roosts and loafs around wetlands, in shallow pools and puddles, or on rocks, sandbanks or small muddy islets.	Marginal	No	Potential	Included based on available habitat that may be affected by the proposed action.	Yes
Birds	*Tyto novaehollandiae*	Masked Owl	V			Recorded over approximately 90% of NSW, excluding the most arid north-western corner. Most abundant on the coast but extends to the western plains.	Dry eucalypt forests and woodlands from sea level to 1100 m.	Often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Good	No	Likely	Excluded as required habitat features will not be impacted by the works.	No
Mammalia	Antechinomys laniger	Kultarr	E			Widespread across arid and semi-arid NSW. Recent records have come primarily from the Cobar and Brewarrina region.	Open country, especially claypans among Acacia woodlands.	Nocturnal, sheltering by day in hollow logs or tree-stumps, beneath saltbush and spinifex tussocks, in deep cracks in the soil and in the burrows of other animals. Populations appear to fluctuate seasonally in response to environmental stresses, including declines following periods of drought and intensive flooding.	Marginal	No	Potential	Included. Records in broader area.	Yes
Mammalia	*Chalinolobus picatus*	Little Pied Bat	V			Inland Qld and NSW (including Western Plains and slopes) extending slightly into SA and Victoria.	Dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands.	Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.	Marginal	Yes	Yes	Included.	Yes
Mammalia	*Mormopterus eleryi*	Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	E			In NSW, the species has been recently recorded from only three disjunct locations: Gundabooka National Park, south of Bourke; Dhinnia Dthinawan Nature Reserve, north of Warialda, and near Bonshaw.	Appears to require areas with tree hollows and fissures.	Knowledge of the ecology of the Hairy-nosed Freetail Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites. All other Australian species from the same family generally roost in tree hollows and fissures.	Marginal	No	Potential	Included. Marginal potential habitat present.	Yes

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Mammalia	*Myotis macropus*	Southern Myotis	V			In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20 m.	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	Marginal	No	Unlikely	Excluded: Although a field survey conducted in 2015 recorded a potential call sequence for this species (OEH, 2015), no definitive identification has been made for this species in Toorale and was therefore deemed unlikely to occur in the area.	No
Mammalia	*Nyctophilus corbeni*	Corben's Long-eared Bat	V		V	Distribution coincides approximately with the Murray Darling Basin; the Pilliga Scrub region is the distinct stronghold for this species.	Mallee, *Allocasuarina luehmannii* (bulloke) and box eucalypt-dominated communities, especially box/ironbark/cypress-pine vegetation.	Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer.	Good	No	Likely	Included. Potential habitat present across Toorale	Yes
Mammalia	*Phascolarctos cinereus*	Koala	V		V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands.	Eucalypt forest and woodland communities, including coastal forests, rainforests, riparian areas, swamp sclerophyll forests, heathland and shrubland.	Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Females breed at two years of age, with mating occurring between September and February.	Good	No	Likely	Included. Potential habitat present in the form of feed tree species	Yes
Mammalia	*Rattus villosissimus*	Long-haired Rat	V			Recorded over vast areas of western NSW. Strongholds are north-west of NSW, with plagues originating from this region and spilling south along river channels into NSW. Otherwise found in scattered localities in low numbers.	Sustained in mesic, densely vegetated sites. During plagues can be found in virtually all inland habitats.	Eats roots, stems and leaves of grasses and herbs, seeds, flowers and insects. Following extended periods of above average rainfall or flood this species can breed rapidly. Resulting populations disperse widely, then die away abruptly as food is depleted and water evaporates. Nocturnal, sheltering during the day in complex burrow systems or in a shallow temporary burrow.	Marginal	No	Potential	Excluded. No records near site. Unlikely to be occupying area of immediate disturbance	No

Class	Scientific Name	Common Name	BC Act	FM Act	EPBC Act	Distribution	Habitat	Ecology	Habitat quality	Species known to occur on Toorale	Likelihood of occurrence	Justification for inclusion/exclusion based on habitat distribution and impacts.	Impact Assessment Required
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V			There are scattered records of this species across the New England Tablelands and North West Slopes. Rare visitor in late summer and autumn to south-western NSW.	Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	It forages for insects above the canopy in eucalypt forests, and closer to the ground in more open country. It is dependent on suitable hollow-bearing trees to provide roost sites. The species has also been recorded using caves and abandoned sugar glider nests as roost sites. Breeding occurs between December and mid-March.	Good	Yes	Yes	Included, based on the chance that potential habitat may be affected for this species	Yes
Mammalia	*Sminthopsis macroura*	Stripe-faced Dunnart	V			Distribution extends into central and northern NSW, east to Dubbo, Coonabarabran, Warialda and Ashford.	Native dry grasslands and low dry shrublands, often along drainage lines.	They shelter in cracks in the soil, in grass tussocks or under rocks and logs. It forages nocturnally, feeding mainly on invertebrates other than ants, and occasionally small mammals and lizards. The breeding season is between June and February.	Marginal	No	Potential	Included. Marginal potential habitat present.	Yes
Mammalia	*Vespadelus baverstocki*	Inland Forest Bat	V			Generally in areas with annual rainfall less than 400 millimetres. In NSW, most regularly captured in the far south west, north from the Murray River to Menindee, and east to the Balranald-Ivanhoe Road. Thought to also occur in the central NSW mallee, centred on Nombinnie Nature Reserve. There are also records just south of the Qld border around the Culgoa River.	Recorded from Mallee, Mulga and River Red Gum woodland.	Colony size ranges from a few individuals to more than sixty. Females congregate to raise young in November and December, with young carried for the first week following birth. Young are independent by January. These bats fly rapidly and cover an extensive foraging area and are presumed to feed on flying insects.	Marginal	No	Potential	Included. Marginal potential habitat present.	Yes
Reptilia	*Antaresia stimsoni*	Stimson's Python	V			In NSW, occurs in north-west from Bourke and Gundabooka National Park in the east to Broken Hill and Wilcannia in the south.	Arid and semi-arid environments including rock outcrops, sandy plains and dunefields, woodlands, shrublands and hummock grasslands.	Rocky outcrops provide caves and deep crevices, and tree-lined watercourses provide numerous low hollows and fallen trees. They forage at night with adults feeding on small mammals (especially bats), birds, geckoes and other lizards, whilst juveniles take geckoes and skinks.	Good	No	Likely	Included. Potential habitat present.	Yes
Reptilia	*Ctenotus pantherinus ocellifer*	Leopard Ctenotus	E			In NSW, the subspecies is known from a single specimen collected west of Goodooga.	Found in spinifex (*Triodia mitchelli)* habitat on red sand country.	Very little is known about the ecological requirements of this subspecies.	None	Yes	Yes	Excluded. Habitat not on site.	No
Reptilia	*Pseudonaja modesta*	Ringed Brown Snake	E			In NSW, thought to occupy the north-west portion of the state, having been recorded from Tarawi Nature Reserve, 140km south of Broken Hill, Silverton, Tibooburra, Wanaaring and from Kilberoo, 140km north-west of Bourke.	Woodlands, shrublands, mallee and grasslands.	It is diurnal but may forage during warm nights. Feeds predominantly on small skinks and occasionally small mammals.	Marginal	Yes	Yes	Included. Marginal potential habitat present.	Yes
Reptilia	*Ramphotyphlops endoterus*	Interior Blind Snake	E			Northwest region of NSW.	Spinifex, Mitchell grassland or shrubland on red sandy soils.	Nocturnal. Feeds principally on ants and termites. Shelters in the ground, termite nests or under rocks and logs.	None	Yes	Yes	Excluded. Habitat not on site.	No

Appendix G : Biodiversity Conservation Act Assessment

Wetland and wading birds

The following wetland and wading bird species require a BC Act Tests of Significance:

- *Botaurus poiciloptilus* – Australasian Bittern (Endangered)
- *Calidris ferruginea* – Curlew Sandpiper (Endangered);
- *Grus rubicunda* – Brolga (Vulnerable);
- *Limosa limosa* – Black-tailed Godwit (Vulnerable);
- *Oxyura australis* – Blue-billed Duck (Vulnerable);
- *Rostratula australis* – Australian Painted Snipe (Endangered); and
- *Stictonetta naevosa* – Freckled Duck (Vulnerable).

These species have been grouped due to similarities in their ecology and the nature of potential impacts due to the works. Potential impacts are likely to be restricted to small scale alterations in habitat suitability at Boera, Booka and Homestead dams due to inundation regime changes and temporary impacts from construction activities. The works will directly impact approximately 34.62 ha of habitat. However, the above listed species typically forage in inundated and/or muddy areas. This only consists of a portion of the area to be impacted, as well as relatively small sections of up and down stream habitat, which may exhibit shifts in inundation regimes because of the modifications to Boera and Booka dams.

The works at Homestead Dam are to restore the previous existing environment prior to dam wall failure and impacts considered are temporary and limited to construction activities.

These species may also experience temporary impacts at Boera, Booka and Homestead dams, during construction activities. Ground disturbance in set down areas, noise and vibration disruptions from equipment/plant and humans in the area are considered likely. These impacts will be temporary and small in nature and all of the above listed species are capable of relocating further up or downstream where larger areas of suitable habitat will remain unaffected by these impacts.

A reduction in inundation frequency of the floodplain derived from changes to water management will potentially reduce the habitat availability for these species at a greater rate than current conditions (see Section 3.3). Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and/or temporary in nature. No viable local population is likely to be put at risk of extinction Although a reduction in inundation frequency may reduce habitat availability at a higher rate, it is unlikely that this will adversely affect the lifecycle of these species so that the local populations will be placed at risk of extinction given that these species are highly mobile and can travel large distances. Furthermore, the

BC Act	Question	Response
		proposed dams and Warrego River will still act as refugia during dry periods.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam, although as these species mostly inhabit the fringes of the dams this impact area is likely a lot less. Inundation frequency of the floodplains under the proposed management will be reduced, this will reduce aquatic habitat availability for these species on the floodplain. Surface water modelling revealed that under current practises, 36 large inundation events (500-500 ML/d) will make its way onto the floodplain over 44 years. This will be reduced to 23-29 events under the proposed management scenario. Although an adaptive management strategy will be adopted and allow for flexible management of water release to the floodplain and will enable corrective action if condition of the floodplain decreases
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Trees will be removed, although the impacts are largely temporary. Inundation in the areas is largely temporary and occurs throughout a much larger contiguous area along the water course. Fragmentation or isolation of habitat areas is considered unlikely or will occur on a negligible scale.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.

BC Act	Question	Response
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to; "Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands" and "Clearing of native vegetation". The clearance of native vegetation KTP contribution is considered negligible given the small scale of the works and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area. Changes of current water management will decrease inundation frequency of the floodplain, although this decrease is small and is considered to have a minor effect on these species. Furthermore, the adaptive management strategy that will be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Woodland birds

The following woodland bird species require a BC Act Tests of Significance:

- *Ardeotis australis* – Australian Bustard (Endangered);
- *Artamus cyanopterus cyanopterus* – Dusky Woodswallow (Vulnerable);
- *Burhinus grallarius* – Bush Stone-curlew (Endangered);
- *Calyptorhynchus banksii samueli* – Red-tailed Black-Cockatoo (inland subspecies) (Vulnerable);
- *Certhionyx variegatus* – Pied Honeyeater (Vulnerable);
- *Daphoenositta chrysoptera* – Varied Sittella (Vulnerable);
- *Epthianura albifrons* – White-fronted Chat (Vulnerable);
- *Geophaps scripta* – Squatter Pigeon (Endangered);
- *Grantiella picta* – Painted Honeyeater (Vulnerable);
- *Melanodryas cucullata cucullata* – Hooded Robin (south-eastern form) (Vulnerable);
- *Melithreptus gularis gularis* – Black-chinned Honeyeater (eastern subspecies) (Vulnerable);
- *Polytelis swainsonii* – Superb Parrot (Vulnerable);
- *Pomatostomus halli* – Hall's Babbler (Vulnerable);
- *Pomatostomus temporalis temporalis* – Grey-crowned Babbler (eastern subspecies) (Vulnerable);
- *Pyrrholaemus brunneus* – Redthroat (Vulnerable);
- *Stagonopleura guttata* – Diamond Firetail (Vulnerable).

These species have been grouped due to similarities in their ecology and the nature of potential impacts due to the works. Potential impacts are likely to be restricted to temporary and small-scale alterations in habitat suitability at Boera, Booka and Homestead dams. Temporary impacts to potential foraging habitat

and disruption from roosting/perching/shelter locations may occur in and around set down and work areas from noisy and/or vibrating equipment/plant and human activity in the area.

These impacts will be temporary and small in nature and all of the above listed species are capable of readily relocating further up or downstream where larger areas of suitable habitat will remain unaffected by these impacts.

Predicted changes to the inundation frequency of the floodplain is unlikely to reduce the condition of these specie's habitat, based upon inundation requirements of the vegetation communities (see Section 5.3.2). Due to this, effects on these species' habitat were considered to be minor. Potential impacts are likely to be restricted to a minor drop in productivity due to a reduction in inundation frequency. Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts of the development are considered sufficiently small and temporary in nature. No viable local population is likely to be put at risk of extinction. Changes to habitat derived from a change in flow regime is predicted to be minor, and unlikely to place these species at risk of extinction.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential foraging and temporary shelter habitat. Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam. The predicted reduction in inundation frequency of the floodplain is highly unlikely to modify these specie's habitat to a condition state that will significantly affect these species. Furthermore, the adaptive management strategy that will be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases

BC Act	Question	Response
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Although trees will be removed, the impacts are largely temporary. Inundation in the areas is largely temporary and occurs throughout a much larger contiguous area along the water course. Fragmentation or isolation of habitat areas is considered unlikely.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Small mammals

The following small mammal species require a BC Act Tests of Significance:

- *Antechinomys laniger* – Kultarr (Endangered); and
- *Sminthopsis macroura* – Stripe-faced Dunnart (Vulnerable).

These species have been grouped due to similarities in their ecology and the nature of potential impacts due to the works. Potential impacts are likely to be restricted to temporary and small-scale alterations in habitat suitability at Boera, Booka and Homestead dams. Temporary impacts to potential foraging habitat and disruption from diurnal shelter and nesting locations may occur in and around set down/work areas from noisy and/or vibrating equipment/plant and human activity in the area. Ground disturbances may also decrease the suitability of some shelter sites within the set down areas at all three sites.

These impacts will be temporary and small in nature and all of the above listed species will be able to relocate overnight to areas of undisturbed habitat in the surrounding areas.

Potential impacts to these species habitat on the floodplain derived from changes to water regime (see section 5) were considered to be minor, and potential impacts will be restricted to a minor drop in overall productivity temporally due to a reduction in inundation frequency. Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and temporary in nature. No viable local population is likely to be put at risk of extinction. The predicted reduction in inundation frequency of the floodplain is also unlikely to affect a local population given that changes to the habitat of these species will be minimal. Intensive flooding is also a known threat to these species. A reduction in these events is therefore considered beneficial.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential foraging and shelter habitat. Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam. Potential impacts to the habitat of these species derived from a reduction in inundation frequency is considered to be minimal.
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.

BC Act	Question	Response
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Microchiropteran bats

The following small Microchiropteran bat species require a BC Act Tests of Significance:

- *Chalinolobus picatus* – Little Pied Bat (Vulnerable);
- *Mormopterus eleryi* – Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat (Endangered);
- *Nyctophilus corbeni* – Corben's Long-eared Bat (Vulnerable);
- *Saccolaimus flaviventris* – Yellow-bellied Sheathtail-bat (Vulnerable); and
- *Vespadelus baverstocki* – Inland Forest Bat (Vulnerable).

These species have been grouped due to similarities in their ecology and the nature of potential impacts due to the works. Potential impacts are likely to be restricted to temporary and small-scale alterations in habitat suitability at Boera, Booka and Homestead dams. Temporary impacts to potential foraging habitat and disruption from diurnal shelter and roosting locations may occur in and around set down/work areas from noisy and/or vibrating equipment/plant and human activity in the area. All of these bat species may utilise hollow bearing trees for shelter and roosting.

These impacts will be temporary and small in nature and all of the above listed species will be able to relocate overnight to areas of undisturbed habitat in the surrounding areas.

Potential impacts to these species habitat on the floodplain derived from changes to water regime (see section 5) were considered to be minor, and that potential impacts will be restricted to a minor drop in productivity temporally due to a reduction in inundation frequency. Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and temporary in nature. No viable local population is likely to be put at risk of extinction. The predicted reduction in inundation frequency of the floodplain is unlikely to place a local population at risk of extinction due to the minor effects projected for these specie's habitat and that these species are highly mobile and

BC Act	Question	Response
		well suited to the 'boom and bust' nature of conditions within Toorale.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential foraging and shelter/roosting habitat. No hollow bearing trees will be removed as a result of the work. Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam. A reduction in inundation frequency of the floodplain is unlikely to have a significant effect on these species' habitat, given that a reduction in condition class is unlikely to occur (5.2.3). Furthermore, the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).

BC Act	Question	Response
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Koala

The Koala (*Phascolarctos cinereus*) requires a BC Act Assessment of Significance as there are individual feed trees located within and nearby Boera, Booka and Homestead dams. Potential impacts to the species are likely to be restricted to the removal of some small listed feed trees for construction activities in the areas and, temporary small-scale alterations in habitat suitability. Temporary impacts to potential foraging habitat and disruption at shelter locations may occur in and around set down/work areas from noisy and/or vibrating equipment/plant and human activity in the area. However, there are no records of the species within Toorale.

These impacts will be temporary and small in nature and the species will be able to relocate to areas of undisturbed habitat in the surrounding areas.

Predicted changes to the inundation frequency of the floodplain is unlikely to reduce the condition of the Koalas habitat, based upon inundation requirements of the vegetation communities (see section 5). Due to this, effects on this species habitat were considered to be minor. Also, the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and/or temporary in nature. No viable local population is thought to occur nor is likely to be put at risk of extinction.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A

BC Act	Question	Response
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential foraging and shelter habitat. Removal of feed trees will be limited to scattered trees within the broader activity area and temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam. Reduction in inundation frequency of the floodplain is unlikely to decrease the condition class of koala feed trees and their communities.
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of this species given that no records exist within Toorale NP.
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to “Clearing of native vegetation”. The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Reptiles

The following reptile species require a BC Act Tests of Significance:

- *Antaresia stimsoni* – Stimson's Python (Vulnerable); and
- *Pseudonaja modesta* – Ringed Brown Snake (Endangered).

These species have been grouped due to similarities in their ecology and the nature of potential impacts due to the works. Potential impacts are likely to be restricted to temporary and small-scale alterations in habitat suitability at Boera, Booka and Homestead dams. Temporary impacts to potential foraging habitat and disruption from diurnal shelter may occur in and around set down/work areas from noisy and/or

vibrating equipment/plant and human activity in the area. Stimson's Python may also utilise hollow bearing trees for diurnal shelter, while the Ringed Brown Snake is diurnal and can readily relocate to nearby similar habitat.

These impacts will be temporary and small in nature and all of the above listed species will be able to relocate overnight to areas of undisturbed habitat in the surrounding areas.

Potential impacts to these species habitat on the floodplain derived from changes to water regime (see Section 5) were considered to be minor, and that potential impacts will be restricted to a minor drop in productivity due to a reduction in inundation frequency. Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and temporary in nature. No viable local population is likely to be put at risk of extinction. A reduction in inundation frequency of the floodplain is also unlikely to place a population of these species at risk of extinction due to the little effect the impact will place on these species' lifecycle.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential foraging and shelter habitat. Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam. A reduction in inundation frequency of the floodplain is unlikely to have a significant effect on these species' habitat, given that a reduction in condition class is unlikely (5.2.3). Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable

BC Act	Question	Response
		corrective action if condition of the floodplain decreases
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding suitable habitat areas throughout Toorale NP and the broader area.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Flora

The following flora species require a BC Act Tests of Significance:

- Chenopodiaceae *Atriplex infrequens* – A saltbush (Vulnerable);
- Poaceae *Austrostipa metatoris* – A spear-grass (Vulnerable);
- Rubiaceae *Dentella minutissima* (Endangered);
- Brassicaceae *Lepidium monoplocoides* – Winged Peppercress (Endangered);
- Chenopodiaceae *Osteocarpum scleropterum* – Squash Bush (Endangered); and
- Malvaceae *Sida rohlenae* – Shrub Sida (Endangered).

These species have been grouped due to similarities in their habits and the nature of potential impacts due to the works. Three are known from being from Toorale: *Atriplex infrequens*, *Dentella minutissima*, and *Osteocarpum scleropterum*.

Potential impacts are likely to be restricted to temporary and small-scale alterations in habitat suitability at Boera (11.18 ha), Booka (12.22 ha) and Homestead (11.29 ha) dams, as none of the species are long-lived trees that may be removed. Temporary impacts to potential habitat and will occur in and around set down/work areas and from human and vehicle/plant traffic in the area. The impacts to these areas may result in minor ground disturbance, however it is likely if any of these species occurred in the locale they would feasibly occur throughout the broader area as well, given the extent of similar habitat along the Warrego River and associated flood plains. These impacts will be temporary and small in nature and with

appropriate mitigation measures such as a pre-clearance survey prior to the works, populations should be avoided.

Potential impacts due to a reduction in inundation frequency of the floodplain is unlikely to affect most of these species given their habits. *Dentella minutissima,* is most at risk given that this species is known to occur within Toorale and directly responds to stages of inundation. Although the lack of research on water requirements for this species means it is difficult to measure the predicted impact of the proposed reduction of inundation frequency will have on this species. Several populations of this species are being monitored in vegetation plots by the CEWO adjacent to Boera Dam. If any significant changes to these populations occur, then the operating strategy should be adaptively managed to minimise these changes.

BC Act	Question	Response
7.3.1 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	No. The direct impacts are considered sufficiently small and temporary in nature. No known viable local populations for the above flora species occur or is likely to be put at risk of extinction. A reduction in inundation frequency of the floodplain is considered unlikely to have a significant effect given that inundation events will still occur and assist the lifecycle of these species. In addition, these species already exist and are well adapted to the 'boom and bust' nature of this wetland. Furthermore, pre-clearance surveys under more ideal conditions closer to the proposed work will allow for a more thorough examination of any populations of these species within the disturbance footprint. If populations are found, the assessment of these species will need to be examined.
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	N/A
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	N/A
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Impacts relate to potential suitable habitat. Temporary impacts will affect approximately 11.18 ha of native vegetation areas at Boera Dam, approximately 12.22 ha at Booka Dam and approximately 11.29 ha at Homestead Dam.

BC Act	Question	Response
		A reduction in inundation frequency is unlikely to affect the habitat of five of these species, although, the 'wetting' of *Dentella minutissima* and *Lepidium monoplocoides* habitat is predicted to occur at a lower rate. It is unclear what affect this will have on the species given that the length of maximum drying periods will not increase, and that inundation of the habitat will still occur regularly. Although the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community: The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The habitat is considered unimportant to the long-term survival of these species.
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and temporary nature of the works, and the extensive surrounding similar potential habitat areas along the Warrego River throughout Toorale NP.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions – Endangered Ecological community

The woodland community is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees. Areas of this EEC occur at Boera (10.43 ha), Booka (10.68 ha) and Homestead (6.53 ha) dams and may be altered by the works. The alterations to these portions of EEC are likely to be largely temporary in nature.

The extent of the community occurs both up and down stream of the Boera, Booka and Homestead dams, suggesting the dam plays little role in the local occurrence of the community and other abiotic factors are

likely more important. Therefore, impacts from inundation regime changes on the community are unlikely. Furthermore, the abiotic factors that help define the community will remain largely unchanged.

The predicted changes to inundation frequency have been assessed for both *Eucalyptus coolabah* (Coolibah) and *Eucalyptus largiflorens* (Black Box) within Section 5.3. Watering requirements for these species are well within the proposed inundation frequencies of the operating strategy, and hence, the modified inundation regime would have negligible impact on the long term health of these species. These requirements have been used as an indication of the overall requirement their respective vegetation community requires, including this EEC. Minor influences on aquatic responding plants may occur at times, given the lower than current inundation frequency, although this is considered to be insignificant.

Furthermore, the adaptive management strategy to be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

BC Act	Question	Response
7.3.1 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	N/A
7.3.1 b) i	In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: 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	The areas to be affected are relatively small and the impacts are largely temporary in nature. The activity 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.
7.3.1 b) ii	In the case of an endangered ecological community or critically endangered ecological community: Whether the proposed development or activity 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.	As above. The activity 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.
7.3.1 c) i	In relation to the habitat of a threatened species or ecological community: The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity	Approximately 10.43 ha at Boera dam, 10.68 ha at Booka dam and approximately 6.53 ha at Homestead dam. A further 18, 600 ha of this community will remain unaffected within Toorale. Changes to inundation frequency of the floodplain will not modify the community to the extent that it will drop in condition class.
7.3.1 c) ii	In relation to the habitat of a threatened species or ecological community: 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	Fragmentation or isolation of habitat areas is considered unlikely due to the small and temporary nature of the majority of the works within extensive areas of similar contiguous habitat in the broader Toorale NP area.
7.3.1 c) iii	In relation to the habitat of a threatened species or ecological community:	The habitat is considered unimportant to the long-term survival of the community.

BC Act	Question	Response
	The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	
7.3.1 d)	Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	No Areas of Outstanding Biodiversity value occur on or near the site (accessed 29/10/19).
7.3.1 e)	Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	The project may contribute to "Clearing of native vegetation". The contribution is considered negligible given the small scale and largely temporary nature of the works, and the extent of the community along the Warrego River throughout Toorale NP.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Appendix H : Environment Protection and Biodiversity Conservation Act Assessment

Critically endangered and endangered fauna species

- Wetland birds
    - *Botaurus poiciloptilus* – Australasian Bittern (Endangered)
    - *Calidris ferruginea* – Curlew Sandpiper (Critically Endangered)
    - *Rostratula australis* – Australian Painted Snipe (Endangered)

The above species have been assessed together as they're habitat requirements are similar. They are not known to occur in the area and their listing status under the EPBC Act requires the same level of scrutiny. As previously stated, the areas to be impacted are relatively small and the related impacts are largely temporary. Small scale localised impacts relating to inundation regime may alter potential habitat suitability. Indirect potential impacts may occur due to a decrease in available habitat, as surface water modelling has shown that a reduction in inundation events of the floodplain will occur as a result of management changes. Although this is considered minor given that large scale inundation events will still occur at a high rate and that the length of the maximum dry period has not increased (see section 5).

Breeding ecology for each species is different, however breeding is considered unlikely to occur or be disrupted by the action. The Australasian Bittern nests are built in secluded densely vegetated wetlands on a platform of reeds which are not present on site. Curlew Sandpiper is a migratory species with no breeding habitat in Australia. Australian Painted Snipe nests in grass and leaf lined scrapes in the ground which are unlikely to be affected by the action.

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	No. There are no known populations of these species within the Toorale NP area.
2)	will the action reduce the area of occupancy of the species	Negligible. These species are
3)	will the action fragment an existing population into two or more populations	No. These species are all large ranging highly mobile species. The works will not create any barriers to the movement of these species.
4)	will the action adversely affect habitat critical to the survival of a species	No critical habitat for these species occurs on site.
5)	will the action disrupt the breeding cycle of a population	No. Breeding is unlikely to occur/be disrupted for these species in the area.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No. The direct impact areas affected are small and the impacts are largely temporary. There are extensive areas of suitable and similar habitat within the area. The predicted reduction in inundation events of the floodplain may decrease available habitat, although this reduction is considered minor and unlikely to cause these species to decline in the locality. Furthermore, the adaptive management strategy that will be adopted will allow for

Criterion	Question	Response
		flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Unlikely. Weed and pathogen protocols will be followed.
7)	will the action introduce disease that may cause the species to decline	Unlikely. Weed and pathogen protocols will be followed.
8)	will the action interfere with the recovery of the species	No.
Conclusion	**Is there likely to be a significant impact?**	No.

Critically endangered and endangered flora species

- Flora
    - *Lepidium monoplocoides* – Winged Peppercress (Endangered)

The above species is not known to occur in the area and the species has a wide distribution. The species is highly dependent on seasonal conditions and occurs on waterlogged grey-brown clay, which can occur on site with sufficient rainfall. The species does not tolerate grazing disturbance, which is likely to occur onsite due to the presence of goats.

As previously stated, the areas to be impacted are relatively small and the related impacts are largely temporary. The area is currently experiencing a prolonged period of drought and the works will occur during dry conditions.

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	No. There are no known populations of these species within the Toorale NP area.
2)	will the action reduce the area of occupancy of the species	Negligible. The impacts are largely temporary, and the areas with residual impacts are relatively small and occur within extensive areas of similar habitat in the Toorale NP area.
3)	will the action fragment an existing population into two or more populations	Unlikely. No known population occurs on site.
4)	will the action adversely affect habitat critical to the survival of a species	No critical habitat for the species occurs on site.
5)	will the action disrupt the breeding cycle of a population	Unlikely. The species responds to local conditions which will remain relatively unchanged.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No. The areas affected are small and the impacts are largely temporary. There are extensive areas of suitable and similar habitat within the surrounding areas.

Criterion	Question	Response
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Unlikely. Weed and pathogen protocols will be followed.
7)	will the action introduce disease that may cause the species to decline	Unlikely. Weed and pathogen protocols will be followed.
8)	will the action interfere with the recovery of the species	No.
Conclusion	**Is there likely to be a significant impact?**	No.

Vulnerable Species

The species below are listed as Vulnerable under the EPBC Act. No important populations of these species occur within the Toorale NP area and so the species have been addressed together.

- Woodland and ground birds
  - *Geophaps scripta* – Squatter Pigeon
  - *Grantiella picta* – Painted Honeyeater
  - Polytelis swainsonii – Superb Parrot
- Mammals
  - *Nyctophilus corbeni* – Corben's Long-eared Bat
  - Phascolarctos cinereus – Koala
- Flora
  - Atriplex infrequens – A saltbush
  - Austrostipa metatoris – A spear-grass

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species	No important populations occur on site.
2)	reduce the area of occupancy of an important population	No important populations occur on site.
3)	fragment an existing important population into two or more populations	No important populations occur on site.
4)	adversely affect habitat critical to the survival of a species	No critical habitat for these species occurs on site.
5)	disrupt the breeding cycle of an important population	No important populations occur on site.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely. Direct impacts are predominantly small and temporary in nature and not considered likely to decrease the availability or quality of habitat to the extent that the species is likely to decline. Indirect impacts due to a change in water management are unlikely to affect these species as their habitat is predicted to remain in the same condition state as it has been under the current management practises. Furthermore, the adaptive

Criterion	Question	Response
		management strategy that will be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. Weed and pathogen protocols will be followed.
8)	introduce disease that may cause the species to decline, or	Unlikely. Weed and pathogen protocols will be followed.
9)	interfere substantially with the recovery of the species.	Unlikely. As above impacts are sufficiently small and temporary, and no important populations occur.
Conclusion	**Is there likely to be a significant impact?**	**No**

Koala EPBC Act referral assessment

The Koala habitat assessment tool (DotEE, 2014) was applied to the study area and wider locality to assess if the area constitutes habitat critical to the survival of the Koala. The study area scored a habitat score of 5 and results of this assessment are presented in **Table I1.**

Table I 1 Koala habitat assessment tool (after DoE 2014)

Attribute	Scores			Assessment criteria (Inland)	Assessment details	
	Boera	Booka	Homestead			
Koala occurrence	0 (low)	0 (low)	0 (low)	No koala records within 10 km of the edge of the impact area.	Desktop	• EPBC PMST report identified Koala as 'Species or species habitat known to occur within area' • NSW BioNet search failed to identify a record of a Koala occurring within 10km of the proposal area
					On-ground	No evidence of Koala, including actual individuals, scats or scratches were identified during the field survey.
Vegetation composition	+1 (medium)	+1 (medium)	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present	On-ground	Coolabah is a primary Koala feed tree species as listed by DPIE. This species occurs within the proposed areas of Boera, Booka and Homestead Dams.
Habitat connectivity	+2 (high)	+2 (high)	+2 (high)	Area is part of a contiguous landscape ≥ 1,000 ha.	On-ground and mapping	A contiguous landscape is defined to encompass 'no barriers' with a barrier being defined as *'a feature (natural or artificial) that is likely to prevent the movement of Koalas. Natural barriers may include steep mountain ranges (cliffs), unsuitable habitats, major rivers / water bodies or treeless areas more than 2 km wide. Artificial barriers may include infrastructure (such as roads, rail, mines, large fences etc.) without effective Koala passage measures, or developments that create treeless areas more than 2 km wide.'* The study area is within and adjacent to the Warrego River riparian corridor. Although unsuitable habitat is present adjacent to both study areas, the

Attribute	Scores			Assessment criteria (Inland)	Assessment details	
	Boera	Booka	Homestead			
						riparian corridor consists of contiguous vegetation that covers an area greater than 1,000 ha.
Key existing threats	+1 (medium)	+1 (medium)	+1 (medium)	Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.	On-ground and mapping	It is likely that Koalas have a minimal risk of dog attack and vehicle strikes in areas surrounding the study area on an infrequent basis.
Recovery value	0 (low)	0 (low)	0 (low)	Habitat is unlikely to be important	On-ground & Reporting	The interim recovery objectives are provided below: • Protect and conserve the quality and extent of habitat refuges for the persistence of the species during droughts and periods of extreme heat, especially in riparian environments and other areas with reliable soil moisture and fertility • Maintain the quality, extent and connectivity of large areas of koala habitat surrounding habitat refuges The study area is not considered to be a habitat refuge for the koala, as there are no records within 25 km of the study areas. Although the study area is connected to a large contiguous area of potential koala habitat, it is not considered to surround any koala habitat refuge, with most the closest record occurring over 25 km to the west of the study site. In addition, because the study areas are surrounded by further potential habitat, the proposed project will not fragment the available habitat.
Total	**4**	**4**	**4**	**Decision: Habitat is not likely to be critical to the survival of the Koala (<5)**		

Will the action adversely affect habitat critical to the survival of the Koala?

As the outcome from the above tool was less than 5 at the Boera, Booka and Homestead dam proposal areas, the below flow chart demonstrates that significant impacts may be likely for other reasons, and to proceed to section 9 (DOTEE, 2014).

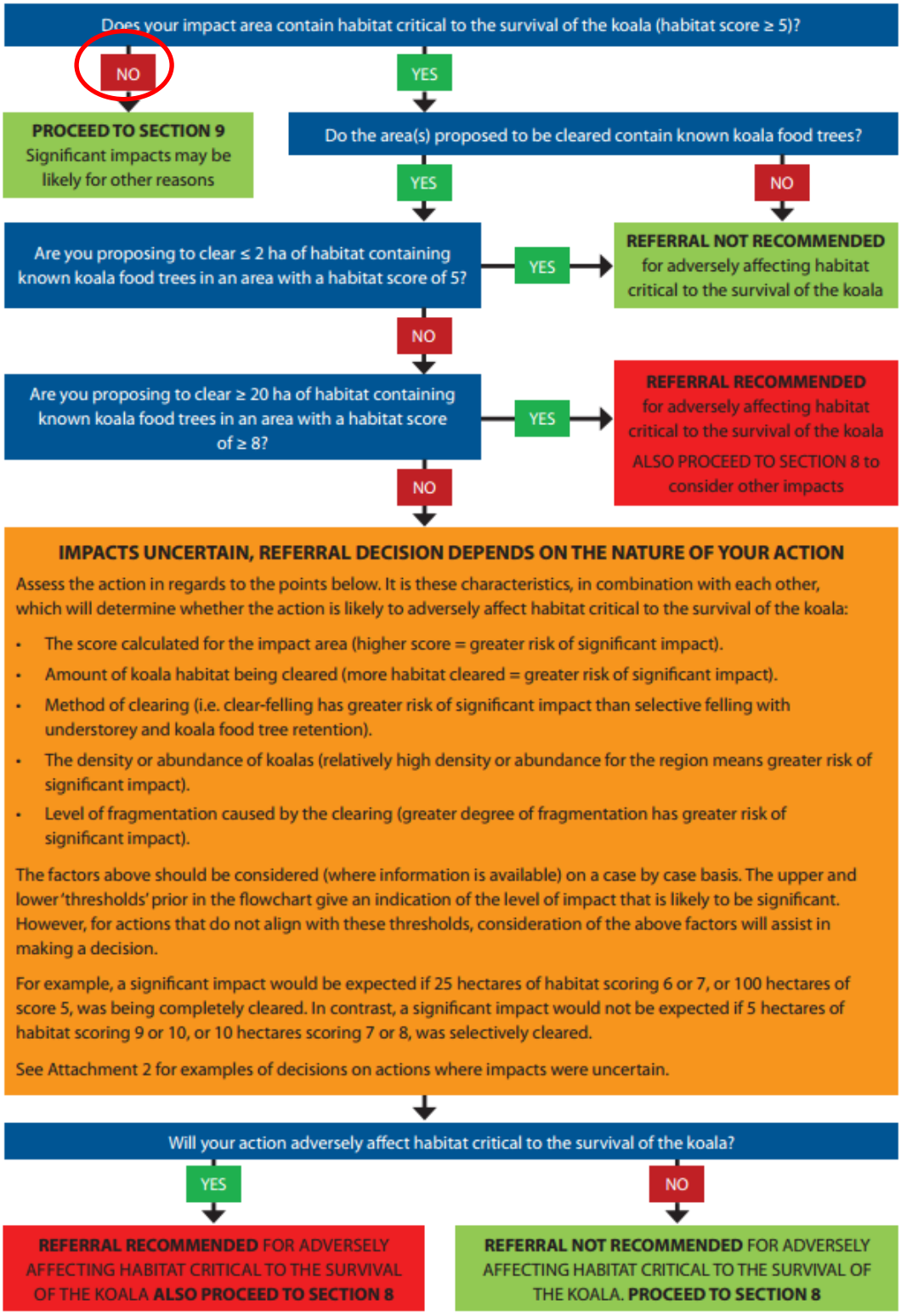


Figure I 1 Assessing adverse effects on habitat critical to the survival of the Koala (DoE, 2014)

Section 9: Could your action require a referral to the Minister for significant impacts on the koala?

The decision whether the proposed action will have or is likely to have a significant impact on the koala comes down to two key considerations outlined in the guidelines from DOTEE, 2014.

- Adversely affecting habitat critical to the survival of the koala (section 7) AND/OR
- Interfering substantially with the recovery of the koala through the introduction or exacerbation of key threats in areas of habitat critical to the survival of the koala (section 8).

As demonstrated, the proposal will not affect habitat critical to the survival of the koala (Table I-1), and therefore the proposed action is highly unlikely to have a significant impact on the Koala.

Coolibah Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions – EEC

The woodland community is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees. Small areas of the EEC occur at Boera Dam (10.43 ha), Booka Dam (10.68 ha) and Homestead Dam (6.53 ha) and may be altered by the works. The alterations to these portions of EEC are likely to be largely temporary in nature.

The extent of the community occurs both up and down stream of the dams suggesting the dam plays little role in the local occurrence of the community and other abiotic factors are likely more important. Therefore, impacts from inundation regime changes on the community are unlikely. Furthermore, the abiotic factors that help define the community will remain largely unchanged.

Surface water modelling revealed that a reduction in inundation events will occur as a result of changes to water management, however this has been demonstrated to unlikely affect the condition class of this community (5.3). Furthermore, the adaptive management strategy that will be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases.

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:		
1)	reduce the extent of an ecological community	Marginally. The impacts will be largely temporary, and the potential for regeneration of the community at the sites will not be hindered.
2)	fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	No. The extent of the works is relatively small and largely temporary, no fragmentation or increase in fragmentation is anticipated.
3)	adversely affect habitat critical to the survival of an ecological community	No habitat critical to the survival of an ecological community.
4)	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Unlikely, given the extent of the community up and downstream of the dams, and the temporary and small nature of the action. The actions at Homestead Dam are to restore previous conditions. Changes to inundation frequency of the floodplain has been demonstrated to

Criterion	Question	Response
		unlikely affect this vegetation community. Furthermore, the adaptive management strategy that will be adopted will allow for flexible management of water release to the floodplain and enable corrective action if condition of the floodplain decreases
.5)	cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	No. Species composition is not likely to change substantially as a result of the action.
6) i	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or	Unlikely. Weed and pathogen protocols will be followed.
6) ii	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	Unlikely. Weed and pathogen protocols will be followed.
7)	interfere with the recovery of an ecological community.	Unlikely, the extent of the works is relatively small and largely temporary.
Conclusion	**Is there likely to be a significant impact?**	**Unlikely**

Migratory Species

The REF identified fourteen species listed as Migratory under the EPBC Act as having the potential to occur within the development site. The species included were:

- *Actitis hypoleucos* (Common Sandpiper)
- *Apus pacificus* (Fork-tailed Swift)
- *Ardea alba* (Eastern Great Egret)
- *Ardea ibis* (Cattle Egret)
- *Calidris acuminata* (Sharp-tailed Sandpiper)
- *Calidris ferruginea* (Curlew Sandpiper)
- *Calidris melanotos* (Pectoral Sandpiper)
- *Gallinago hardwickii* (Latham's Snipe)
- *Glareola maldivarum* (Oriental Pratincole)
- *Limosa limosa* (Black-tailed Godwit)
- *Merops ornatus* (Rainbow Bee-eater)
- *Motacilla flava* (Yellow Wagtail)
- *Plegadis falcinellus* (Glossy Ibis)
- *Tringa nebularia* (Common Greenshank)

Of these 14 species, Eastern Great Egret, Glossy Ibis, Oriental Pranticole and Rainbow Bee-eater are the only species to be recorded within Toorale NP.

An assessment of the impacts on migratory species has been undertaken. The assessment considered the extent of important habitat, and the impacts to any ecologically significant proportions of these 14 species, in accordance with *EPBC 1.1 Matters of National Environmental Significance Significant impact guidelines 1.1* (Commonwealth of Australia 2013).

The initial step of this assessment is to identify any areas of important habitat for each of the listed species. The assessment of important habitat considered the information available for each species within:

- EPBC 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Commonwealth of Australia, 2017)
- Migratory shorebirds of the east Asian – Australasian flyway: Population estimates and internationally important sites (Bamford et. al., 2008)
- Species Profile and Threats Database (https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl)

The assessment of important habitat for each species is contained in the table below.

Migratory Bird species important habitat

Species name	Common name	Is the site identified as internationally important?	Does the site support: a) At least 0.1% of the flyway population b) >2000 migratory birds c) At least 15 shorebird species	Is the development site important habitat?
Actitis hypoleucos	Common Sandpiper	No – Two important populations exist in Australia (Kakadu National Park & SE Gulf of Carpentaria)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Apus pacificus	Fork-tailed Swift	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Ardea alba	Eastern Great Egret*	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – there is no internationally recognised site of importance for this species.
Ardea ibis	Cattle Egret	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Calidris acuminata	Sharp-tailed Sandpiper	No – the closest important site for this species is Yantabulla Swamp (≈ 150km North of the study area)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat

Species name	Common name	Is the site identified as internationally important?	Does the site support: a) At least 0.1% of the flyway population b) >2000 migratory birds c) At least 15 shorebird species	Is the development site important habitat?
Calidris ferruginea	Curlew Sandpiper	No – the closest important site for the Curlew Sandpiper is Hunter Estuary (≈ 750 km from study area)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Calidris melanotos	Pectoral Sandpiper	No – the closest important site for the Pectoral Sandpiper is Hunter Estuary (≈ 750 km from study area)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Gallinago hardwickii	Latham's Snipe	No – the only important site for Latham's Snipe is the Seaford swamp (Australia)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Glareola maldivarum	Oriental Pratincole*	No – important sites for this species are Eighty Mile Beach (WA) and Roebuck Plains (WA)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Limosa limosa	Black-tailed Godwit	No – the closest important site for the Black-tailed Godwit is Hunter Estuary (≈ 750 km from study area)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Merops ornatus	Rainbow Bee-eater*	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site	No – The development site is not considered to be important habitat

Species name	Common name	Is the site identified as internationally important?	Does the site support: a) At least 0.1% of the flyway population b) >2000 migratory birds c) At least 15 shorebird species	Is the development site important habitat?
			c) no, there are only four migratory birds known to Toorale NP	
Motacilla flava	Yellow Wagtail	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat
Plegadis falcinellus	Glossy Ibis*	No – there is no internationally recognised site of importance for this species.	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – there is no internationally recognised site of importance for this species.
Tringa nebularia	Common Greenshank	No – the closest important site for the Common Greenshank is Eastern Port Phillip Bay (≈ 1000 km from study area)	a) no, the development will not impact on any of the flyway population b) no, there are less than 2,000 migratory birds within the development site c) no, there are only four migratory birds known to Toorale NP	No – The development site is not considered to be important habitat

* species has been recorded in Toorale NP

Based on the database review above and combined with the brief field assessment (as described in this REF), neither the Homestead, Boera or Booka Dams are likely to be important habitat for any of the listed Migratory species.

The second consideration in the process is whether an ecologically significant proportion of any of the 14 species occurs within the disturbance sites and could be impacted by the works. As none of these species were recorded as foraging or breeding within the disturbance sites, it is unlikely that any ecologically significant proportion of any of these species could be impacted by the works Homestead, Boera or Booka Dams.

However, the proposal has the chance to impact on potential habitat for these species on the floodplain of Toorale due to changes in water management. Although the proposed scenarios in Section 5.3 predict a decrease in inundation frequency, this is considered minor. Furthermore, the management strategy that will be adopted will allow for the flexible management of water release to the floodplain as corrective action if condition of the floodplain decreases.

Considering the information provided above, an assessment following the Significant Impact Criteria for Migratory Species (Commonwealth of Australia, 2013) is provided below:

Will the proposal substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?

There are no areas of important habitat for any of the listed migratory species within either the floodplains or Homestead, Boera and Booka Dams. As such the proposed works will not modify, destroy, or isolate any areas of important habitat.

Will the proposal result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?

The proposal is unlikely to result in any additional invasive species establishment and will not impact on any areas of important habitat.

Will the proposal seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?

The proposal is unlikely to directly impact on any listed Migratory species, and as such will not seriously disrupt an ecologically significant proportion of the population of any of these species.

Conclusion

Based on the review of information above, the proposed works will not significantly impact any migratory species listed under the EPBC Act. As such a referral to the Commonwealth is not recommended.

Appendix I : Fisheries Management Act Assessment

The following assessments describe the nature and severity of any potential impacts arising during construction and operation of the Project on those threatened species and communities listed under the *Fisheries Management Act, 1994* (FM Act) and considered 'known', 'likely' or 'possible' to occur in the Project locality. The assessments have been prepared in accordance with Part7A of the FM Act.

The Aquatic Ecological Community of the Lowland Darling River

The *Lowland Darling River Aquatic Ecological Community* is listed as an endangered ecological community (EEC) under the FM Act. The *Lowland Darling River Aquatic Ecological Community* occurs in a lowland riverine environment characterised by meandering channels and a variety of habitats that form an integral part of the river system, including deep channels and pools, wetlands, gravel beds and floodplains. In its natural state, many of the water-bodies in this area are characterised by variable and unpredictable patterns of high and low flows.

The *Lowland Darling River Aquatic Ecological Community* includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches (a secondary channel that diverts from and re-joins the river), flow diversions to anabranches and the floodplains of the Darling River within New South Wales (NSW), and including Menindee Lakes and the Barwon River (NSW Department of Primary Industries [DPI] 2007). Specifically, these areas include the main Barwon-Darling channel from Mungindi (Queensland-NSW border) to the confluence with the Murray River, the arid zone intermittent intersections streams (Warrego, Culgoa, and Narran Rivers), Border Rivers (Macintyre, Severn and Dumaresq Rivers) and regulated tributaries (Gwydir, Namoi, Macquarie, Castlereagh, and Bogan Rivers). Excluded from the definition are manmade/ artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs (NSW DPI 2007).

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

Not applicable.

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

Not applicable.

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

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

There will be relatively minor changes to the extent of standing water at the Boera and Booka Dams, however this is considered to be temporary. The repair of Homestead Dam would not change the extent of the current ecosystem.

In addition, fishways will be installed to assist fish movement up and down the watercourse.

Therefore, the project would have negligible impact on the extent of the ecological community and would not place the local occurrence or substantially or adversely modify the composition of the *Lowland Darling River Aquatic Ecological Community* at risk of extinction.

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

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

The naturally occurring watercourse within the study area is the Warrego River. Boera, Booka and Homestead Dams are long-established artificial habitats, and aquatic habitat will remain relatively unchanged from the proposed works. The proposed fishways will also assist the movement of fish up and down the watercourse.

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

There would be no long-term fragmentation of aquatic habitat in the river as a result of the design and construction of the Toorale Infrastructure Project, as the dams are long-established artificial habitats, and the proposal will connectivity for aquatic fauna via the fishways.

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

The removal or modification of the habitat would not affect the long-term survival of the *Lowland Darling River Aquatic Ecological Community* in the locality as the level of impact would be minimal.

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

No critical habitat would be adversely affected by the Project.

f. whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

There is no published recovery plan for *Lowland Darling River Aquatic Ecological Community*, but the action is consistent with the Toorale Plan of Management (OEH 2018).

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

The action is not a key threatening process to this EEC.

Conclusion

The Project would not significantly impact the *Lowland Darling River Aquatic Ecological Community* given:

- the extent of the occurrence of this EEC throughout NSW and the predicted minimal impact associated with the Project;
- the Project would comply with the *DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)* (DPI Fisheries 2013) for all crossings of the Namoi River, Thompsons Lagoon, and Deadman's Gully;
- the Project rail spur would have an insignificant impact on the limited aquatic habitat in the ephemeral drainage lines it traverses; and,
- indirect impacts would be minimal.

Fish (Olive Perchlet, Purple-spotted Gudgeon, Silver Perch, Murray Cod)

The study area provides potential habitat for the four following species of threatened fish.

- Olive Perchlet (Ambassis agassizii)
- Purple-spotted Gudgeon (Morgurnda adspersa)
- Silver Perch (Bidyanus bidyanus)
- Murray Cod (Maccullochella peelii)

Olive Perchlet

Olive Perchlets are a small native fish that occur in the Murray-Darling drainages. They have an oval shaped body with a moderately large mouth, very large eyes and a forked tail. They are usually semi-transparent, with dark-edged scales forming a distinct pattern. The fins are generally clear, although there is often a broad, blackish band along the edges of the pelvic and anal fins. They can grow up to 70-80 mm but are more commonly less than 60 mm (DPI, 2019)

Purple spotted Gudgeon

The Purple Spotted Gudgeon occurs in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. They are small and robust with a rounded head, a relatively small mouth and a rounded tail. They are generally dark chocolate in colour along the back, fading to pale fawn on the belly, with a number of distinguishing markings. These include black to grey patches on the sides, which are surrounded by numerous white and red spots that brighten during breeding. The fins are yellow in colour, darkening towards the extremities (DPI, 2019).

Silver Perch

Silver Perch are a moderate to large freshwater fish native to the Murray-Darling river system. Silver Perch are oval shaped with a small head that can become beak-like in larger fish. The colour can be grey, greenish, gold or silvery, darker on the back and paler on the sides, with a white belly. Juveniles may be mottled with vertical dark bars (DPI, 2019).

Although this species historic distribution indicates that it once occupied the Warrego River, five years of LTIM surveys in the area did not locate this species (CEWO, 2019).

Murray Cod

Murray Cod, also referred to as cod or codfish, were once abundant throughout the Murray-Darling river system, but overfishing and environmental changes have drastically reduced its numbers. The species has been selectively stocked in other river systems in NSW, Victoria and Western Australia, but has generally failed to establish itself in those areas. Murray Cod generally prefer slow flowing, turbid water in streams and rivers, favouring deeper water around boulders, undercut banks, overhanging vegetation and logs. Small numbers are still present in the Nepean River and Yarra River (DPI, 2019).

Although this species historic distribution indicates that it once occupied the Warrego River, five years of LTIM surveys in the area did not locate this species (CEWO, 2019).

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

Lifecycle can be impacted by direct impacts of habitat removal or by indirect impacts which are undertaken during important stages of the species lifecycle or which reduce habitat quality. In order to place populations at risk of extinction, the impacts would have to be of a magnitude and duration that would inhibit the continual completion of the lifecycle stages

The proposal is not expected to adversely effect on the lifestyle of these species, as stream connectivity is expected to increase due to the construction of fishways at the dams.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

Not applicable.

c. in relation to the habitat of a threatened species or ecological community:

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

The proposal is expected to modify the habitat in a way that is beneficial to these fish species. An increase in stream connectivity via fishways will assist in fish migration to other areas of habitat within the river system. Other impacts during the construction phase will be largely temporary and small in nature.

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

Although, the reinstallation of Homestead Dam may provide a barrier to these species' movement, the construction of a fishway will retain connectivity.

There will be no further isolation at the Boera or Booka dam sites, with an installation of fishways expected to facilitate movement of these species within the watercourse.

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

Since 2015, Eco-logical Australia have undertaken annual fish surveys within the Warrego River. None of these fish species have been identified in this system (CEWO, 2018). Due to the absence of these fish within the Warrego River it is unlikely that the habitat is important to the long-term survival of these species.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The proposal will not have any adverse effect on any declared area of outstanding biodiversity value.

e. the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined under the BC Act as "a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities". Two key threatening process is relevant to the fish species listed above in the current 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.

Degradation to the riparian vegetation will be minimized, whilst the recommissioning of Homestead dam would be returning the area to pre-existing conditions. In addition, the dam designs include fishways which will increase in stream connectivity for these species.

Conclusions

The proposed disturbance is unlikely to significantly impact these threatened fish species given that:

- The proposal is expected to modify the habitat in a way that is beneficial to these fish species.
- The proposal will increase in stream connectivity.
- The habitat is unlikely to be important to the long-term survival of these fish species.

Therefore, the proposal is unlikely to have a significant impact on the fish species listed above and their survival in the locality. As such, a SIS is not required.

Reference

Department of Primary Industries (DPI). (2019). *Threatened Species Lists* [online]. Available https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current. Accessed May 2019

Appendix J : Aboriginal Cultural Heritage Assessment

These have not been included in public exhibition due to sensitive contents

Appendix K :

Toorale Water Infrastructure – Phase 2: Statement of Heritage Impact

NSW Office of Environment and Heritage

DOCUMENT TRACKING

Project Name	Toorale Water Infrastructure – Phase 2: Statement of Heritage Impact
Project Number	18ARM 9568
Project Manager	Robert Cawley
Prepared by	Lorien Perchard, Caitlin Marsh, Karyn McLeod
Reviewed by	Karyn McLeod
Approved by	Robert Cawley
Status	**Draft**
Version Number	**1**
Last saved on	**24 December 2019**

This report should be cited as 'Eco Logical Australia 2019. *Toorale Water Infrastructure – Phase 2: Statement of Heritage Impact*. Prepared for NSW Office of Environment and Heritage.'

8.1.1 Acknowledgements

This document has been prepared by Eco Logical Australia Pty Ltd with support from Sonya Ardill from National Parks and Wildlife.

Template 2.8.1

Contents

1. Introduction **312**
1.1 Background 312
1.2 Study area location 312
1.3 Proposal 312
1.4 Methodology 313
1.5 Author identification 313

2. Site context **317**
2.1 Site history 318
2.2 Site description 318

3. Heritage Impact Assessment **322**
3.1 Listing 322
3.2 Statement of Significance 322

4. Statutory Controls **325**
4.1 Heritage Act 1977 325
4.2 National Parks and Wildlife Act 1974 (NPW Act) 325
4.3 Environmental Planning and Assessment Act 1979 (EP&A Act) 325
4.4 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) 326
4.4.1 Burke Local Environmental Plan 2012 327

5. Impacts and mitigation **330**
5.1 Impacts 330
5.2 Heritage Office guidelines 332
5.3 Mitigation 333

6. Conclusion and Recommendations **336**
6.1.1 Conclusions 336

7. References **337**

List of Figures

Figure 1: Location of the study area, regional setting 314

Figure 2 Location of works area - Boera Dam 315

Figure 3 Location of works area – Booka Dam 316

Figure 4 Location of works – Homestead Dam 317

Figure 5: Boera Dam gates 319

Figure 6: Boera Dam embankment 319

Figure 7: Infrastructure associated with Boera Dam 319

Figure 8: Downstream Boera Dam 319

Figure 9: Booka Dam gates 320

Figure 10: Booka Dam gate 320

Figure 11: Booka Dam embankment 320

Figure 12: Downstream Booka Dam 320

Figure 13: View of Homestead Dam embankment south of the homestead 321

Figure 14: Homestead Dam view south 321

Figure 15: Embankment adjacent to the homestead 321

Figure 16: View of the homestead from the embankment 321

Figure 17 Toorale Homestead and Outbuildings heritage curtilage listed on the Bourke LEP (Heritage map 5) 324

List of Tables

Table 1 LEP clauses 327

Table 2 Heritage Office guidelines 332

Abbreviations

Abbreviation	Description
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Alluvium	Alluvium Pty Ltd
Biosis	Biosis Pty Ltd
CMP	Conservation Management Plan
DCP	Development control Plan
DPIE	Department of Planning Industry and Environment
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Reg	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
Heritage Act	Heritage Act 1977
HHI	NPWS Historic Heritage Inventory
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
JMAC	Joint Management Advisory Committee
JMC	Joint Management Committee
LEP	Local Environment Plan
LLS	Local Land Services
LTIM Project	Long-Term Intervention Monitoring Project
MDBA	Murray Darling Basin Authority
Native Title Act	Commonwealth Native Title Act 1993
NPW Act	NSW National Parks and Wildlife Act 1974
NPW Reg	National Parks and Wildlife Regulation 2009
NPW	National Parks and Wildlife
NPWS	National Parks and Wildlife Service
NSW	New South Wales
PoM	Plan of Management
RAPs	Registered Aboriginal Parties
REF	Review of Environmental Factors

SEPP	State Environmental Planning Policy
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
Toorale	Property including Toorale National Park and State Conservation Area

1. Introduction

1.1 Background

Eco logical Australia (ELA) has been commissioned by the New South Wales Office of Environment and Heritage to prepare a Statement of Heritage Impact (SoHI) to support a Review of Environmental Factors (REF) to satisfy environmental assessment and approval requirements to modify three dams at Toorale National Park and State Conservation Area (Toorale), within the Warrego River Catchment.

Toorale is an important part of Australian pastoral heritage. At its peak in the late 19th century, it was a significant part of the largest sheep station in the world. The historic buildings at Toorale, in particular the Old Toorale Woolshed (built around 1873–74) and Toorale Homestead (built around 1896), are considered 'iconic monuments to the pastoral history of the nation' as they represent 'the biggest and the best of the far western region's surviving historic pastoral buildings with the most significant technology and history attached' (Sheppard 2013).

'Toorale Homestead and Outbuildings, Toorale Station via Bourke, NSW, Australia' is listed on Schedule 5 of the Bourke LEP (Item 28). Toorale is also listed on NPWS Historic Heritage Inventory (HHI) and covers Built Heritage, Archaeological Resources and Landscape. The Darling River is listed on Schedule 5 of the Bourke LEP (Item 10).

The property is a new addition to the Department of Planning Industry and Environment (DPIE) estate, purchased in 2008. The property is a mixture of National Park and State Conservation Area tenures and was acquired for its natural conservation values, which include examples of the poorly represented Darling Riverine Plains. Toorale National Park also has important cultural heritage values, both indigenous and historical, and is home to several heritage precincts within an area known as Toorale Station. NSW National Parks and Wildlife Service (NPWS) has begun a repair and conservation project to protect this property and its farming history for future generations.

1.2 Study area location

Toorale is located approximately 65 km southwest of Bourke in north western NSW and is managed by DPIE, National Parks and Wildlife Service (NPWS). Toorale encompasses a combined area of approximately 85,251 ha and experiences a semi-arid climate (Figures 1 & 2). The property is associated with a number of creeks and billabongs connected to the Warrego and Darling Rivers. Boera and Booka Dams are located on the Warrego River within the Conservation Area, while Homestead Dam is located on the Warrego River within the boundaries of the National Park (Figure 1).

1.3 Proposal

The NSW DPIE is managing the Toorale Water Infrastructure Project on behalf of the Commonwealth Government to achieve outcomes sought by both the NSW and Commonwealth Governments including updating structures and operations in a contemporary manner.

The proposal comprises modification of the existing flow management infrastructure on Toorale to enable more effective management of water. Environmental assessment of Phase 2 – Modification works at Boera, Booka and Homestead Dams is required. The works at all three Dams include embankment modifications to allow for additional infrastructure. The proposed works are summarised below.

1.3.1 *Boera Dam*

The proposed works are to modify the existing water infrastructure to increase the capacity of water delivered to Warrego River in circumstances that require maximum delivery of flows to the Darling River.

These works will involve modification to the embankment at the main Warrego River site of Boera Dam, the installation of lay flat gates, regulator gates to provide controlled discharge, and a bridge to provide access across the structure. The existing pipes will be removed during the works. A vertical slot fishway will also be installed to allow fish passage independent of the regulator gates.

1.3.2 *Booka Dam*

The proposed works are to lower the spillway elevation approximately 500 mm and install a rock ramp fishway into the lowered embankment.

1.3.3 *Homestead Dam*

The proposed works are to repair the previously breached dam wall consistent with the existing works approval and to reinstate Homestead Dam to a state that is consistent with its recognised heritage values. Material from Peebles Dam may be used to fill the breach at Homestead Dam as Peebles Dam is in the process of being decommissioned. The spillway elevation will be lowered approximately 1 m from pre-breach condition and a culvert or bridge will be installed at the spillway to allow for safe vehicle access. A rock ramp fishway will be installed to allow fish passage.

1.4 Methodology

This Heritage Impact Statement has been prepared with reference to the NPWS Guidelines for historic heritage approvals (DPIE & NPWS 2016), the NSW Heritage Manual 'Statements of Heritage Impact' (Heritage Office & Department of Planning 2002) and 'Assessing Heritage Significance' (Heritage Office & Department of Planning 2001) guidelines.

The subject proposal has also been assessed in relation to the Bourke Local Environmental Plan 2012, the State Environmental Planning Policy (Infrastructure) 2007 and the Toorale Conservation Management Plan 2013. The philosophy and process adopted is that guided by the Australia ICOMOS Burra Charter 1999.

1.5 Author identification

This report has been prepared by ELA Archaeologists Lorien Perchard and Caitlin Marsh and reviewed by Karyn McLeod, ELA Principal Heritage Consultant, (BA Hons [Archaeology] University of Sydney, MA [Cultural Heritage] Deakin University).

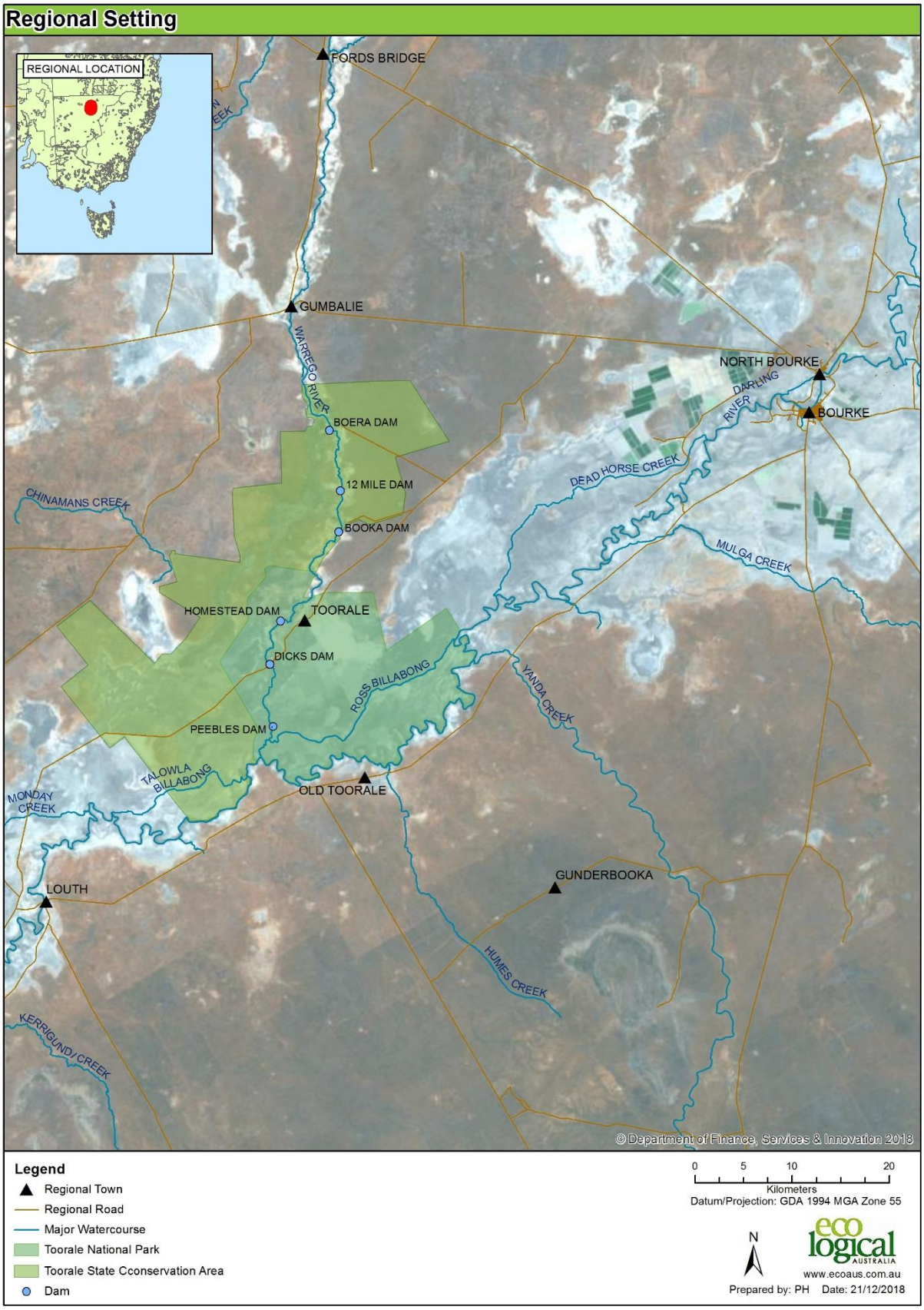


Figure 30: Location of the study area, regional setting

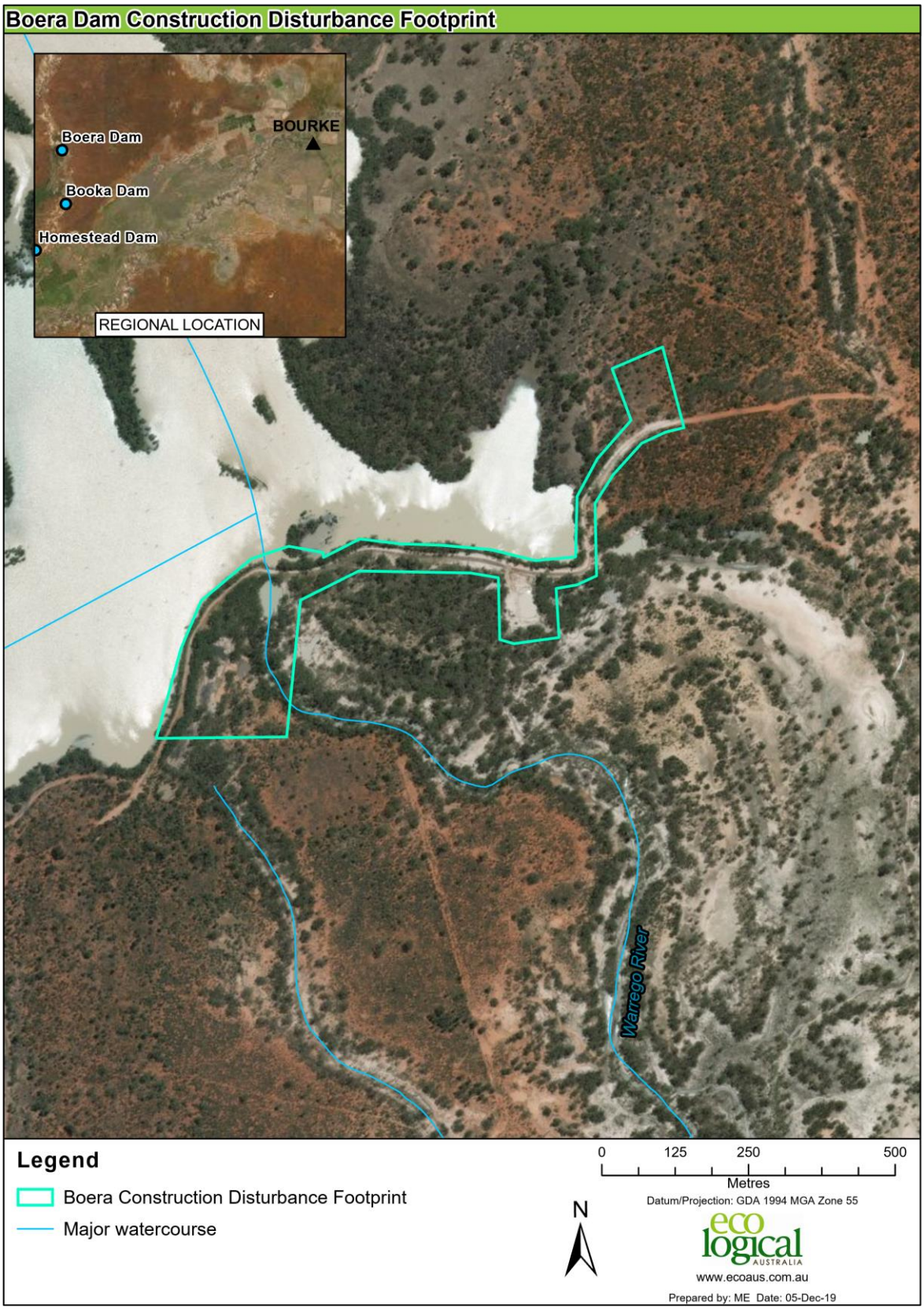


Figure 31 Location of works area - Boera Dam

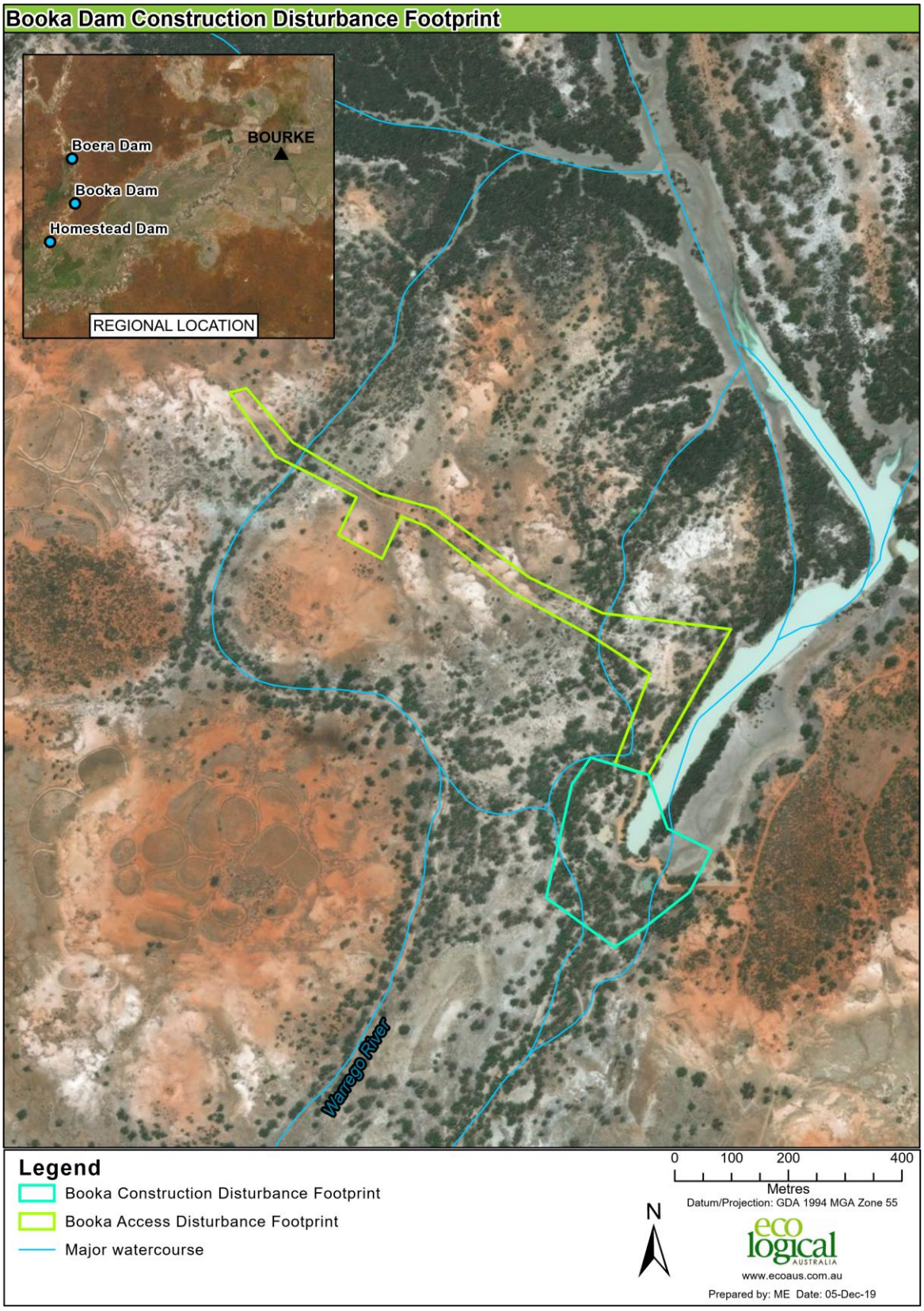


Figure 32 Location of works area – Booka Dam

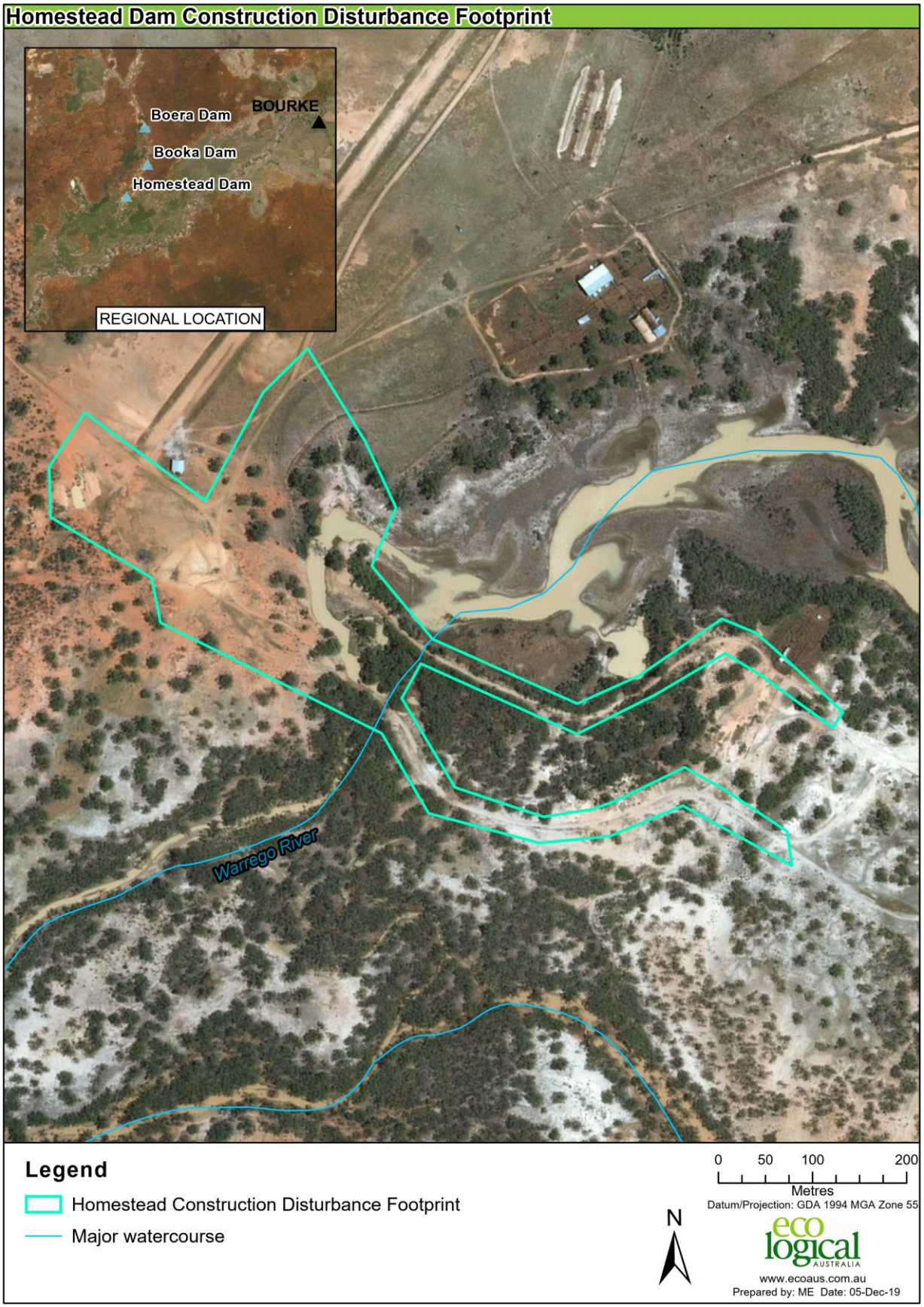


Figure 33 Location of works – Homestead Dam

2. Site context

2.1 Site history

The Toorale Station has been a sheep run since all the riverfront was taken up and leased in 1857 by W. B. Tooth. The property, straddling the southern reaches of the Warrego River and its junction with the Darling River, meant that major water capture and diversion works could be carried out. Historically, Toorale has made a significant contribution at a local, State and Federal-level as a large pastoral enterprise. There were three dams within Toorale on the Warrego by 1860, there were ten dams around the turn of the century, and at its zenith by 1924 there were thirteen dams on the Warrego within the Toorale property. There are still seven dams within the property on the Warrego today which are more or less intact (HHI 2013).

In the late nineteenth century, the property was owned by (Sir) Samuel Wilson (from 1871 -1880) followed by his nephew (Sir) Samuel McCaughey (from 1880-1912). Both Wilson and McCaughey had a strong interest in, and a major aptitude for civil engineering works associated with water capture and management. Their considerable wealth, accumulated from wool production, allowed them to undertake these massive projects. The construction of the Boera Dam and Floodwaters Scheme c.1882 by McCaughey is one of the most massive nineteenth century civil engineering and water management constructions known to be undertaken by a private individual on a remote property in New South Wales. The modified flow regimes associated with the Boera Dam resulted in a tenfold increase in flood frequency across the Western Floodplain and the creation of a diverse wetland, which is an important breeding habitat for colonial water birds (Shepherd 2013).

The subsequent owners, Robinson and Vincent, were both trained as property managers by McCaughey and effectively carried on his approach to management of the property until 1924, including building numerous tanks and sinking bores (HHI 2013).

Falling wool prices and variable weather conditions (floods and droughts) in the 20th century meant that the old buildings from the 1870s and 1880s were retained, maintained and re-used. The property appears to have been largely intact in terms of retaining many of the early (post 1870) buildings and much of the machinery and plant, including working steam engines until around 1969 (HHI 2013).

2.2 Site description

Detailed pedestrian survey of all dams and the Toorale Homestead and its surrounds was undertaken over three days (28-30 May 2018) by a qualified and experienced ELA Archaeologist and Heritage Consultant. The dam structures and associated water management infrastructure at Boera, Booka and Homestead Dams have been photographed in detail.

Historic heritage site inspections undertaken by ELA did not identify any historically significant features or fabric associated with the sections of Boera and Booka Dams that will be modified, or the section of Homestead Dam that will be repaired.

2.2.1 *Boera Dam*

Boera Dam is an earthen embankment across the Warrego River in the northern part of the system that distributes flow to the Western Floodplain and serves as a Stock and Domestic water supply for Toorale and two adjoining properties, Yandaroo and Delta Stations. The dam was expanded in 1882 into the 'Boera Dam and Floodwaters Scheme' altering the flow and flooding regime across the lower Warrego

floodplain. Depending on inflows, water can be diverted onto the Western Floodplain or to the Warrego River via the opening and closing of regulator gates on two 1,200 mm diameter pipes in the 4 m high earthen embankment. *These gates must remain open until flow in the Darling River at Louth, downstream of the Warrego River confluence reaches 330 ML/d. The gates can then be closed to allow water levels to rise in Boera and flow onto the Western Floodplain, or they can be left open to provide a longer duration flow to the lower Warrego River.* The earthen embankment has no grass cover or protection from weathering processes.

Figure 34: Boera Dam gates

Figure 35: Boera Dam embankment

Figure 36: Infrastructure associated with Boera Dam

Figure 37: Downstream Boera Dam

2.2.2 *Booka Dam*

Booka Dam was constructed c.1880, presumably as part of the improvement works occurring to the Boera Dam and Floodwaters Scheme (Jill Sheppard Heritage Consultants, 2013). Booka Dam provides storage from which the adjoining Booka Station accesses water.

The dam is a bare earthen embankment approximately 3 m high with two 1,200 mm diameter outlet pipes are located at its base. The pipes discharge approximately 600 ML/d to the Warrego River. The regulating gates on the outlet pipes at Booka Dam are required to be opened in a similar manner as those at Boera Dam. At all other times, the gates at Booka Dam remain closed.

Figure 38: Booka Dam gates

Figure 39: Booka Dam gate

Figure 40: Booka Dam embankment

Figure 41: Downstream Booka Dam

2.2.3 *Homestead Dam*

Homestead Dam is a 540 m embankment 30 km downstream from Boera Dam. Homestead Dam was constructed in the 1870s to provide water for stock and domestic purposes following the construction of the Homestead property (Shepard 2013). The embankment of Homestead Dam consists of bare earthen mound with no grass cover or protection from weathering processes. A levee runs along the high-water level to protect the historic Toorale Homestead and outbuildings from elevated water levels caused by the main embankment. This levee is currently reinforced by sandbags in several locations. A bywash is located on the eastern side of the dam. Two 1200 mm diameter regulator pipes have been installed through the embankment at the original river bed level.

The embankments around Homestead Dam are currently stable, with evidence of previous erosion. Flooding as early as 1880 carried away portions of the dam infrastructure, which was replaced by July 1880 (HHI 2013:21). The Dam was breached during flooding in 2012 and has not been repaired. The breach is 100 m west of the regulator pipes and has significantly reduced the storage capacity of Homestead Dam. It has also decreased historic, cultural, ecological and visitor amenity at the site.

Currently a small body of water is retained within the storage controlled by an existing low-level road causeway located downstream of the original dam wall, with a crest level of 97.5 m AHD.

Figure 42: View of Homestead Dam embankment south of the homestead

Figure 43: Homestead Dam view south

Figure 44: Embankment adjacent to the homestead

Figure 45: View of the homestead from the embankment

3. Heritage Impact Assessment

3.1 Listing

- Toorale is listed as a heritage item under Schedule 5 of the Bourke Local Environmental Plan 2012 (item 28).
- Toorale is listed on NPWS Historic Heritage Inventory (HHI) and includes Built Heritage, Archaeological Resources and Landscape.
- The Darling River is listed on Schedule 5 of the Bourke LEP (Item 10).

3.2 Statement of Significance

The statement of significance and a physical description of the locally listed Toorale Homestead is provided below.

Statement of significance

The homestead of 'Toorale' represents well the prosperity and challenge of remote rural 'Australian's' pastoral settlers. The National Trust on their visit of August 1986 stated: 'Toorale' is a remarkable example of a large western homestead of unpretentious appearance yet with an interior of surprisingly sophisticated details. The house is remarkable too for its size, and spacious atrium, the scale and variety of outbuildings, the extensive collection of rural equipment within its curtilage, that make the complex of outstanding significance.

Physical description

Toorale homestead is both magnificent and unusual. Built primarily of ‘lath and plaster' walls internally and ripple iron cladding externally, it contained 27 large rooms. A formal section of the house for the owners at the south is connected directly to a generous central hall 18m x 6m (atrium) with all the service rooms arranged around it containing stores, kitchens, servants accommodation and wash rooms. The 4m high hall is lit by coloured glass roof lights, and a generous verandah surrounds the whole homestead flanked by enormous Phoenix palm trees, creating an ‘oasis' setting.

Once beautifully finished internally, today only remnants of the elaborate wall papers (dating from the late 19th and early 20th C) remain, but most of the delicately patterned Wunderlich ceilings are still intact, and the broad panelled solid timber doors, with fanlights and side lights reflected the wealth and prosperity of the good wool seasons before the drought of 1895. Toorale's single storey building features a large gabled section roof behind, a smaller hipped section. The roof is of corrugated iron, and there are original ogee gutters and timber eaves. Verandahs on all sides of the building have been partially enclosed. The front door is a large four-panel door with bolection mouldings, semi-circular Georgian fan and sidelights. There were several very ornate marble fireplaces, including one exceptional one in coloured marble; one of the fireplaces was removed to the Royal Hotel (now The Port of Bourke) in Bourke. Ceilings in the house are very high (3 metres or more). The long hallway leading from the front door to the atrium features a square fanlight and coloured sidelights, while there are fine plaster motifs on the arch above the door. From the atrium, three panels of coloured glass and corresponding roof lights are visible. Roof timbers are of heavy sawn timber construction. In the structure there is some termite damage. The remains of the

> laundry are located in the northeast corner of the house and include copper troughs. The small cellar is entered by stairs off the northern verandah. Outside the main house the old garden is still defined by concrete edgings, a galvanised pipe rose frame to the west and south of the building and some original, old fashioned roses. To the north of the house is a meat house on stumps and with a hipped and gabled corrugated iron roof. The sides are gauzed and the original mechanism for hanging meat remains. there is also a small store. and complex contains numerous other outbuildings. (SHI listing https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=1220008).

Clearly this description is focussed on the homestead building and not the dams, other built structures or surrounding property/landscape. The current Conservation Management Plan (CMP) for Toorale (Sheppard 2013) concludes that there are four precincts considered to possess very significant historic fabric, these are:

- The Toorale Homestead Precinct;
- The Old Toorale Woolshed Precinct;
- The Boera Precinct (i.e. the Boera Dam & Floodwaters Scheme), and
- The Nissen & Quonset Huts Shearing Sheds Precinct.

The CMP (Shepherd 2013) states that each of these precincts meet the criteria for State Heritage listing. However, the precinct and property as a whole is not the subject of an interim heritage order, nor has it been added to the State Heritage Register in accordance with the *Heritage Act 1977*.

Significance of the Dams

The CMP includes Boera, Booka and Homestead Dams as part of the Boera Dam Floodwaters Scheme. They are components of a much larger water management scheme. The Dams and water management in general across the entire Toorale property has constantly evolved and has been modified through time to adapt to new technologies, uses and farming practices. Apart from the earthen mounds that form the dam embankments, the dams include associated infrastructure such as overflow pipes and flow regulators, ratchet and gate as well as boardwalk and wheel.

The CMP concludes that all water management infrastructure at Toorale contributes to the potential State significance of the whole site as they constitute a significant technological achievement for the time. No dams or infrastructure are identified as individually significant. The CMP also states that the most significant phase of construction for the earthworks which form the dams occurred when Samuel McCaughey took over in 1880. Homestead Dam was constructed prior to this time for purposes not specifically associated with floodplain watering.

The Historic Toorale Homestead Precinct includes Homestead Dam which is associated with the heritage significance of the standing Homestead. The Dam was constructed for domestic use and is not noted in the CMP as a significant item on its own right, nor is it discussed as part of Toorale's listing. The heritage curtilage of the Toorale Homestead and Outbuildings local listing extends across some of Toorale National Park and the State Conservation Area and is not confined to the homestead and its immediate surroundings. Boera and Booka Dams are located outside Toorale's listed heritage curtilage (Figure 17).

All of the dams associated with Toorale have a long history of construction and modification (Sheppard 2013: Appendix B) and it appears they have regularly required repair since they were constructed. The CMP (Sheppard, 2013:61) states that the nature of construction involving logs covered by earth means that the structures are vulnerable to breaching during flood events. There have been breaches in recent times, including Homestead and Peebles Dams.

Due to continuous alteration over the years and documentation of dam construction, dams have little historical research potential and therefore have little or only local historical archaeological significance. NPWS has invested significant amount of money to conserve and repair the historic heritage in this precinct and the proposed works would enhance that investment. The Heritage Inventory sheet for Boera Dam states no historical archaeological oversight is required.

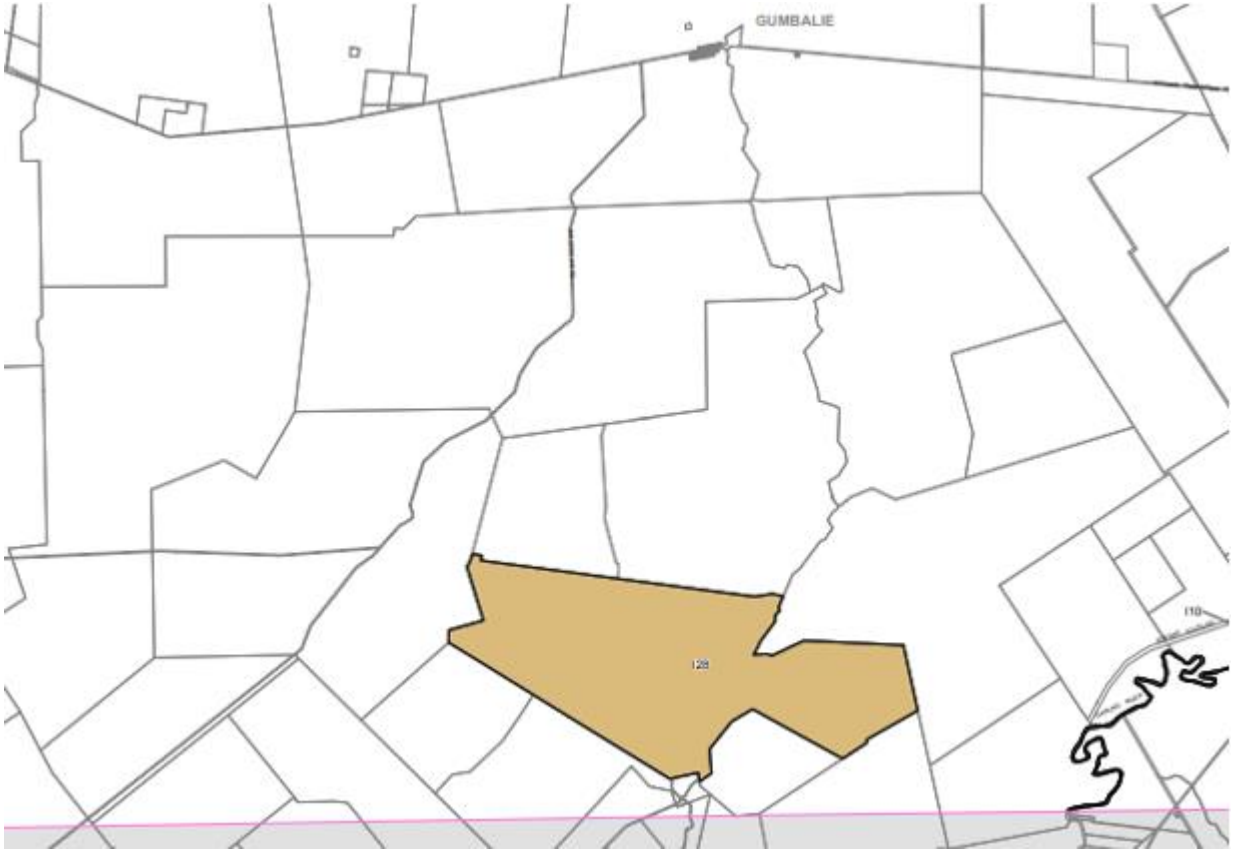


Figure 46 Toorale Homestead and Outbuildings heritage curtilage listed on the Bourke LEP (Heritage map 5)

4. Statutory Controls

4.1 Heritage Act 1977

Under section 140 of the *Heritage Act 1977* (Heritage Act) a person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damage or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. A relic is any deposit, artefact, object or material that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and is of State or local heritage significance.

Section 140 does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Register (SHR). Works to items listed on the SHR are subject to approval by the Heritage Council under Section 60 of the Heritage Act. Toorale is not listed on the SHR.

4.2 National Parks and Wildlife Act 1974 (NPW Act)

Moderate or major activity within a National Park where the site is listed in the Historic Heritage Information Management System (HHIMS) as state significant but not yet listed on the state heritage register require the preparation of a Review of Environmental Factors (REF).

(i) No application is required to the Heritage Council of NSW unless a project involves excavation.

(ii) Written notification is required to the Heritage Council of NSW for demolition.

(iii) An Aboriginal Heritage Impact Permit (AHIP) may also be required if work has the potential to harm an Aboriginal object or place.

Aboriginal objects and places in NSW are afforded protection under the NPW Act regardless of whether they are registered on the Aboriginal Heritage Information Management System (AHIMS) register or not. Strict penalties apply for harm to an Aboriginal object or place without a defence under the Act. Under Section 87 of the Act there are five defences to causing harm to an Aboriginal object:

- The harm was authorised under an AHIP.
- By exercising due diligence and being able to demonstrate this.
- The actions compiled with a code of practice as described in the *National Parks and Wildlife Regulation 2009*, for example, undertaking test excavation in accordance with the '*Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*'.
- It was a low-impact activity, or omission under the regulation, or where there was no knowledge of an Aboriginal object already present.
- Was an exemption under Section 87A, for example emergency fire-fighting act or bush fire hazard reduction work within the meaning of the *Rural Fires Act 1997*.

Two AHIPs have been approved for the proposed works under permit numbers C0003079 and C0004300. AHIP C0003079 covers the survey, geotechnical investigations and construction works at Boera, Booka, Homestead, Dick's and Peebles Dams. A second AHIP (C0004300) covers the modified project works area at Boera, Booka, Homestead and Peebles Dams and includes permission to harm all Aboriginal objects located within the AHIP boundary.

4.3 Environmental Planning and Assessment Act 1979 (EP&A Act)

The proponent of the project is the NSW Government acting through the DPIE. Under section 5.1 of the EP&A Act, certain government entities are deemed to be a determining authority and it is assumed that

this project shall be assessed under Part 5 of the EP&A Act. The project aligns with a number of activities permissible without consent under the *State Environmental Planning Policy (Infrastructure) 2007* (ISEP). Further detail regarding the ISEPP is given in Section 2.2.3.

Notwithstanding this, under section 5.5 of the EP&A Act, a determining authority has the duty to fully consider the environmental impact of an activity and is required to "take into account to the fullest extent possible all matters affecting, or likely to affect the environment" arising from the proposal. This is facilitated through the current REF, the purpose of which is to identify, assess and determine the significance of potential environmental impacts, as well as mitigating actions and responsibilities to minimise potential impacts.

The proposed works for both Homestead Dam and Peebles Dam will be assessed under Part 5 of the EP&A Act. This Part applies for infrastructure projects approved by the local council or a State agency undertaking the project. No excavation permit is required from the Heritage Council.

Development consent from council is not required, however for a locally listed heritage item, written notice to the Local Council is required to carry out a development, including demolition, with consideration of any response received within 21 days. To comply with this, DPIE shall provide a copy of the REF and any specific CMP, heritage assessment or impact assessment to the Bourke Shire Council. Consultation with the local community and local stakeholders is also recommended.

4.4 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The aim of this Policy is to facilitate the effective delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development. In the absence of a PoM adopted by the Minister, clause 8 of the ISEPP provides that, in the event of an inconsistency between it and any other environmental planning instrument, including an LEP, the ISEPP will prevail.

Pursuant to clause 127(m) of the ISEPP, development for the purpose of maintenance or replacement of components of water supply systems that does not increase capacity (or increases capacity only to a minimal extent) may be carried out by or on behalf of a public authority as exempt development. However, the development must in connection with a water supply system and comply with clause 20 and involve no greater soil and vegetation disturbance than necessary and no increase in stormwater drainage and run-off from the site.

Under the *Bourke Local Environmental Plan 2012* (Bourke LEP), a water supply system means any of the following:

a. a water reticulation system,
b. a water storage facility,
c. a water treatment facility,
d. a building or place that is a combination of any of the things referred to in paragraphs (a)–(c)

Therefore, a water storage facility, including a dam, weir or reservoir for the collection and storage of water, is a component of a water supply system. As such, within the meaning of the ISEPP, the proposed modifications at Homestead Dam is considered to be maintenance and/or replacement of existing water storage facilities.

The modification of Boera and Booka Dams is permissible under clause 129(1) of the ISEPP, whereby development for the purpose of waterway management activities may be carried out by or on behalf of a public authority without consent. The Dam embankments are within the main Warrego River channel and is therefore instream management to restore environmental flows for ecological purposes, pursuant to clause 129(b).

Notwithstanding the above, under section 111 of the EP&A Act, a determining authority has the duty to fully consider the environmental impact of an activity and is required to "take into account to the fullest extent possible all matters affecting, or likely to affect the environment" arising from the proposal.

4.4.1 Burke Local Environmental Plan 2012

The objectives of Heritage conservation in the Bourke LEP 2012 are to conserve the environmental heritage of Bourke including the fabric, settings, views and heritage significance of heritage items and heritage conservation areas, archaeological sites, Aboriginal objects and Aboriginal places of heritage significance.

Uses authorised under the NPW Act are permitted without consent. However, in the absence of a PoM adopted by the Minister, clause 8 of the ISEPP provides that, in the event of an inconsistency between it and any other environmental planning instrument, including an LEP, the ISEPP will prevail (Section 2.2.3).

Table 3 LEP clauses

Clause	Discussion
2) Requirement for consent Development consent is required for any of the following: demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance): (i) a heritage item, (ii) an Aboriginal object, (iii) a building, work, relic or tree within a heritage conservation area, altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item, disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed, disturbing or excavating an Aboriginal place of heritage significance, erecting a building on land: i on which a heritage item is located or that is within a heritage conservation area, or ii on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance, ▪ subdividing land:	The Homestead Dam Development Footprint is located within the curtilage of a listed local heritage item. Pursuant to clause 127(m) of the ISEPP, the activity is permitted without Development Consent. Boera and Booka Dams are not located within the heritage curtilage and are not listed heritage items.

on which a heritage item is located or that is within (i) a heritage conservation area, or; (ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.	
(5) Heritage assessment The consent authority may, before granting consent to any development: on land on which a heritage item is located, or on land that is within a heritage conservation area, or on land that is within the vicinity of land referred to in paragraph (a) or (b), Require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.	Pursuant to clause 127(m) of the ISEPP, the activity is permitted without Development Consent. This REF and Heritage Impact Assessment fulfils this clause as the proposed development at Homestead Dam is within the curtilage of a heritage item.

4.4.2 Bourke Development Control Plan 2012 (DCP)

The general heritage provisions set out in the Bourke DCP are applicable to all Heritage Items, Heritage Conservations Areas, Potential Heritage Items (Built Environments, Cultural and Visual Landscapes, European Archaeological Sites) and for development in the vicinity of Heritage Places. However, it principally concerns buildings, alterations, additions and fencing and therefore does not directly apply to the proposed works associated with this project. The conservation objectives of the DCP include retention and conservation of heritage items and their significant elements and settings. The DCP does not include specific controls for Toorale. The proposed development is not contrary to the heritage provisions of the Bourke DCP 2012.

4.4.3 Toorale National Park & State Conservation Area CMP

The CMP (Jill Sheppard Heritage Consultants, 2013) recommended that the procedures for managing the site be consistent with the management of the site as a State Heritage item, however this contradicts the *The NPWS Guidelines for historic heritage approvals* which states no application is required to the Heritage Council of NSW unless a project involves excavation. In this case there is no archaeological potential and therefore an excavation permit from DPIE is not necessary. Policy relevant to dams and water management in the CMP is as follows:

CMP Policy	Response
7.5.2 Fabric Management of Water Infrastructure Partial decommissioning of historic water infrastructure where necessary will where possible be carried out in a sensitive manner so that the majority of the Dam or tank remains to	While the proposal will result in the modification of the embankments of the Boera, Booka and Homestead Dams to lower the spillway levels and introduce fishway, none of the directly impacted

identify its location, size and shape and evidence the construction techniques used. As historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials.	infrastructure has been assessed as individually significant and/or dates to the 20th century. The embankments have no archaeological potential. The embankment at Homestead Dam has been breached since 2012.

5. Impacts and mitigation

5.1 Proposal and Impacts

The proposal comprises modification of the existing flow management infrastructure on Toorale to enable more effective management of water. There are three main objectives that the operating strategy seeks to meet, including;

- Watering the Western Floodplain. Historically Boera Dam has been operated such that the largest proportion of flows have been diverted to the Western Floodplain. Ensuring the values of the Western Floodplain are maintained is an objective for the project.
- Providing downstream flows for the Warrego and Darling Rivers. Provision of flows for the Warrego River and also the Darling River is an objective for this project. This is particularly important when there are low flows in the Darling River.
- Enabling fish passage up the Warrego River in all three dams. A Vertical Slot Fishway constructed of natural stone is being designed for inclusion at the Dams to enable fish passage – a complementary operating regime will be required to optimise the use and function of the fishway.

Proposed modifications and impacts are summarised below.

5.1.1 *Boera Dam*

The proposed works are to modify the existing water infrastructure to increase the capacity of water delivered to Warrego River in circumstances that require maximum delivery of flows to the Darling River. These works will involve modification to the embankment with the installation of three lay flat gates to increase capacity *of discharge.* There will also be the provision of stop boards on the upstream side of the gates to provide a failsafe limit on the potential drawdown of the lake and can be used to isolate a gate for repair and/or removal.

The existing pipes will be removed during the works. The gauging equipment is located within the construction footprint for the proposed works and is therefore necessary that it is temporarily decommissioned and stored at an appropriate location to be later reinstalled at the site upon the completion of all demolition and construction activities.

A vertical slot fishway will also be installed to allow fish passage independent of the regulator gates. The fishway will have 21 cells, each 2.5 m long x 2 m wide. The six lowest cells will be 3 m wide to reduce turbulence. The effective slope of the fishway is 1:31. Precast baffles will be installed with keyholes slots for fish passage.

- The existing full supply of Boera Dam will be retained, thereby continuing to support the wetlands ecosystem that has been created.
- Allowing Warrego River flows to pass through to the Darling River (when required) is a positive ecological outcome.
- There will be limited archaeological impact as the embankment has little archaeological potential or significance.
- The existing pipes will be removed during the works, however, as they were installed in the latter half of the 20th century, they have limited heritage value.
- If additional materials are required for management of the banks, it can be sourced from the remaining spoil from Peebles Dam or local materials.
- Existing roads and tracks will be used for access.
- All works and stored materials will be located within areas covered by an Aboriginal Heritage Impact Permit (AHIP).

- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

5.1.2 *Booka Dam*

The full supply level will be reduced by 0.5 m to 100.9 m AHD, by providing a spillway in the embankment at the southwest corner of the dam. The existing embankment will be cut down for the new spillway. The spillway will discharge into the Warrego River at this point via a rock ramp fishway installed in the lowered existing embankment.

The rock ramp fishway will be provided on the downstream side of the concrete spillway. The fishway will be 0.9 m high and at a grade of 1(V):30(H). Where possible, the 35 m wide fishway is designed to fit within the width of the existing channel.

The existing pipe will remain for maintenance purposes, if required, but will not be operated.

- *There will be no archaeological impact as the embankments have little archaeological significance.*
- *The existing pipes will be retained for maintenance purposes, if required, but not* be operated*.*
- If additional materials are required for management of the banks, it can be sourced from the remaining spoil from Peebles Dam or local materials.
- Existing roads and tracks will be used for access.
- All works and stored materials will be located within areas covered by an AHIP.
- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

5.1.3 *Homestead Dam*

The dam embankment will be reinstated at the existing embankment site at Homestead Dam, however the embankment will be approximately 1m lower than previously. The proposed spillway crest level is at 98.5 m AHD, compared to the 99.5 m previously. The dam will operate as a fill and spill arrangement. The existing pipes will no longer be operated to deliver flows through the dam to the Warrego River, however the pipes will be retained for maintenance purposes.

The dam and spillway will be earthen fill with a selected clay core. The downstream face will be a full width rock ramp fishway with a grade of 1(V):30(H). The existing channel will be widened from 21 m to 35 m wo accommodate the 35 m fishway width with 1V:2H side slopes.

Access across the spillway will be achieved either by concrete culverts or a bridge. The bridge design has been developed based on a 40 m span after the embankments re trimmed and widened. Alluvium (2018) propose two supports, with a 13.7 m central span and two 13.7 m approach spans. The bridge deck width would be 4.8 m, allowing for single lane access and no vehicle passing. Maximum vehicle load would be 15 tonnes and a standard guard rail provided.

A culvert arrangement would consist of 2.4 m (w) x 1.5 m (h) precast units, installed on a concrete slab designed to minimise differential settlement. The road pavement would be 4.8 m wide and would require four 1.2 m long culvert pieces. A bank of 15 culverts will span the opening. The culvert arrangement will include some lower culverts to transition to the low flow channel of the rock ramp fishway.

- There are no potential direct impacts to heritage values associated with Toorale Homestead Precinct posed by the proposed reinstatement of Homestead Dam. The works area is 1 km to the west of the Homestead.

- Establishment of 98.5 m AHD water levels in Homestead Dam will enhance the significance of the Homestead precinct by reinstating the storage capacity of the dam for high volume events and thereby retaining a reasonably constant water level.
- Re-establishment of existing historic water management infrastructure is a positive heritage outcome for the historic Toorale Homestead setting and the local ecosystem.
- There will be no archaeological impact as the embankments have little archaeological significance.
- If additional materials are required for management of the banks, it can be sourced from the remaining spoil from Peebles Dam or local materials.
- The existing pipes will be retained for maintenance purposes (if required) but will not be used.
- All works and stored materials will be located within areas covered by an AHIP.
- Existing roads and tracks will be used for access.
- Indirect impacts such as temporary noise, dust and disturbance in the precinct will be minor or non-existent.

5.2 Heritage Office guidelines

The proposed works are addressed in relation to relevant questions posed in the Heritage Office & Department of Planning guidelines (2001).

Table 4 Heritage Office guidelines

Question	Discussion
The following aspects of the proposal respect or enhance the heritage significance of the item or conservation area for the following reasons:	The re-instatement of the breach in the embankment at Homestead Dam will repair potential detrimental impacts to the heritage significance of the Toorale Homestead as the original form of the dam wall will be restored albeit at a slightly lower level. This will have a positive impact on historic heritage values associated with the Toorale Homestead Precinct. Lowering the height if the embankments at all three dams will increase capacity to deliver water down the Warrego River for circumstances when maximum delivery of flows to the Darling River are required is a positive ecological outcome. Installation of a fishway at all three dams is also a positive ecological outcome. Use of natural rock at all 3 sites for fishways will minimise visual impacts. The dams will still function as intended, as a means of storing water, and there will be no archaeological impacts as the dams have little archaeological potential or significance.
The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:	There are no significant detrimental impacts to the addition of fishways and improving water management in the system. The dams are not significant heritage items in their own right and the

	proposal will not effect to the overall significance of Toorale.
The following sympathetic solutions have been considered and discounted for the following reasons:	Extensive consultation with the Joint Management Committee (JMC) has resulted in the current proposal including construction and operational procedures. This proposal results in good environmental and heritage outcomes and sympathetic solutions have not been discounted.
Minor additions How is the impact of the addition on the heritage significance of the item to be minimised? Can the additional area be located within an existing structure? If no, why not? Will the additions visually dominate the heritage item? Is the addition sited on any known or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered? Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?	Addition of materials to Homestead Dam to fix the breach will not impact heritage values associated with the dam itself or Toorale Homestead Precinct. Re-establishment of existing historic water management infrastructure is a positive heritage outcome for the historic Toorale Homestead setting and the local ecosystem. *Modification of the three dams to increase the capacity of water delivered to Warrego and Darling Rivers is a positive ecological outcome.* *The dams will retain their function as water storage and management infrastructure.* There will be no archaeological impact as local materials or spoil from Peebles Dam will be used and the embankments have low archaeological potential and low archaeological significance.

5.3 Summary

The repair of Homestead Dam will result a positive impact on historic heritage values associated with the Toorale Homestead Precinct, and there will be no significant impact to other historic precincts associated with the site. The non-repair of Homestead Dam was noted within the CMP as potentially contravening 'Minimum Standards of Maintenance' provisions under the *Heritage Act 1977* (CMP 2013:104). Therefore, repair of Homestead Dam site will enhance the significance of the precinct and restore the historic Toorale Homestead setting and the local ecosystem.

The potential impacts associated with the lowering of the embankments and addition of fishways to all three dams are minor and considered acceptable considering the positive environmental outcomes. Due to continuous alteration over the years and documentation of dam construction, dams have little historical research potential and therefore have little historical archaeological significance.

5.4 Mitigation

5.4.1 General

- The CMP states that as historic water infrastructure is modified or decommissioned the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials' (Sheppard 2013:129).

- Historic features and landscapes within and beyond the heritage precincts will, where practical, be interpreted.
- To ensure that a continuous history of the Boera Dam and Floodwaters Scheme is maintained it is recommended that a pre and post works photographic record be compiled for all three dams (that meets DPIE requirements for such recording).
- All site personnel to be briefed on elements related to relevant legislation, CEMP requirements, unexpected finds and discovery of human remains process at induction (Section 5.5).
- Works to be conducted in accordance with AHIP number C0003079, permit ID 4175 and AHIP number C0004300 and in consultation with the JMC.
- Laydown areas or site office areas must be kept within the area covered by the AHIP.
- Vehicles to keep to existing tracks outside of areas covered by AHIP.
- Boundaries of AHIP area should be marked.
- Ongoing surveillance and monitoring of water levels and riparian vegetation within the three dams to determine potential changes to vegetation as a result of the changes proposed.
- Any fences damaged or need replacing due to the proposed works must be retained or maintained of a similar appearance and style.

5.4.2 Boera Dam

Only the existing pipes at Boera will be removed and replaced by *three lay flat gates to* increase capacity *of discharge. The pipes can be stored for future use if required.* Interpretation of any existing pipes or water management infrastructure that require removal shall be considered. The current infrastructure is not part of the 19th century water management scheme and is likely to date to the 1980s when the embankment was raised in association with Duncan's Wall (HHI 2013:45).

Maintain and protect remaining components of Boera Precinct, including Duncan's Wall and remaining historic fabric of Boera Dam Wall.

5.4.3 Booka Dam

As far as is practical, maintain and protect remaining historic fabric of Booka Dam Wall.

5.4.4 Homestead Dam

As far as is practical, maintain and protect remaining significant historic fabric of Homestead Dam Wall.

5.5 Unexpected finds

An 'unexpected heritage find' can be defined as any unanticipated archaeological discovery, that has not been previously assessed or is not covered by an existing approval under the *Heritage Act 1977* (Heritage Act) or *National Parks and Wildlife Act 1974* (NPW Act). These discoveries are categorised as either:

(a) Aboriginal objects (archaeological remains ie stone tools),
(b) Historic (non-Aboriginal) heritage items (archaeological remains (ie artefacts) or movable objects),
(c) Human skeletal remains.

Historical

Stop all work in the immediate area of the item and notify the Project Manager. Establish a 'no-go zone' around the item. Use high visibility fencing, where practical. Inform all site personnel about the no-go zone. No work is to be undertaken within this zone until further investigations are completed. Engage a suitably qualified and experienced Archaeologist to assess the finds.

The Heritage Council must be notified if the finds are of local or state significance. Additional approvals will be required before works can recommence on site.

If the item is assessed as not a ‘relic’, a ‘heritage item’ or an ‘Aboriginal object’ by the Archaeologist, work can proceed with advice provided in writing.

Indigenous

Aboriginal objects can be destroyed under the current AHIP.

In the event that human remains are found, works will immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, DPIE may also be contacted at this time to assist in determining appropriate management.

6. Conclusion and Recommendations

8.1.2 Conclusions

Based on the information provided above, it is concluded that the proposed works will result a positive impact on historic heritage values associated with the Toorale Homestead Precinct, and no significant impact to other historic precincts associated with the site. The works to repair the Homestead Dam site will enhance the heritage significance of the precinct as it will reinstate an element of the modified landscape to better reflect its previous state, helping to restore the historic Toorale Homestead setting and the local ecosystem.

The sympathetic alteration of Boera Dam to increase capacity to deliver water down the Warrego River for circumstances when maximum delivery of flows to the Darling River are required is a positive ecological outcome. When additional flows to the Darling River are not required, Boera Dam will retain its existing full supply level, aiding to maintain the condition of the wetlands ecosystem. The pipes at Boera Dam are not part of the 19th century water management scheme and are likely to date to the 1980s when the embankment was raised in association with Duncan's Wall (HHI 2013:45). The Heritage Inventory sheet for Boera Dam states no historical archaeological oversight is required.

The overarching context of the larger Toorale Water Infrastructure Project aligns with this objective, seeking to retain and enhance environmental outcomes associated with the ongoing operation of the Boera Dam and Floodwaters Scheme. Implementation of these actions demonstrates concurrence with the objects of the CMP. NPWS has invested significant amount of money to conserve and repair the historic heritage in this precinct and this work would enhance that investment.

Due to continuous alteration over the years and documentation of dam construction, dams have little historical research potential and therefore have little historical archaeological significance.

8.1.3 Recommendations

As historic water infrastructure is modified the opportunity will be taken to identify and record any unusual or obviously historic construction techniques and materials' (Shepherd 2013:129).

To ensure that a continuous history of the Scheme is maintained it is recommended that a pre and post works photographic record be compiled for all three dams (according to DPIE guidelines).

Reuse or interpretation of any existing pipes or water management infrastructure that require removal should be considered.

Any fences damaged or need replacing due to the proposed works must be retained or maintained of a similar appearance and style.

Brief project team on unexpected finds and discovery of human remains process at induction.

Boundaries of AHIP area should be marked and no works outside the AHIP area should be undertaken.

7. References

Alluvium Pty Ltd (Alluvium) (2018). *Functional Design Report: Toorale water infrastructure project – survey and design.* Final report prepared by Alluvium Consulting Australia for NSW Office of Environment and Heritage, Dubbo, NSW.

Australia ICOMOS 1999, *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*, Australia ICOMOS, Burwood (revised 2013).

Biosis (2018). *Toorale water infrastructure study: Aboriginal cultural heritage assessment report* (draft). Prepared for Office of Environment and Heritage & NSW National Parks and Wildlife Service.

Heritage Act 1977: https://www.legislation.nsw.gov.au/#/view/act/1977/136

Heritage Office and Department of Urban Affairs & Planning 1996, *NSW Heritage Manual*, Heritage Office and Department of Urban Affairs & Planning (NSW), Sydney.

Heritage Office and Department of Planning 2001, *Assessing Heritage Significance*, Heritage Office, Parramatta.

Heritage Office and Department of Planning 2002, *Statements of Heritage Impact*, Heritage Office, Parramatta.

Land and Property Department Six Maps: https://maps.six.nsw.gov.au/

Office of Environment and Heritage & NSW National Parks and Wildlife Service 2016, *NPWS Guidelines for Historic Heritage Approvals.*

Shepard J, 2013 *Toorale National Park and Conservation Area, Conservation Management Plan.* Prepared for Office of Environment and Heritage & NSW National Parks and Wildlife Service

State Heritage Inventory - Toorale Homestead; https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=1220008

Do not delete this section break!!!

ecological AUSTRALIA

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 9542 5622

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 9542 5622

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2685
F 02 9542 5622

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 9542 5622

BRISBANE
Suite 1, Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7192
F 07 3854 0310

1300 646 131
www.ecoaus.com.au

HUSKISSON
Unit 1, 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 9542 5622

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4302 1266
F 02 9542 5622

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1234
F 02 6372 9230

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1221
F 02 9542 5622

ADELAIDE
2, 70 Pirie Street
Adelaide SA 5000
T 08 8470 6650
F 02 9542 5622