



NSW Long Term Water Plans: Background Information

A description of the development of the 9 LTWPs in NSW

Part D: Appendices

Department of Planning and Environment



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Published by:

Environment and Heritage
Department of Planning and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and Heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
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ISBN 978-1-922975-47-8
EHG 2023/0052
February 2023

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Overview of the background information document

NSW Long Term Water Plans (LTWPs) bring together information from a range of planning material, scientific literature and expert opinion. This varied and complex information has been interpreted and analysed to produce new information products and tools to support development of the plans. The purpose of this background information document is to:

- describe the information sources that informed the development of the LTWPs
- describe how this information was interpreted and analysed
- outline the rationale behind the analyses, methods, assumptions and decisions that have underpinned the LTWPs
- provide a reference for future revision of the LTWPs.

The background information document has been divided into 4 parts for ease of use:

Part A: Introduction

1. Background to the development of NSW Long Term Water Plans
2. Priority environmental assets

Part B: Objectives and targets

3. Introduction to Part B
4. Native fish objectives and targets
5. Native vegetation objectives and targets
6. Waterbird objectives and targets
7. Priority ecosystem functions objectives and targets
8. Frogs and other species objectives and targets

Part C: Environmental water requirements

9. Introduction to Part C
10. Developing environmental water requirements

Part D: Appendices – this document

Chapter 2 appendices: Priority environmental assets

Appendix 2.1: Prioritised list of wetland feature datasets used to develop water-dependent environmental assets

Catchment (file name)	Input dataset name (priority number)
Border Rivers	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water ¹ 3) HydroArea Natural Watercourses ² 4) NSW Landuse Dataset ³ 5) NWLLS_Wetlands_Composite_20150202
Barwon–Darling	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset
Gwydir	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset 5) Ramsar wetland boundaries
Intersecting Streams	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset 5) Ramsar wetland boundaries
Lachlan	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset
Lower Darling (subset of Murray–Lower Darling)	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset

¹ HEVEA Riverlines represent 3rd order Strahler streams and greater

² Contains natural watercourses only

³ Is keyword searched (wetland, swamp, billabong, oxbow, waterhole, riverine, creek, stream, lagoon, floodplain, marsh, riparian, cowl, lake, flood, drainage depression)

Catchment (file name)	Input dataset name (priority number)
Macquarie	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset 5) Ramsar wetland boundaries 6) Mitchell Landscapes
Murray (subset of Murray-Lower Darling)	1) ANAE Wetlands 2) BogsAndFensSnowyMountains 3) Cadell_MIL (MIL Wetland Imagery Digitisation) ⁴ 4) MIL Private Watered Wetlands ⁴ 5) OEH Private Property Wetlands ⁴ 6) HEVEA Riverlines DPI Water 7) Forestry NSW Mapped Wetlands 8) HydroArea Natural Watercourses 9) NSW Landuse Dataset 10) Ramsar wetland boundaries 11) Wetlands_Upper_Murray 12) WetlandsWestHumeCorowa 13) Ramsar wetland boundaries
Murrumbidgee	1) ANAE Wetlands 2) BogsAndFensSnowyMountains 3) Benson Layer (highland wetlands) 4) HEVEA Riverlines DPI Water 5) Forestry NSW Mapped Wetlands 6) HydroArea Natural Watercourses 7) NSW Landuse Dataset 8) Ramsar wetland boundaries 9) WetlandsFrazierGundagai_Ha 10) Ramsar wetland boundaries
Namoi	1) ANAE Wetlands 2) HEVEA Riverlines DPI Water 3) HydroArea Natural Watercourses 4) NSW Landuse Dataset 5) NWLLS_Wetlands_Composite_20150202 6) IRF_WarrahCrkFMP_wetlands_2008 7) OEH Anthony Young wetlands

⁴ Digitised private wetlands within the Murray catchment

Appendix 2.2: Prioritised list of vegetation mapping datasets used to develop water-dependent vegetation products and identify priority environmental assets

Catchment	Input vegetation dataset name ⁵ (priority number)	VIS ID
Border Rivers	1) BRG_Namoi_v2_0_E_4204 (1)	4204
Barwon–Darling	1) DarlingFloodplain2014_E_4186 (1)	4186
	2) Balonne_vegetation_201603001 (1)	4453
	3) Darling_vegetation_20160301 (1)	4454
	4) ParooDarlingNP_Coonavitra_E_3965 (1)	3965
	5) ParooDarlingNP_MtMurch_E_3966 (1)	3966
	6) ParooDarlingNP_Peery_E_3968 (1)	3968
	7) ParooDarlingNP_Thiltakarra_E_968 (1)	968
	8) ParooDarlingNP_Wilga_E_3967 (1)	3967
	9) TooraleNP_2012_E_4027 (1)	4027
	10) WarramboolSCA_2012_E_3985 (1)	3985
	11) SVTM_Western_PCTv0p1_5m (2)	4492
Gwydir	1) Gwydir Wetlands Mapping (1)	3922
	2) BRG_Namoi_v2_0_E_4204 (2)	4204
	3) NVMP Mapping (2)	2136, 2134, 3796, 4196, 804
Intersecting Streams	1) DarlingFloodplain2014_E_4186 (1)	4186
	2) Balonne_vegetation_201603001 (1)	4453
	3) Darling_vegetation_20160301 (1)	4454
	4) ParooDarlingNP_Coonavitra_E_3965 (1)	3965
	5) ParooDarlingNP_MtMurch_E_3966 (1)	3966
	6) ParooDarlingNP_Peery_E_3968 (1)	3968
	7) ParooDarlingNP_Thiltakarra_E_968 (1)	968
	8) ParooDarlingNP_Wilga_E_3967 (1)	3967
	9) TooraleNP_2012_E_4027 (1)	4027
	10) WarramboolSCA_2012_E_3985 (1)	3985
	11) SVTM_Western_PCTv0p1_5m (2)	4492
Lachlan	1) VIS database: (1)	
	FE_Revised2002_SEH_E_4136	4136
	EcosystemsVulnRev02_SC_E_4130	4130
	CWLachlanCMA_CentTab2010_E_4163	4163
	CRA_Goulburn_Floristics_E_4139	4139
	CopperhanniaNR_1998_E_3971	3971
	boorowa_extant_VISmap_1624	1624
	barton_nr_VISmap_837	837
	2) PCT_v1p0_Lachlan (2)	4468

⁵ SEED reference

Catchment	Input vegetation dataset name ⁵ (priority number)	VIS ID
Lower Darling (subset of Murray– Lower Darling)	1) SVTM_Western_PCTv0p1_5m (1)	4492
Macquarie	1) DarlingFloodplain2014_E_4186 (1)	4186
	2) MMVeg2013IntPU27042016 (Bowen et al. 2014) (1)	N/A 1658
	3) brewarrina_VISmap_1658 (2)	4163
	4) CWLachlanCMA_CentTab2010_E_4163 (2)	4468
	5) PCT_v1p0_Macquarie (3)	
Murray (subset of Murray–Lower Darling)	1) Barmah – Millewa Vegetation Mapping (Bowen 2010) (1)	3869, 3870
	2) MM_VegV5_20160829 (2)	N/A
	3) RiverinaSVM_v1_0_PCT_E_4371 (3)	4371
	4) SVTM_Western_PCTv0p1_5m (3)	4492
Murrumbidgee	1) SELLS_veg_combined2014: (2)	4211
	BioMetric_ShoalhavenEurobodalla	3900
	BogsFensSnowyMtns	N/A
	MonaroGrasslands_GDA94	3915
	murrumbidgeecma_2011_e_3879	3879
	scivi_v14_e_2230_class_VIS_v10	2230
	2) MM_VegV5_20160829 (2)	
	3) Lowbidgee Yanga Vegetation Mapping (Bowen and Simpson 2010) (1)	3872
	4) balranald92_rbg_VISmap_3178 (3)	3178
	5) RiverinaSVM_v1_0_PCT_E_4371 (3)	4371
Namoi	1) PilligaNP_2010_E_3980 (1)	3980
	2) NamoiCMAcomposite_2013_E_4028 (1)	4028
	3) BRG_Namoi_v2_0_E_4204 (2)	4204

Appendix 2.3: Prioritised list of water-dependent fauna datasets used to develop water-dependent environmental assets

Fish records were not included within the water-dependent fauna datasets as fish are considered separately within the LTWP environmental asset identification methodology.

Catchment	Input vegetation dataset name (priority number)
Border Rivers	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Queensland WildNet records⁶ 3) Annual Waterbird Survey of Eastern Australia⁷
Barwon–Darling	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) Australian Museum aquatic snail records⁸ 4) University of Canberra turtle records⁸
Gwydir	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) MDBA Aerial Waterbird Surveys 2010–2015 3) Additional OEH bird ground survey data 2007–2015 4) OEH frog data 2015–16 5) Healthy Floodplain Project records (additional data)
Intersecting Streams	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) MDBA Aerial Waterbird Surveys 2010–2015 4) Australian Museum aquatic snail records 5) University of Canberra turtle records 6) OEH Narran lakes survey 2012 onwards
Lachlan	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) MDBA Aerial Waterbird Surveys 2010–2015 4) CSU frog data 2012–2016

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⁷ Obtained from UNSW and not to be shared without their permission

⁸ Obtained from Healthy Floodplains Project and not to be distributed further

Catchment	Input vegetation dataset name (priority number)
Lower Darling (subset of Murray–Lower Darling)	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) Australian Museum aquatic snail records 4) University of Canberra turtle records 5) South Australian BioData records⁹ 6) MDBA Aerial Waterbird Surveys 2010–2015
Macquarie	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) MDBA Aerial Waterbird Surveys 2010–2015 4) Additional OEH bird ground survey data 2007–2015 5) OEH frog data 2014–2016 6) Healthy Floodplain Project records (additional data)
Murray (subset of Murray–Lower Darling)	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) Australian Museum aquatic snail records 4) University of Canberra turtle records 5) MDBA Aerial Waterbird Surveys 2007–2015 6) Rick Webster’s waterbird ground survey data for the Murray catchment
Murrumbidgee	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) MDBA Aerial Waterbird Surveys 2010–2015 4) Lowbidgee RERP records 5) Additional OEH bird ground survey data 2008–2015 6) CMA frog records 7) ACT Wildlife Atlas records 8) Rick Webster’s waterbird ground survey data for the Murrumbidgee catchment 9) LTIM monitoring data 2014–15 10) CSU frog data 2008–2015
Namoi	<ol style="list-style-type: none"> 1) NSW OEH BioNet records 2) Annual Waterbird Survey of Eastern Australia 3) Australian Museum aquatic snail records 4) University of Canberra turtle records

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Chapter 4 appendices: Native fish

Appendix 4.1: Basin-wide environmental watering strategy (BWS) priorities for increasing the distribution of key native fish species by 2024

Species	Priorities for increasing distribution in the southern Basin	Priorities for increasing distribution in the northern Basin
Macquarie perch	<p>Range extension: Expand at least 2 current populations (candidate sites include Cotter River, Murrumbidgee above Cooma, Adjungbilly Creek, King Parrot Creek, Hughes Creek, and Hollands Creek).</p> <p>Additional populations: Establish at least 4 additional riverine populations (candidate sites include mid Goulburn River, Ovens River, Kiewa River and Goodradigbee River)¹⁰.</p>	<p>Range extension: The distribution of Macquarie perch in the northern Basin is limited to the Lachlan catchment. Range expansion of at least 2 current populations is a priority.</p> <p>Additional populations: Establish 1–3 additional riverine populations within the Lachlan catchment.</p>
Trout cod	<p>Range extension: Expand the range of trout cod up the Murray upstream of Lake Mulwala and into the Kiewa River. For the connected population of the Murrumbidgee–Murray–Edwards, continue downstream expansion.</p> <p>Additional populations: Establish at least 2 additional populations (candidate sites include the Macquarie River and mid Goulburn River)¹¹.</p>	<p>Range extension: The distribution of trout cod in the northern Basin is limited to the Macquarie catchment downstream of Burrendong Dam. Range expansion of the current population is a priority.</p> <p>Additional populations: Establish 1–3 additional populations (candidate sites are primarily within the Macquarie catchment; within the Lachlan, a candidate site is downstream of Wyangla Dam).</p>

¹⁰ Ovens River and Goulburn populations – attempts to re-establish have commenced.

¹¹ Macquarie River and mid Goulburn populations – attempts to re-establish have commenced.

Species	Priorities for increasing distribution in the southern Basin	Priorities for increasing distribution in the northern Basin
Silver perch ¹²	<p>Range extension: Expand the core range within the River Murray (Yarrowonga–Euston) and populations within the Edward–Wakool, lower Murrumbidgee and Goulburn rivers. Expand upstream of Lake Mulwala and into the Ovens River, increase up the lower Goulburn River.</p> <p>Additional populations: Improve core range in at least 2 additional locations – (candidate sites include Gunbower Creek, Broken Creek, the lower Loddon, Lower Darling, Billabong–Yanco system and Campaspe River, ACT reaches of the Murrumbidgee).</p>	<p>Range extension: Expand the core range of at least 2 existing populations (candidate sites include populations in the Namoi, Barwon–Darling and Macquarie catchments)</p> <p>Additional populations: Improve core range (candidate sites are the Warrego, Paroo and Condamine rivers (including Oakey Creek).</p>
Freshwater catfish ¹²	<p>Range extension: Expand the core range of at least 2 current populations (candidate sites include Colombo–Billabong Creek and Wakool system and Wimmera River).</p> <p>Additional populations: Improve core range in at least 3 additional locations (candidate sites include the Avoca River, Loddon River upstream of Laanecoorie Reserve, Merran Creek area in NSW).</p>	<p>Range extension: Expand the core range of at least 3–5 existing populations (candidate sites include the Gwydir, Namoi, Border Rivers, Macquarie, Warrego and Condamine catchments and the Paroo River)</p>
Southern pygmy perch	<p>Range extension: Expand the range of at least 2 current populations (candidate sites include Barmah–Millewa and other mid Murray wetlands).</p> <p>Additional populations: Establish 3–4 additional populations (candidate sites include the lower Murrumbidgee wetlands and Lower Lakes).</p>	<p>Range extension: Expand the range of the Lachlan populations.</p> <p>Additional populations: Establish 1–3 additional populations in the Lachlan catchment.</p>

¹² Note this is about improving core range of this species (southern and northern).

Species	Priorities for increasing distribution in the southern Basin	Priorities for increasing distribution in the northern Basin
Olive perchlet ¹³	Olive perchlet are considered extinct in the southern Basin ¹⁴ . Reintroduction using northern populations is the main option for recovery. Candidate sites may result from improved flow that reinstates suitable habitat in River Murray and mid Murrumbidgee wetlands).	Range extension: Expand the range (or core range) of at least 3 existing populations (candidate sites include the Border Rivers, Lachlan River and middle Condamine River). Additional populations: Establish or improve the core range of 2–4 additional populations (candidate sites include the Macquarie and Namoi rivers, Gowrie Creek and Oakey Creek (Condamine tributaries).
Southern purple-spotted gudgeon ¹³	Range extension: Expand the range of at least 2 current populations (candidate sites include the Jury Swamp populations). Additional populations: Establish 3–4 additional populations (candidate sites include the Murrumbidgee in Adjungbilly and Adelong creeks and Murray wetlands).	Range extension: Expand the range (or core range) of at least 3 existing populations (priority catchments Border Rivers/Gwydir, Macquarie and Condamine). Additional populations: Establish or improve the core range of 2–5 additional populations (priority catchments Border Rivers/Gwydir, Macquarie, Namoi, Barwon–Darling, Lachlan and Condamine in Oakey Creek).
Yarra pygmy perch	Range extension: Expand the range of at least 2 current populations (candidate sites include the Lower Lakes/Coorong region). Additional populations: Establish 3–4 additional populations.	Not present
Murray hardyhead	Range extension: Expand the range of at least 2 current populations. Additional populations: Establish 3–4 additional populations, with at least 2 of these within the lower Murray conservation unit, one in the mid Murray conservation unit and a further population potentially within the Kerang Lakes region.	Not present

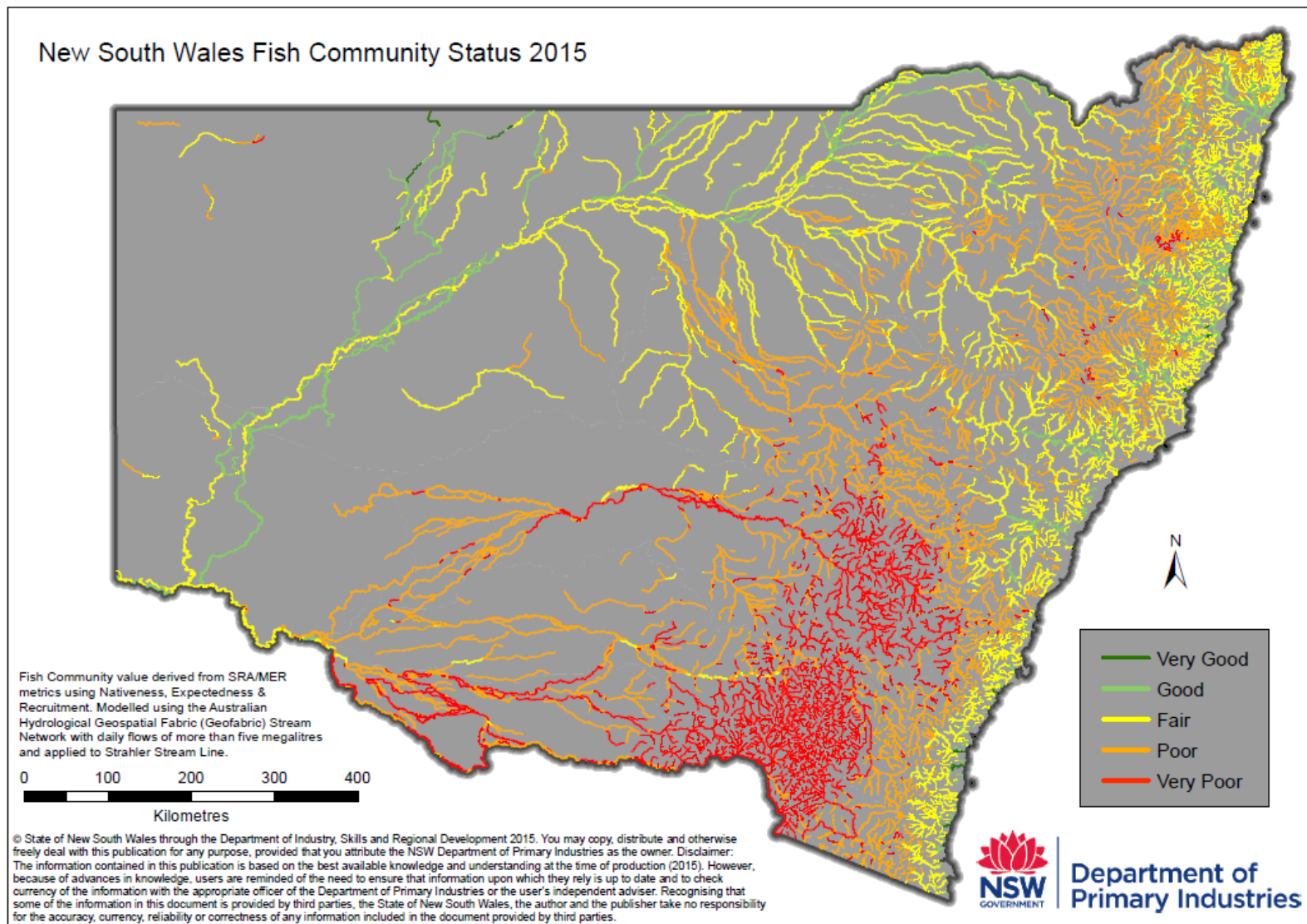
¹³ Note this is about improving core range of this species in Queensland parts of the northern Basin

¹⁴ Lachlan populations are included in the northern Basin in this document.

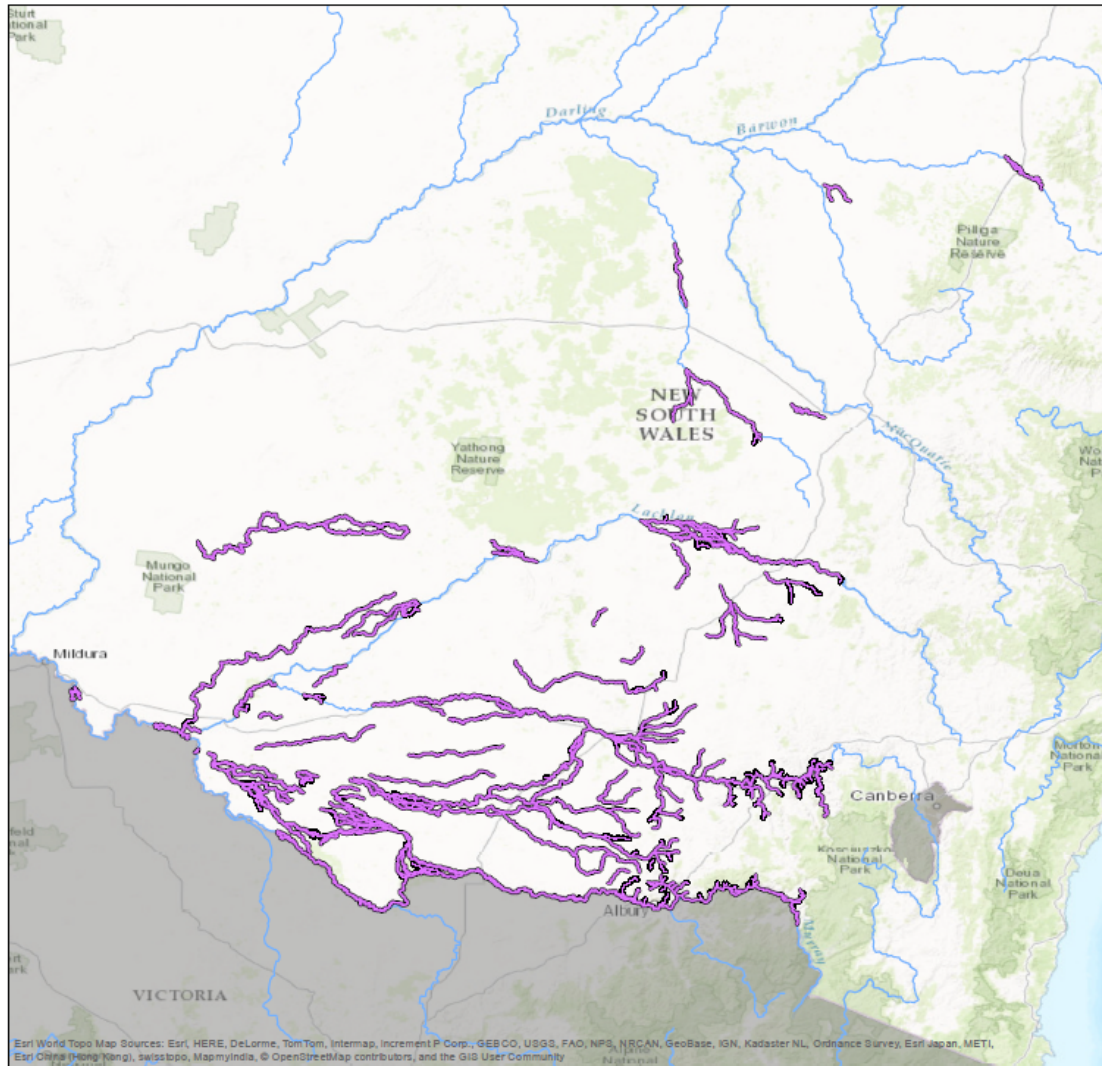
Species	Priorities for increasing distribution in the southern Basin	Priorities for increasing distribution in the northern Basin
River blackfish ¹⁵	<p>Range extension: Expand the range of at least 2 current populations (candidate sites include the Murrumbidgee River and from the Mulwala canal).</p> <p>Additional populations: Establish 1–3 additional populations (candidate sites include downstream of the Loddon and Campaspe rivers).</p>	<p>Range extension: Expand the range of at least 2 current populations (candidate sites include tributaries of the Condamine and upland systems of the Border Rivers, Gwydir and Namoi).</p> <p>Additional populations: Establish 1–3 additional populations.</p>
Two-spined blackfish ¹⁵	<p>Range extension: Expand the range of at least 2 current populations (candidate sites include the Kiewa/Ovens population and upper Goulburn tributaries).</p> <p>Additional populations: Establish 1–3 additional populations.</p>	Not present
Flathead galaxias	<p>Range extension: Expand the core range in the wetlands of the River Murray.</p> <p>Additional populations: Improve core range in 1–2 additional locations (candidate sites include Murrumbidgee, Goulburn, Kiewa and Mitta Mitta rivers and suitable wetlands in these systems).</p>	Flathead galaxias are considered extinct in the northern Basin; therefore, the focus for this species is likely to be in the southern Basin. However, reintroduction using southern populations may be an option for recovery in the northern Basin in the longer term. Candidate sites may be considered within their former range in the Lachlan and Macquarie catchments.
Diadromous species (congolli, short-headed and pouched lamprey)	<p>Range extension: Upstream expansion facilitated through flows to operate fishways.</p>	Not present

¹⁵ Recent genetic studies on these 2 blackfish species have potentially identified 6 candidate species across river blackfish and two-spined blackfish; for example, Goulburn River system sites are genetically different. This may require adapting outcomes and approaches for management of these species.

Appendix 4.2: Fish community status for the NSW section of the Murray–Darling Basin (MDB)



Appendix 4.3: Map series of NSW listed threatened species distributions for the NSW section of the MDB



Indicative Distribution in NSW

Flathead Galaxias

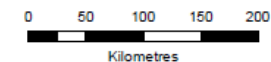


(*Galaxias rostratus*)

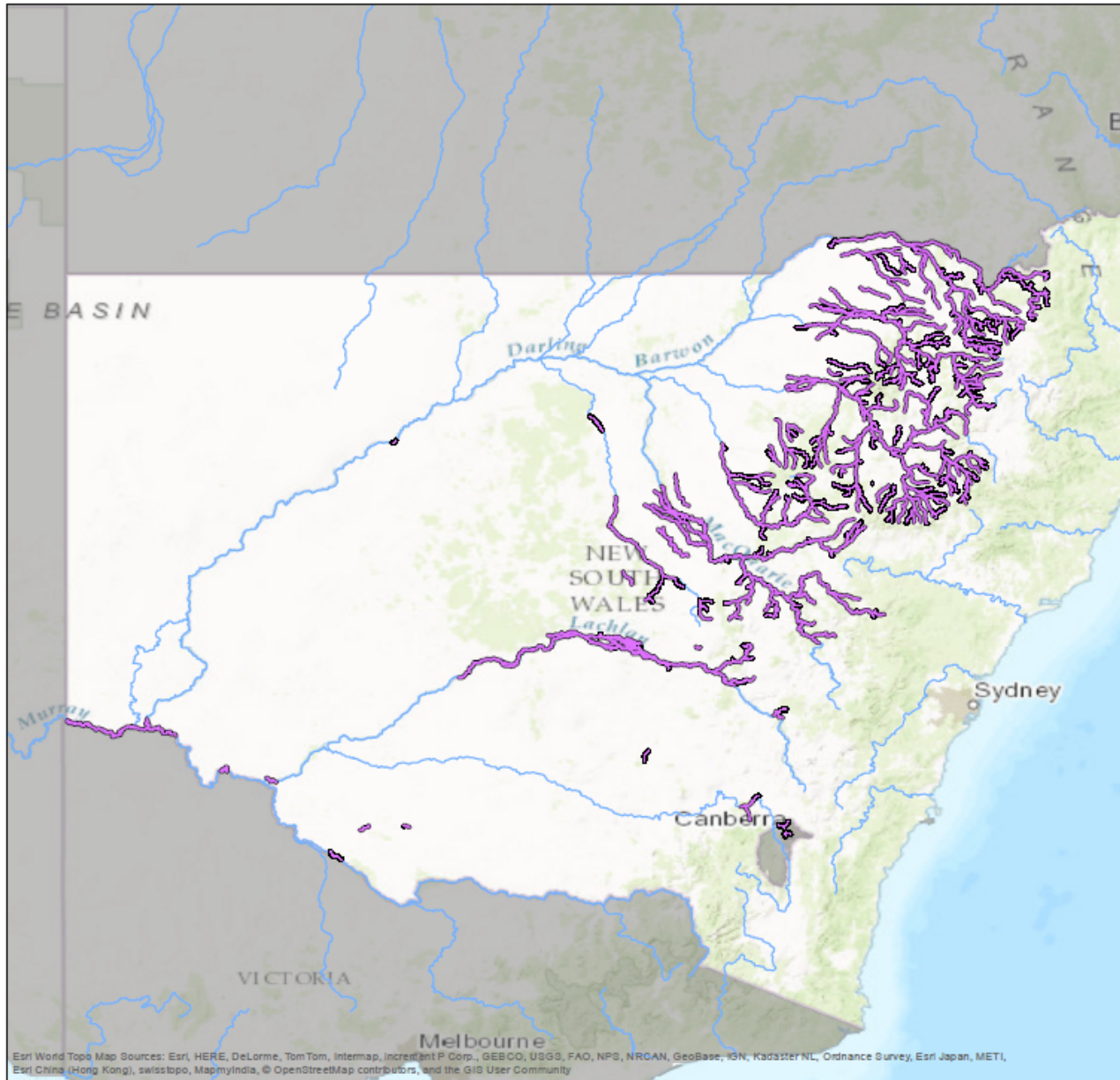


Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. Output restricted to named streams with a modelled average daily flow of more than 5 megalitres. 2015.



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Indicative Distribution in Murray Darling Basin NSW

Eel Tailed Catfish



(*Tandanus tandanus*)



Indicative Distribution

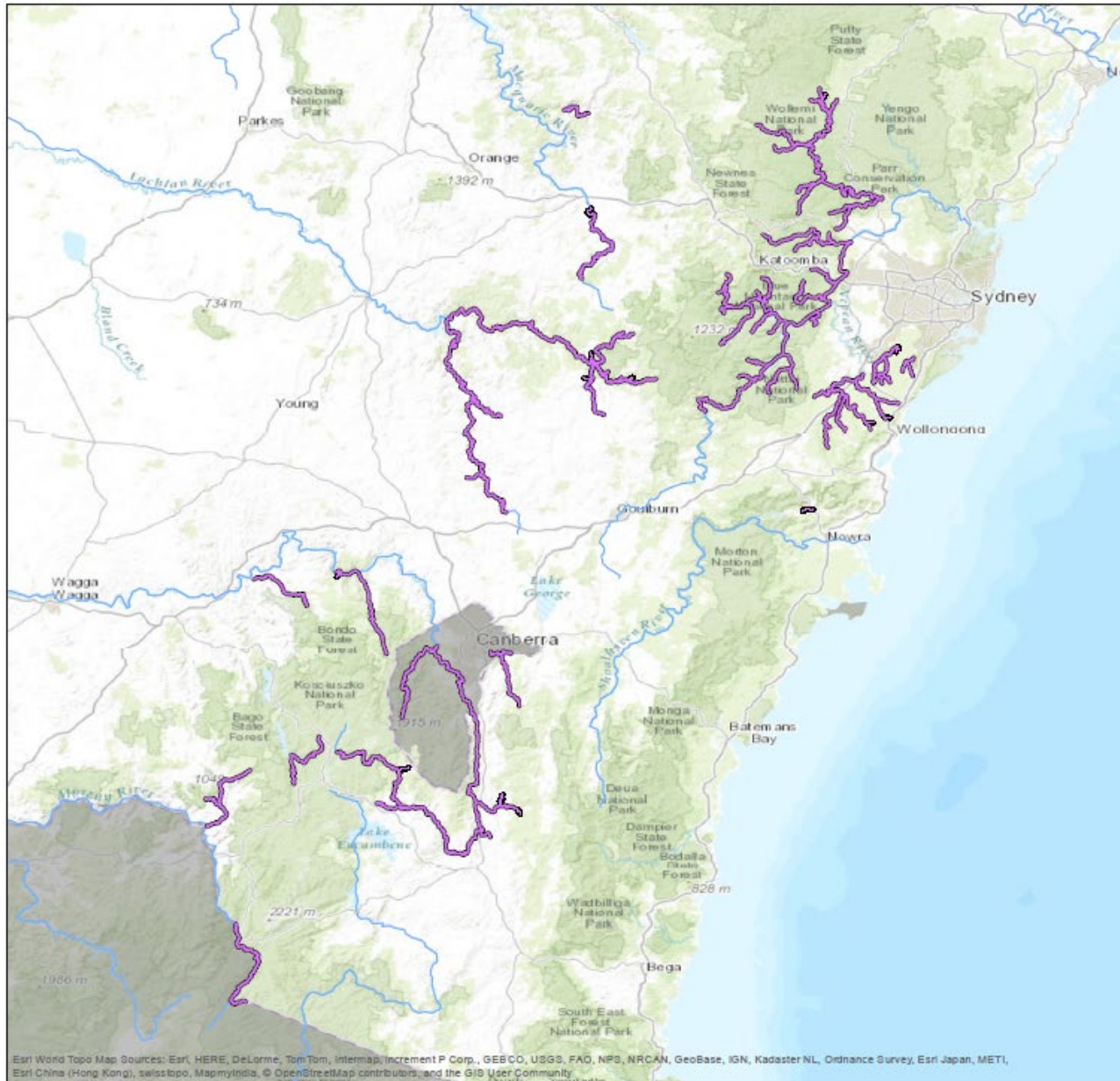
Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. Output restricted to named streams with a modelled average daily flow of more than 5 megalitres. 2015.



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Indicative Distribution in NSW

Macquarie Perch



(*Macquaria australasica*)



Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. Output restricted to named streams with a modelled average daily flow of more than 5 megalitres. 2015.



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Indicative Distribution in Western NSW

Olive Perchlet

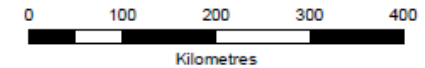


(*Ambassis agassizii*)



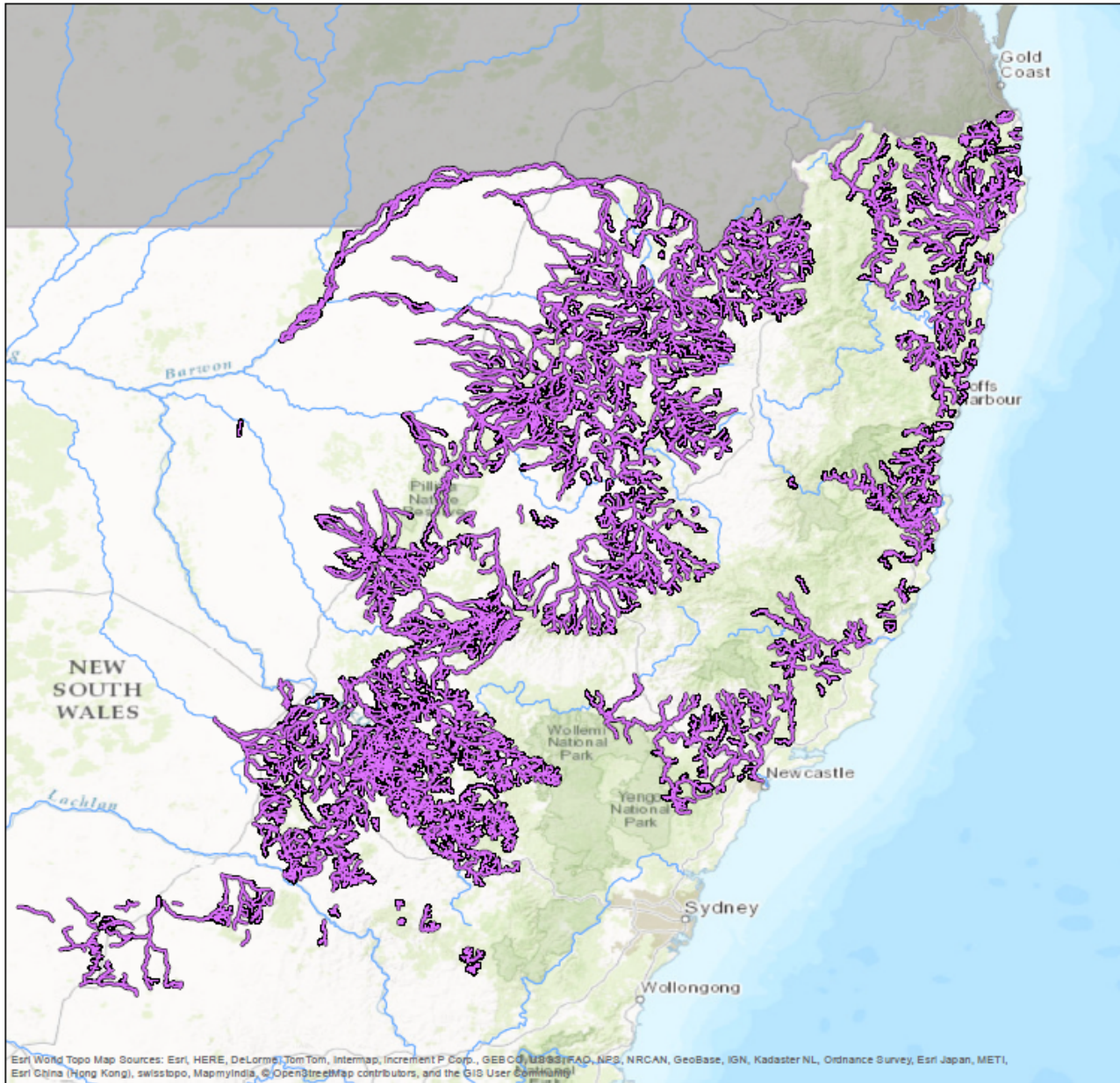
Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. 2015.



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Indicative Distribution in NSW

Purple Spotted Gudgeon

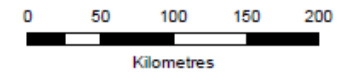


(*Mogurnda adspersa*)



— Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. 2015.



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Department of Primary Industries



Indicative Distribution in Murray Darling Basin NSW

Silver Perch

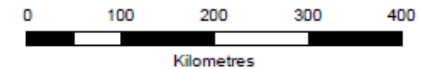


(Bidyanus bidyanus)



Indicative Distribution

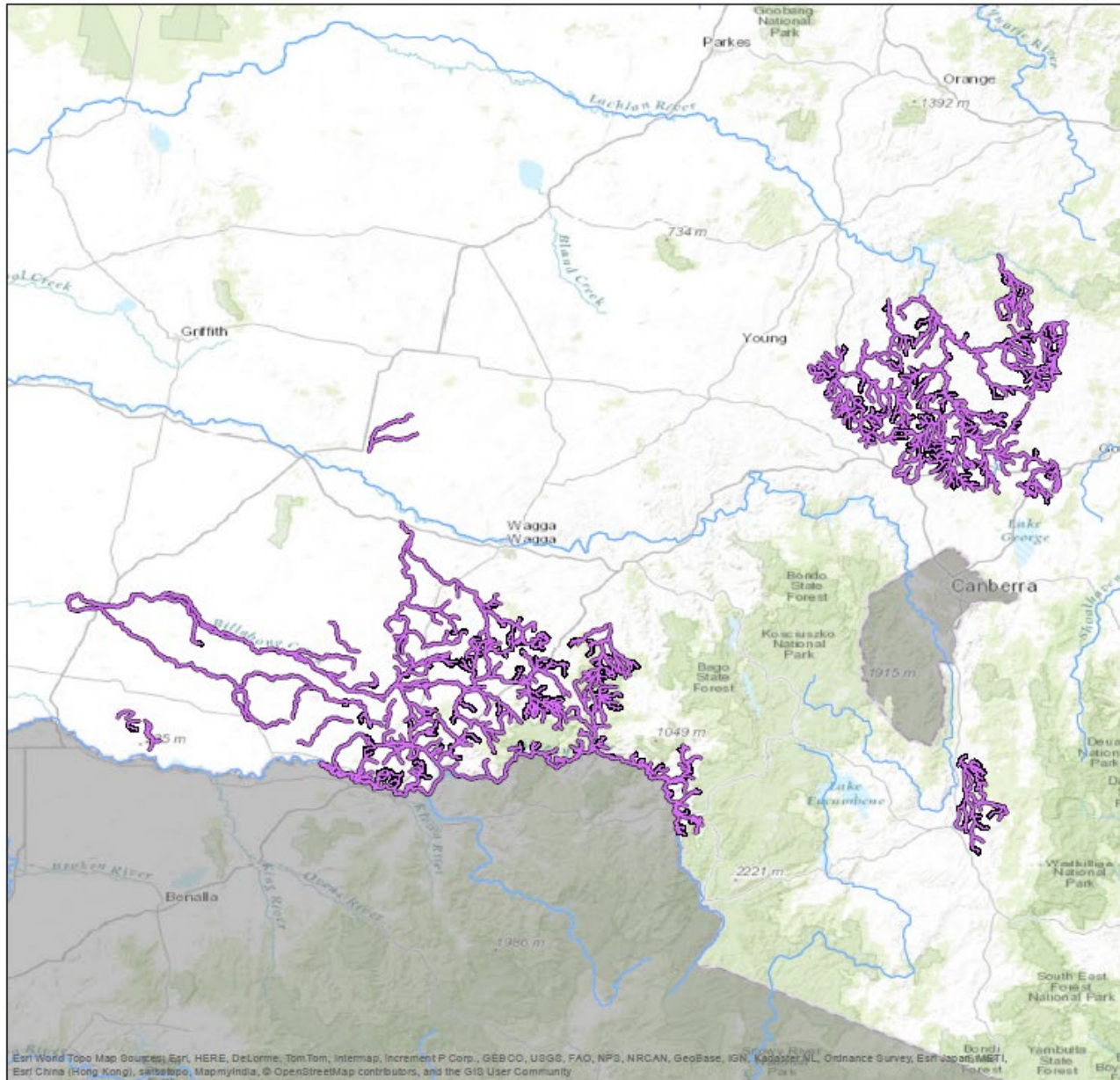
Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. Output restricted to named streams with a modelled average daily flow of more than 5 megalitres. 2015.



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**Department of
Primary Industries**



Indicative Distribution in NSW
Southern Pygmy Perch

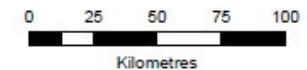


(*Nannoperca australis*)



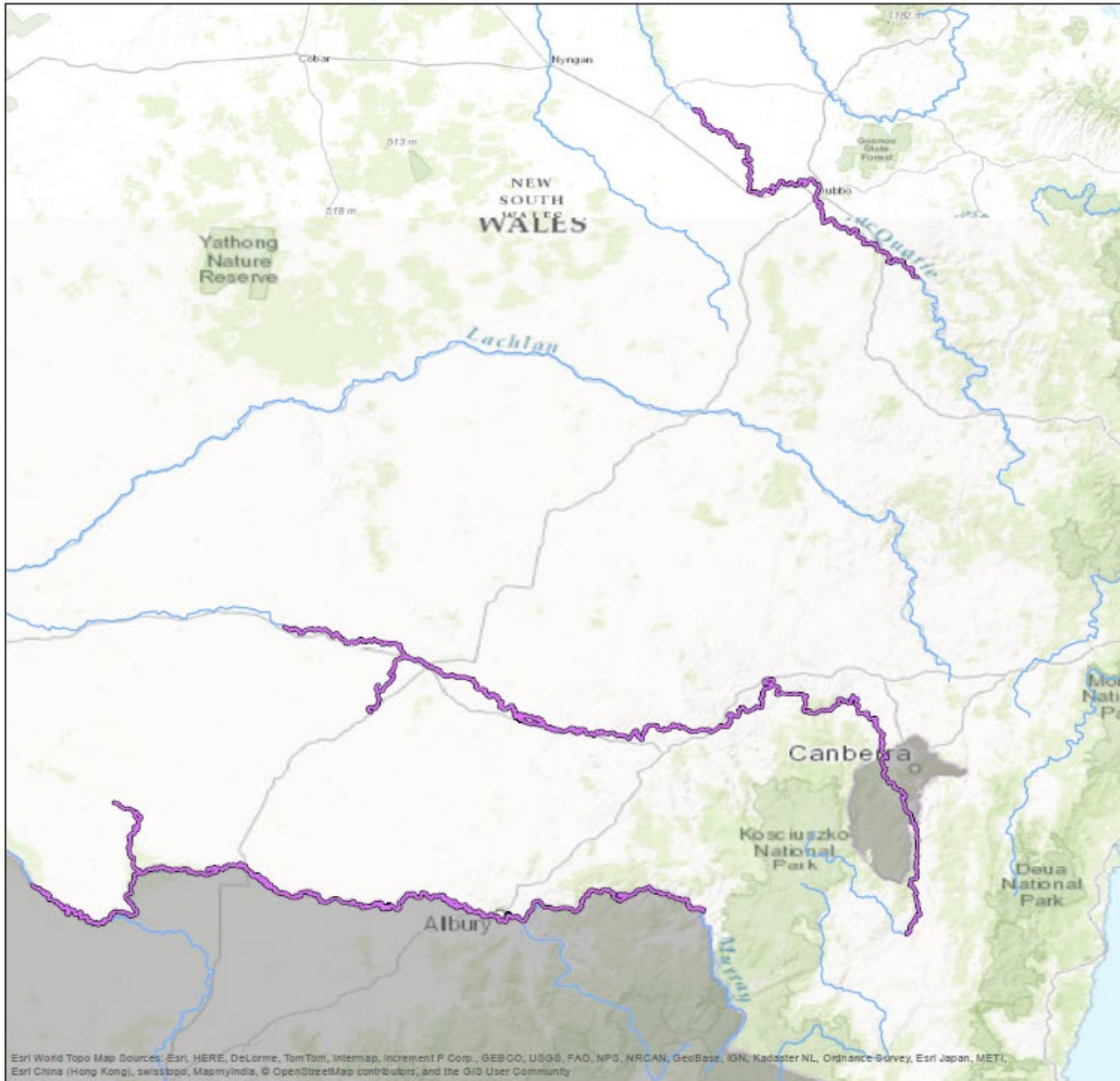
— Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion, 2015.



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Indicative Distribution in NSW

Trout Cod



(*Maccullochella macquariensis*)



— Indicative Distribution

Distribution based on survey records, predicted occurrence (MaxEnt 3.3.3) and expert opinion. Output restricted to named streams with a modelled average daily flow of more than 5 megalitres. 2015.



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Chapter 5 appendices: Native vegetation

Appendix 5.1: Water-dependent plant community types (PCTs) for each water resource plan area (WRPA)

Border Rivers water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
1	Candidate Native Grasslands – only in Coolibah woodlands	N/A	Floodplain	10 years	Candidate Native Grasslands	Candidate Native Grasslands
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

¹⁶ Developed by DPE-EHG for the NSW LTWPs

¹⁷ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

¹⁸ Refers to the NSW Keith formation

¹⁹ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
40	Coolibah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Coolibah	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
52	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
71	Carbeen – White Cypress Pine – River Red Gum – bloodwood tall woodland on sandy loam alluvial and eolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Shrubby sub-formation)	North-west Alluvial Sand Woodlands
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
84	River Oak – Rough-barked Apple – red gum – box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Eastern Riverine Forests
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
112	Black Tea-tree – River Oak – Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
168	Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
204	Water Couch marsh grassland wetland of frequently flooded inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
211	Slender Saltbush – samphire – copperburr low open shrubland wetland on irregularly inundated floodplains mainly in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
214	Native Millet – Cup Grass grassland of the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
241	River Coobah swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	N/A	Floodplain	10 years	Grassy Woodlands	Floodplain Transition Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
362	Weeping Bottlebrush – Rough-barked Apple riparian low open forest / tall shrubland wetland mainly in the Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Forested Wetlands	Inland Riverine Forests
446	Riparian tea tree – bottlebrush – pennywort forbland / shrubland / wetland of montane creeks in the Brigalow Belt South Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Heathlands	Northern Montane Heaths
447	Sedgeland – forbland wetland in depressions on valley flats of the NSW North-western Slopes	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
500	Upland wetlands of the New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Lakes
518	Heath swamps wetland on leucogranite and granite of the New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ¹⁶	ARI ¹⁷	DPE-EHG vegetation formation ¹⁸	DPE-EHG vegetation class ¹⁹
574	Tea-tree riparian shrubland / heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion	N/A	Flood-dependent shrubland wetland	1–2 years	Heathlands	Northern Montane Heaths
582	Sedgeland fens wetland of impeded drainage of the Nandewar Bioregion and New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
607	Montane bogs on the western fall of the New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens

Barwon-Darling and Intersecting Streams water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
2	River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests

²⁰ Developed by DPE-EHG for the NSW LTWPs

²¹ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

²² Refers to the NSW Keith formation

²³ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
11	River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
13	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	5–10 years	Semi-arid Woodlands	Inland Floodplain Woodlands
16	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands
25	Lignum shrubland wetland on floodplains and depressions of the Mulga Lands Bioregion, Channel Country Bioregion in the arid and semi-arid (hot) climate zones	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands	North – west Floodplain Woodlands
38	Black Box low woodland wetland lining ephemeral watercourses or fringing lakes and clay pans of semi-arid (hot) and arid zones	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands	Semi-arid Floodplain Grasslands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
40	Coolibah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Coolibah	Flood-dependent woodland	5–10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
41	River Red Gum open woodland wetland of intermittent watercourses mainly of the arid climate zone	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
43	Mitchell Grass grassland – chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
49	Partly derived Windmill Grass – copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Grasslands	Semi-arid Floodplain Grasslands
52	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
62	Samphire saline shrubland/forbland wetland of lake beds and lake margins in the arid and semi-arid (hot) zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
63	Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Swamps
67	Yapunya woodland wetland of Cuttaburra–Paroo River system, Mulga Lands Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
71	Carbeen – White Cypress Pine – River Red Gum – bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (shrubby sub-formation)	North-west Alluvial Sand Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
115	Eurah shrubland of inland floodplains	N/A	Floodplain	10 years	Freshwater Wetlands	Inland Floodplain Shrublands
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
161	Golden Goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
163	Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
166	Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	N/A	Non-woody wetland	N/A	Saline Wetlands	Riverine Chenopod Shrublands
168	Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
181	Common Reed – Bushy Groundsel aquatic tall reed land grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
195	Bladder Saltbush chenopod shrubland on alluvial plains mainly in the Darling Riverine Plain Bioregion	N/Aa	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
197	Black Box – Gidgee – chenopod low open woodland wetland on alluvial clay soils in the Culgoa River region of the Darling Riverine Plains Bioregion and Mulga Lands Bioregion	Black box	Flood-dependent woodland	5–10 years	Arid Shrublands (Acacia sub-formation)	Gibber Transition Shrublands
198	Sparse saltbush forbland wetland of the irregularly inundated lakes of the arid and semi-arid (persistently hot) climate zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
206	Dirty Gum – White Cypress Pine tall woodland of alluvial sand (sand monkeys) in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
207	Poplar Box grassy low woodland of drainage lines and depressions of the semi-arid (hot) and arid zone climate zones	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
211	Slender Saltbush – samphire – copperburr low open shrubland wetland on irregularly inundated floodplains mainly in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	North-west Floodplain Woodlands
212	Chenopod low open shrubland – ephemeral partly derived forland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
214	Native Millet – Cup Grass grassland of the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
230	Coolabah woodland wetland of intermittent watercourses in arid zone, mainly in the Channel Country Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
233	River Red Gum – Poplar Box grassy woodland wetland on Quaternary alluvial sandy-loam soils of the Cobar Peneplain	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
234	River Red Gum woodland wetland of rocky creeks in the ranges of the arid climate zone	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁰	ARI ²¹	DPE-EHG vegetation formation ²²	DPE-EHG vegetation class ²³
241	River Cooba swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
377	Copperburr low open shrubland on loam – clay flats and playas, western Brigalow Belt South Bioregion and northern Darling Riverine Plains Bioregion	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands

Gwydir water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands

²⁴ Developed by DPE-EHG for the NSW LTWPs

²⁵ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

²⁶ Refers to the NSW Keith formation

²⁷ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
38	Black Box low woodland wetland lining ephemeral watercourses or fringing lakes and clay pans of semi-arid (hot) and arid zones	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands	Semi-arid Floodplain Grasslands
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
40	Coolibah woodland wetland with chenopod/grassy ground cover on grey and brown clay inner floodplains adjacent to major inland rivers	Coolibah	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
43	Mitchell Grass grassland – chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
49	Partly derived Windmill Grass – copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Grasslands	Semi-arid Floodplain Grasslands
52	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern–eastern Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
62	Samphire saline shrubland/forbland wetland of lake beds and lake margins in the arid and semi-arid (hot) zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
71	Carbeen – White Cypress Pine – River Red Gum – bloodwood tall woodland on sandy loam alluvial and eolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Shrubby sub-formation)	North-west Alluvial Sand Woodlands
74	Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	River red gum	Flood-dependent woodland	2–3 years	Grassy Woodlands	Floodplain Transition Woodlands
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
84	River Oak – Rough-barked Apple – red gum – box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Eastern Riverine Forests
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
112	Black Tea-tree – River Oak – Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Forested Wetlands	Inland Riverine Forests
115	Eurah shrubland of inland floodplains	N/A	Floodplain	10 years	Freshwater Wetlands	Inland Floodplain Shrublands
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
161	Golden Goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
163	Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
166	Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	N/A	Non-woody wetland	N/A	Saline Wetlands	Riverine Chenopod Shrublands
168	Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
181	Common Reed – Bushy Groundsel aquatic tall reed land grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
198	Sparse saltbush forbland wetland of the irregularly inundated lakes of the arid and semi-arid (persistently hot) climate zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
204	Water Couch marsh grassland wetland of frequently flooded inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
205	Marsh Club-rush wetland very tall sedgeland of inland watercourses, mainly Darling Riverine Plains Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
206	Dirty Gum – White Cypress Pine tall woodland of alluvial sand (sand monkeys) in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
207	Poplar Box grassy low woodland of drainage lines and depressions of the semi-arid (hot) and arid zone climate zones	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
211	Slender Saltbush – samphire – copperburr low open shrubland wetland on irregularly inundated floodplains mainly in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
212	Chenopod low open shrubland – ephemeral partly derived forbland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
214	Native Millet – Cup Grass grassland of the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
241	River Coobah swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	N/A	Floodplain	10 years	Grassy Woodlands	Floodplain Transition Woodlands
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
375	Budda Pea – Channel Millet ephemeral reedland wetland on floodplains in north-western NSW	Coolibah	Flood-dependent woodland	3–5 years	Freshwater Wetlands	Inland Floodplain Swamps
582	Sedgeland fens wetland of impeded drainage of the Nandewar Bioregion and New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
1270	Tea-tree shrubland of drainage areas of the slopes and tablelands	N/A	Flood-dependent shrubland wetland	1–2 years	Dry Sclerophyll Forest (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forest

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁴	ARI ²⁵	DPE-EHG vegetation formation ²⁶	DPE-EHG vegetation class ²⁷
1324	Windmill grass – Bluegrass derived grassland of the Moree plains of the Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands

Lachlan water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
2	River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests

²⁸ Developed by DPE-EHG for the NSW LTWPs

²⁹ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

³⁰ Refers to the NSW Keith formation

³¹ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
7	River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
9	River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
10	River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
11	River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
12	Shallow marsh wetland of regularly flooded depressions on floodplains mainly in the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
13	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	5–10 years	Semi-arid Woodlands	Inland Floodplain Woodlands
16	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	N/A	Floodplain	10 years	Semi-arid Woodlands	North-west Floodplain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
47	Swamp grassland of the Riverine Plain	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
50	Couch Grass grassland wetland on river banks and floodplains of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
74	Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Eastern Riverine Forests
85	River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	N/A	Flood-dependent woodland	N/A	Forested Wetlands	Eastern Riverine Forests
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	N/A	Inland Floodplain Shrublands	Freshwater Wetlands
166	Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW (recorded in the PCT list with the same name as 164)	N/A	Non-woody wetland	N/A	Saline Wetlands	Riverine Chenopod Shrublands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
181	Common Reed – Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
208	River Red Gum low woodland of rocky gorges and creeks in the Cobar Peneplain	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
240	River Coobah tall shrubland wetland of the floodplains in the Riverina Bioregion and Murray Darling Depression Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
242	Rats Tail Couch sod grassland wetland of inland floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
251	Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion	River red gum	Flood-dependent woodland	3–5 years	Grassy Woodlands	Floodplain Transition Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
271	Spotted Fuchsia shrubland wetland in drainage depressions on inland plains	N/A	Floodplain	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
278	Riparian Blakelys Red Gum – box – shrub – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion	N/A	Floodplain	5–10 years	Forested Wetlands	Eastern Riverine Forests
333	Bottlebrush riparian shrubland wetland of the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	N/A	Flood-dependent shrubland wetland	1–2 years	Dry Sclerophyll Forest (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forest
335	Tussock grass – sedgeland fen – rushland – reedland wetland in impeded creeks in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
356	Blakelys Red Gum x Dirty Gum – White Cypress Pine tall riparian woodland, NSW South Western Slopes Bioregion	N/A	Floodplain	5–10 years	Forested Wetlands	Eastern Riverine Forests
677	Black Gum grassy woodland of damp flats and drainage lines of the eastern Southern Tablelands, South Eastern Highlands Bioregion	N/A	Floodplain	5–10 years	Grassy Woodlands	Subalpine Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ²⁸	ARI ²⁹	DPE-EHG vegetation formation ³⁰	DPE-EHG vegetation class ³¹
766	Carex sedgeland of the slopes and tablelands	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
1110	River Tussock – Tall Sedge – Kangaroo Grass moist grasslands of the South Eastern Highlands Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Grassy Woodlands	Temperate Montane Grasslands
1270	Tea-tree shrubland of drainage areas of the slopes and tablelands	N/A	Flood-dependent shrubland wetland	1–2 years	Dry Sclerophyll Forest (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forest
1299	Wetlands on alluvial valley floors of the South Eastern Highlands Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Lakes

Macquarie–Castlereagh water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests

³² Developed by DPE-EHG for the NSW LTWPs

³³ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

³⁴ Refers to the NSW Keith formation

³⁵ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
9	River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
40	Coolibah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Coolibah	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
43	Mitchell Grass grassland – chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
49	Partly derived Windmill Grass – copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Grasslands	Semi-arid Floodplain Grasslands
50	Couch Grass grassland wetland on river banks and floodplains of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
84	River Oak – Rough-barked Apple – red gum – box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Eastern Riverine Forests
85	River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	N/A	Flood-dependent woodland	N/A	Forested Wetlands	Eastern Riverine Forests
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	N/A	Inland Floodplain Shrublands	Freshwater Wetlands
181	Common Reed – Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
204	Water Couch marsh grassland wetland of frequently flooded inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
208	River Red Gum low woodland of rocky gorges and creeks in the Cobar Peneplain	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
241	River Coobah swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
242	Rats Tail Couch sod grassland wetland of inland floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
399	Red gum – Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga – Goonoo sandstone forests, Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³²	ARI ³³	DPE-EHG vegetation formation ³⁴	DPE-EHG vegetation class ³⁵
454	River Red Gum grassy chenopod open tall woodland (wetland) on floodplain clay soil of the Darling Riverine Plains Bioregion and western Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands
766	Carex sedgeland of the slopes and tablelands	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens

Murray–Lower Darling water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
2	River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests

³⁶ Developed by DPE–EHG for the NSW LTWPs

³⁷ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

³⁸ Refers to the NSW Keith formation

³⁹ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
7	River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
8	River Red Gum – Warrego Grass – Couch Grass riparian tall woodland wetland of the semi-arid (warm) climate zone (Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
9	River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
10	River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
11	River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
12	Shallow marsh wetland of regularly flooded depressions on floodplains mainly in the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
13	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	5–10 years	Semi-arid Woodlands	Inland Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
16	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands
25	Lignum shrubland wetland on floodplains and depressions of the Mulga Lands Bioregion, Channel Country Bioregion in the arid and semi-arid (hot) climate zones	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands	North-west Floodplain Woodlands
38	Black Box low woodland wetland lining ephemeral watercourses or fringing lakes and clay pans of semi-arid (hot) and arid zones	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands	Semi-arid Floodplain Grasslands
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
40	Coolibah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Coolibah	Flood-dependent woodland	5–10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
41	River Red Gum open woodland wetland of intermittent watercourses mainly of the arid climate zone	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
43	Mitchell Grass grassland – chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
49	Partly derived Windmill Grass – copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Grasslands	Semi-arid Floodplain Grasslands
52	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
62	Samphire saline shrubland/forbland wetland of lake beds and lake margins in the arid and semi-arid (hot) zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
63	Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Swamps
64	Samphire – Water Weed – Sea-Heath shrubland saline wetland of depressions of the arid and semi-arid (warm) zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
65	Halosarcia lylei low, open shrubland saline wetland of arid and semi-arid regions	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
67	Yapunyah woodland wetland of Cuttaburra-Paroo River system, Mulga Lands Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
71	Carbeen – White Cypress Pine – River Red Gum – bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains	River red gum	Flood-dependent woodland	2–3 years	Semi-arid Woodlands (shrubby sub-formation)	North-west Alluvial Sand Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
74	Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion	River red gum	Flood-dependent woodland	2–3 years	Grassy Woodlands	Floodplain Transition Woodlands
79	River Red Gum shrub/grass riparian tall woodland or open forest wetland mainly in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
85	River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	N/A	Floodplain	2–3 years	Forested Wetlands	Eastern Riverine Forests
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
115	Eurah shrubland of inland floodplains	N/A	Floodplain	10 years	Freshwater Wetlands	Inland Floodplain Shrublands
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
161	Golden Goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
163	Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
164	Cotton Bush open shrubland of the semi-arid (warm) zone	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
165	Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
166	Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	N/A	Non-woody wetland	N/A	Saline Wetlands	Riverine Chenopod Shrublands
168	Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
181	Common Reed – Bushy Groundsel aquatic tall reed land grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
195	Bladder Saltbush chenopod shrubland on alluvial plains mainly in the Darling Riverine Plain Bioregion	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
197	Black Box – Gidgee – chenopod low open woodland wetland on alluvial clay soils in the Culgoa River region of the Darling Riverine Plains Bioregion and Mulga Lands Bioregion	Black box	Flood-dependent woodland	5–10 years	Arid Shrublands (Acacia sub-formation)	Gibber Transition Shrublands
198	Sparse saltbush forbland wetland of the irregularly inundated lakes of the arid and semi-arid (persistently hot) climate zones	N/A	Floodplain	>10 years	Saline Wetlands	Inland Saline Lakes
206	Dirty Gum – White Cypress Pine tall woodland of alluvial sand (sand monkeys) in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands
207	Poplar Box grassy low woodland of drainage lines and depressions of the semi-arid (hot) and arid zone climate zones	N/A	Floodplain	10 years	Semi-arid woodlands (grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
211	Slender Saltbush – samphire – copperburr low open shrubland wetland on irregularly inundated floodplains mainly in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	North-west Floodplain Woodlands
212	Chenopod low open shrubland – ephemeral partly derived forland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
214	Native Millet – Cup Grass grassland of the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
230	Coolabah woodland wetland of intermittent watercourses in arid zone, mainly in the Channel Country Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
233	River Red Gum – Poplar Box grassy woodland wetland on Quaternary alluvial sandy-loam soils of the Cobar Peneplain	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests
234	River Red Gum woodland wetland of rocky creeks in the ranges of the arid climate zone	River red gum	Flood-dependent woodland	3–5 years	Forested Wetlands	Inland Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
241	River Cooba swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
249	River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
335	Tussock grass – sedgeland fen – rushland – reedland wetland in impeded creeks in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ³⁶	ARI ³⁷	DPE-EHG vegetation formation ³⁸	DPE-EHG vegetation class ³⁹
336	Rush – Sedge – Common Reed mainly lentic channel wetland of the Upper Murray and mid-Murrumbidgee River floodplains in the NSW South Western Slopes Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
377	Copperburr low open shrubland on loam – clay flats and playas, western Brigalow Belt South Bioregion and northern Darling Riverine Plains Bioregion	N/A	Floodplain	>10 years	Arid shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
637	Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Alpine Complex	Alpine Bogs and Fens
939	Montane wet heath and bog of the eastern tablelands, South Eastern Highlands Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
1271	Tea-tree tall riparian shrubland, South Eastern Highlands Bioregion, South East Corner Bioregion and Australian Alps Bioregion	N/A	Flood-dependent shrubland wetland	1–2 years	Forested Wetlands	Eastern Riverine Forests

Murrumbidgee water-dependent PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁰	ARI ⁴¹	DPE-EHG vegetation formation ⁴²	DPE-EHG vegetation class ⁴³
2	River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW	River red gum	Flood-dependent forest	1-2 years	Forested Wetlands	Inland Riverine Forests
7	River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion	River red gum	Flood-dependent forest	1-2 years	Forested Wetlands	Inland Riverine Forests
9	River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	River red gum	Flood-dependent woodland	3-5 years	Forested Wetlands	Inland Riverine Forests
10	River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent woodland	3-5 years	Forested Wetlands	Inland Riverine Forests

⁴⁰ Developed by DPE-EHG for the NSW LTWPs

⁴¹ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

⁴² Refers to the NSW Keith formation

⁴³ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁰	ARI ⁴¹	DPE-EHG vegetation formation ⁴²	DPE-EHG vegetation class ⁴³
11	River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
12	Shallow marsh wetland of regularly flooded depressions on floodplains mainly in the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
13	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	3–5 years	Semi-arid Woodlands	Inland Floodplain Woodlands
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Black box	Flood-dependent woodland	5–10 years	Semi-arid Woodlands	Inland Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁰	ARI ⁴¹	DPE-EHG vegetation formation ⁴²	DPE-EHG vegetation class ⁴³
17	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Shrublands
26	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Coolibah	Floodplain	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
160	Nitre Goosefoot shrubland wetland on clays of the inland floodplains	N/A	Flood-dependent shrubland wetland	5–10 years	Freshwater Wetlands	Inland Floodplain Shrublands
181	Common Reed – Bushy Groundsel aquatic tall reed land grassland wetland of inland river systems	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁰	ARI ⁴¹	DPE-EHG vegetation formation ⁴²	DPE-EHG vegetation class ⁴³
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
1110	River Tussock – Tall Sedge – Kangaroo Grass moist grasslands of the South Eastern Highlands Bioregion	Non-woody wetland	Non-woody wetland	1–2 years	Grasslands	Temperate Montane Grasslands

Namoi water-dependent vegetation PCTs

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Coolibah	Floodplain	5–10 years	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands
36	River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Inland Riverine Forests

⁴⁴ Developed by DPE-EHG for the NSW LTWPs

⁴⁵ ARI = average recurrence interval, the water requirements of the PCT between flooding episodes, in years.

⁴⁶ Refers to the NSW Keith formation

⁴⁷ Refers to the NSW Keith class

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Black box	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
39	Coolibah – River Coobah – Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Coolibah	Flood-dependent woodland	3–5 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
40	Coolibah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Coolibah	Flood-dependent woodland	5–10 year	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
43	Mitchell Grass grassland – chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones	N/A	Floodplain	10 years	Grasslands	Semi-arid Floodplain Grasslands
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Forested Wetlands	Inland Riverine Forests
84	River Oak – Rough-barked Apple – red gum – box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	River red gum	Flood-dependent forest	1–2 years	Forested Wetlands	Eastern Riverine Forests
87	Poplar Box – Coolibah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion	N/A	Floodplain	10 years	Semi-arid Woodlands (Grassy sub-formation)	North-west Floodplain Woodlands
112	Black Tea-tree – River Oak – Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion	N/A	Floodplain	10 years	Forested Wetlands	Inland Riverine Forests
115	Eurah shrubland of inland floodplains	N/A	Floodplain	10 years	Freshwater Wetlands	Inland Floodplain Shrublands
204	Water Couch marsh grassland wetland of frequently flooded inland watercourses	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
211	Slender Saltbush – samphire – copperburr low open shrubland wetland on irregularly inundated floodplains mainly in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
241	River Coobah swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Lignum	Flood-dependent shrubland wetland	1–2 years	Freshwater Wetlands	Inland Floodplain Shrublands
361	Sedgeland fen wetland of spring-fed or runoff-fed creeks in the southern Pilliga – Warrumbungle Range region, Brigalow Belt South Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
399	Red gum – Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga – Goonoo sandstone forests, Brigalow Belt South Bioregion	River red gum	Flood-dependent woodland	2–3 years	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests
400	Riparian sedgeland rushland wetland of the Pilliga to Goonoo sandstone forests, Brigalow Belt South Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Inland Floodplain Swamps
410	Swamp Paper-bark very tall shrubland wetland on sodic soils in the Pilliga Scrub region	Non-woody wetland	Non-woody wetland	2–5 years	Freshwater Wetlands	Inland Floodplain Swamps
416	Pilliga tank gilgai wetland sedgeland rushland, Brigalow Belt South Bioregion	Non-woody wetland	Non-woody wetland	2–5 year	Freshwater Wetlands	Inland Floodplain Swamps
446	Riparian tea tree – bottlebrush – pennywort forbland/ shrubland / wetland of montane creeks in the Brigalow Belt South Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Heathlands	Northern Montane Heaths
486	River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range	N/A	Flood-dependent woodland	>1 year	Forested Wetlands	Eastern Riverine Forests

PCT ID	PCT	BWS vegetation type	Hydro-ecological functional group ⁴⁴	ARI ⁴⁵	DPE-EHG vegetation formation ⁴⁶	DPE-EHG vegetation class ⁴⁷
497	Tea tree shrubland / sedgeland / forbland swamp wetland on the Liverpool Range, mainly Brigalow Belt South Bioregion	N/A	Flood-dependent shrubland wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
511	Queensland Bluegrass – Redleg Grass – Rats Tail Grass – spear grass – panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion	N/A	Floodplain	>10 years	Grassy Woodlands	Western Slopes Grassy Woodlands
574	Tea-tree riparian shrubland / heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion	N/A	Flood-dependent shrubland wetland	>1 year	Heathlands	Northern Montane Heaths
582	Sedgeland fens wetland of impeded drainage of the Nandewar Bioregion and New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
607	Montane bogs on the western fall of the New England Tableland Bioregion	Non-woody wetland	Non-woody wetland	>1 year	Freshwater Wetlands	Montane Bogs and Fens
628	Carbeen +/- Coolibah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	River red gum	Flood-dependent woodland	2–3 years	Grassy Woodlands	Floodplain Transition Woodlands

Chapter 6 appendices: Waterbirds

Appendix 6.1: Important waterbird assets in the Basin

The BWS (MDBA 2014) identifies 33 sites important for waterbirds across the WRPAs in the MDB (see Figure 1 below for locations of WRPAs). This includes 19 sites in NSW that are important for achieving sustainable populations of waterbirds through increases in total abundance, providing opportunities for colonial waterbird breeding and/or supporting shorebirds. Note that the Tallywalka system is in the Barwon–Darling watercourse WRPAs, not the NSW Murray–Lower Darling WRPAs as shown in the BWS.

Waterbird asset	WRPA	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance
Narran Lakes	Intersecting Streams (SW13)	X		X	X
Cuttaburra Channels	Intersecting Streams (SW13)	X		X	X
Paroo River Overflow Lakes	Intersecting Streams (SW13)	X		X	X
Yantabulla Swamp	Intersecting Streams (SW13)	X			
Upper Darling River	Barwon–Darling Watercourse (SW12)	X	X		
Tallywalka System	Barwon–Darling Watercourse (SW12)	X			
Gwydir Wetlands	Gwydir (SW15)	X		X	
Macquarie Marshes	Macquarie–Castlereagh (SW11)	X		X	X
Booligal Wetlands	Lachlan (SW10)	X		X	
Great Cumbung Swamp	Lachlan (SW10)	X		X	
Lake Brewster	Lachlan (SW10)	X		X	
Lake Cowal	Lachlan (SW10)			X	
Fivebough Swamp	Murrumbidgee (SW9)	X			X
Lowbidgee Floodplain	Murrumbidgee (SW9)	X	X	X	X
Gunbower–Koondrook–Perricoota	NSW Murray and Lower Darling (SW8)			X	
Menindee Lakes	NSW Murray and Lower Darling (SW8)	X		X	
River Murray and Euston Lakes	NSW Murray and Lower Darling (SW8)		X		
Darling Anabranch	NSW Murray and Lower Darling (SW8)	X			
Barmah–Millewa	NSW Murray and Lower Darling (SW8)	X		X	

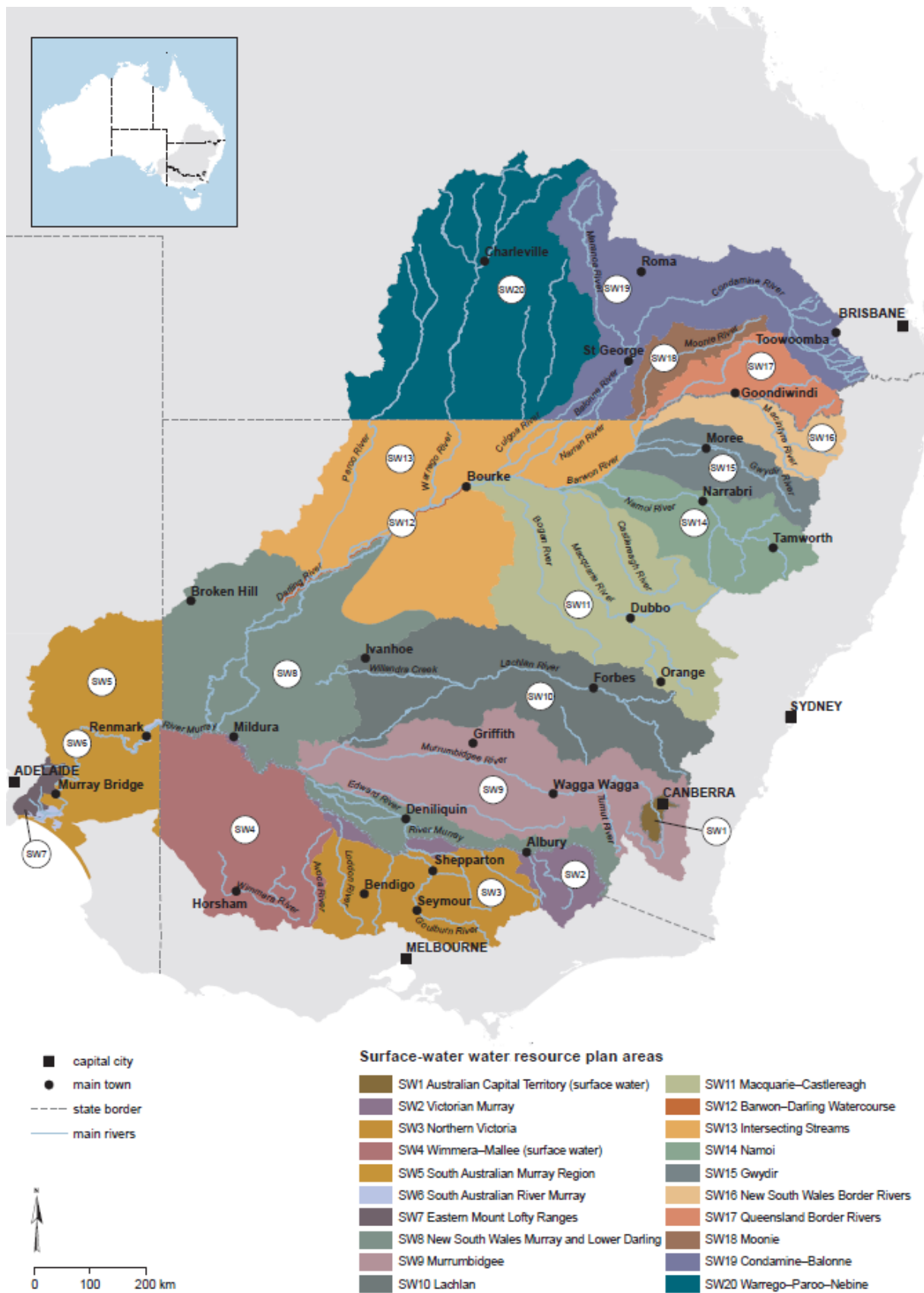


Figure 1 Locations of surface-water WRPAs in the MDB (from MDBA 2014)

Appendix 6.2: Description of the waterbird areas used for setting quantified objectives and targets in the NSW Long Term Water Plans⁴⁸

WRPA	BWS waterbird asset(s)	Spatial boundary of LTWP waterbird area	Source of information
NSW Border Rivers	None identified	NSW Border Rivers WRPA	MDBA (2014)
Gwydir	Gwydir Wetlands	Area west of Moree to include the main watercourses and floodplain of the Gingham, Lower Gwydir and Mehi–Mallowa watercourses	Thomas et al. (2014a), Gwydir River water sources
Namoi	None identified	Namoi WRPA boundary	MDBA (2014)
Intersecting Streams	Narran Lakes	Narran Lakes and Narran River	Thomas and Heath (2015), Narran River and Paroo River water sources
	Cuttaburra Channels Paroo Overflow Lakes Yantabulla Swamp	Far Western NSW to include Paroo Overflow Lakes, Cuttaburra Channels, Yantabulla Swamp	
Barwon–Darling Watercourse	Upper Darling River	Upper Darling Planning unit from Bourke–Louth	Kingsford et al. (2004), Barwon–Darling River water sources
	Tallywalka System	Wilcannia US to Lake Weatherill to include Tallywalka Lakes	
Macquarie–Castlereagh	Macquarie Marshes	Area to the north of Warren to include the East, South and North Marsh, Lower Macquarie and Marra Creek systems	Thomas, Cox and Love (2013), Macquarie River water sources
Lachlan	Lake Brewster (mid) Lake Cowal (mid)	The mid Lachlan region east of Forbes along the Lachlan River and its floodplain west to Lake Brewster and includes other major lakes including Lake Cowal and Lake Cargelligo	Thomas et al. 2017 (Lower Lachlan), Lachlan River water sources

⁴⁸ Note that the BWS does not identify any major waterbird assets in the NSW Border Rivers or Namoi WRPAs.

WRPA	BWS waterbird asset(s)	Spatial boundary of LTWP waterbird area	Source of information
	<p>Booligal Wetlands (lower)</p> <p>Great Cumbung Swamp (lower)</p>	The lower Lachlan was defined as the floodplain downstream of Lake Brewster to include the Lachlan River and its regulated and unregulated creeks including Willandra, Merrowie, Merrimajeel, Muggabah, Box Creek that feed the Booligal Wetlands and Great Cumbung Swamp north of the Redbank system in the Lowbidgee Floodplain	
Murrumbidgee	Lowbidgee Floodplain	Lowbidgee Floodplain west of Maude to Balranald to include the Nimmie–Caira, Redbank and Western Lakes systems Mid Murrumbidgee wetlands to include wetlands along river corridor between Hay and upstream of Wagga (note not identified as a BWS asset but recognised in LTWP planning)	Thomas et al. (2014b), Murrumbidgee River water sources
	Fivebough Swamp	Fivebough Swamp is defined by the Fivebough–Tuckerbil Swamp Ramsar boundary	Fivebough–Tuckerbil Ramsar boundary
NSW Murray and Lower Darling (and Victorian Murray/ SA River Murray)	Menindee Lakes Darling Anabranh	Lower Darling: from Renmark north along the Darling Anabranh to Menindee Lakes	Kingsford et al. 2004, NSW Murray–Lower Darling River water sources
	River Murray and Euston Lakes	Lower Murray: from Wakool Junction to NSW Chowilla Floodplain to include Euston Lakes	
	Gunbower–Koondrook–Perricoota Barmah–Millewa	Mid Murray: from Yarrawonga to Wakool Junction to include Millewa and Koondrook-Perricoota Forests	

Appendix 6.3: Waterbird species and groups identified in the NSW MDB

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Duck	Anatidae	Australasian shoveler	Anas rhynchotis		Wetland generalist	212
Duck	Anatidae	Australian shelduck	Tadorna tadornoides		Herbivore	207
Duck	Anatidae	Blue-billed duck	Oxyura australis	v	Open water forager	216
Duck	Anatidae	Chestnut teal	Anas castanea		Wetland generalist	210
Duck	Anatidae	Freckled duck	Stictonetta naevosa	v	Wetland generalist	214
Duck	Anatidae	Garganey	Spatula querquedula	J,C,R vagrant	Herbivore	209
Duck	Anatidae	Grey teal	Anas gracilis		Wetland generalist	211
Duck	Anatidae	Hardhead	Aythya australis		Open water forager	215
Duck	Anatidae	Musk duck	Biziura lobata		Open water forager	217
Duck	Anatidae	Northern shoveler	Spatula clypeata	Vagrant	Wetland generalist	905
Duck	Anatidae	Pacific black duck	Anas superciliosa		Wetland generalist	208
Duck	Anatidae	Pink-eared duck	Malacorhynchus membranaceus		Wetland generalist	213
Duck	Anatidae	Wandering whistling-duck	Dendrocygna arcuata		Herbivore	204
Duck	Jacanidae	Comb-crested jacana	Irediparra gallinacea	v	Emergent vegetation dependent	171
Duck	Podicipidae	Australasian grebe	Tachybaptus novaehollandiae		Open water forager	61

⁴⁹ Status/Other column: CE = critically endangered, E = endangered (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)), e = endangered, v = vulnerable (NSW *Biodiversity Conservation Act 2016* (BC Act)), J = JAMBA, C = CAMBA, R = RoKAMBA (listed under international migratory bird agreements Australia has with Japan, China and Republic of North Korea, respectively), x = colonial-nesting waterbird species that breed in the MBD. Nomenclature follows Christidis and Boles (2008). Spp. no. is the unique number given to each species in the Australian Fauna Directory (AFD). Vagrants are identified as per Birdlife Australia (2016) (note there were 3 other vagrant species (ringed plover, little stint, Wilson's phalarope) excluded from the list as only single records for these species were available).

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Duck	Podicipidae	Great crested grebe	Podiceps cristatus		Open water forager	60
Duck	Podicipidae	Hoary-headed grebe	Poliiocephalus poliocephalus		Open water forager	62
Duck	Rallidae	Australian spotted crane	Porzana fluminea		Emergent vegetation dependent	49
Duck	Rallidae	Baillon's crane	Porzana pusilla		Emergent vegetation dependent	50
Duck	Rallidae	Buff-banded rail	Gallirallus philippensis		Emergent vegetation dependent	46
Duck	Rallidae	Lewin's rail	Lewinia pectoralis		Emergent vegetation dependent	45
Duck	Rallidae	Spotless crane	Porzana tabuensis		Emergent vegetation dependent	51
Herbivore	Anatidae	Australian wood duck	Chenonetta jubata		Herbivore	202
Herbivore	Anatidae	Black swan	Cygnus atratus		Wetland generalist	203
Herbivore	Anatidae	Cape Barren goose	Cereopsis novaehollandiae		Herbivore	198
Herbivore	Anatidae	Cotton pygmy-goose	Nettapus coromandelianus	e	Herbivore	200
Herbivore	Anatidae	Green pygmy-goose	Nettapus pulchellus		Herbivore	201
Herbivore	Anatidae	Plumed whistling-duck	Dendrocygna eytoni		Herbivore	205
Herbivore	Anseranatidae	Magpie goose	Anseranas semipalmata	v	Herbivore	199
Herbivore	Rallidae	Black-tailed native-hen	Tribonyx ventralis		Wetland generalist	55
Herbivore	Rallidae	Dusky moorhen	Gallinula tenebrosa		Wetland generalist	56
Herbivore	Rallidae	Eurasian coot	Fulica atra		Open water forager	59
Herbivore	Rallidae	Purple swamphen	Porphyrio porphyrio		Emergent vegetation dependent	58
Large wader	Ardeidae	Australasian bittern	Botaurus poiciloptilus	E,e	Emergent vegetation dependent	197
Large wader	Ardeidae	Australian little bittern	Ixobrychus dubius		Emergent vegetation dependent	8703

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Large wader	Ardeidae	Cattle egret	Bubulcus ibis	x	Large wader	977
Large wader	Ardeidae	Eastern great egret	Ardea alba modesta	x	Large wader	8712
Large wader	Ardeidae	Intermediate egret	Ardea intermedia	x	Large wader	186
Large wader	Ardeidae	Little egret	Egretta garzetta	x	Large wader	185
Large wader	Ardeidae	Nankeen night-heron	Nycticorax caledonicus	x	Large wader	192
Large wader	Ardeidae	Pied heron	Egretta picata	x	Large wader	190
Large wader	Ardeidae	White-faced heron	Egretta novaehollandiae	x	Large wader	188
Large wader	Ardeidae	White-necked heron	Ardea pacifica	x	Large wader	189
Large wader	Ciconiidae	Black-necked stork	Ephippiorhynchus asiaticus	e	Large wader	183
Large wader	Gruidae	Brolga	Grus rubicunda	v	Large wader	177
Large wader	Threskiornithidae	Australian white ibis	Threskiornis molucca	x	Large wader	179
Large wader	Threskiornithidae	Glossy ibis	Plegadis falcinellus	x	Large wader	178
Large wader	Threskiornithidae	Royal spoonbill	Platalea regia	x	Large wader	181
Large wader	Threskiornithidae	Straw-necked ibis	Threskiornis spinicollis	x	Large wader	180
Large wader	Threskiornithidae	Yellow-billed spoonbill	Platalea flavipes	x	Large wader	182
Piscivore	Anhingidae	Australasian darter	Anhinga novaehollandiae	x	Open water forager	8731
Piscivore	Laridae	Australian gull-billed tern	Gelochelidon macrotarsa	C	Open water forager	8794
Piscivore	Laridae	Caspian tern	Hydroprogne caspia	J	Open water forager	112
Piscivore	Laridae	Franklin's gull	Leucophaeus pipixcan	Vagrant	Open water forager	885
Piscivore	Laridae	Pacific gull	Larus pacificus		Open water forager	126
Piscivore	Laridae	Silver gull	Chroicocephalus novaehollandiae		Open water forager	125

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Piscivore	Laridae	Whiskered tern	<i>Chlidonias hybrida</i>		Open water forager	110
Piscivore	Laridae	White-winged black tern	<i>Chlidonias leucopterus</i>	J,C,R	Open water forager	109
Piscivore	Pelicanidae	Australian pelican	<i>Pelecanus conspicillatus</i>	x	Open water forager	106
Piscivore	Phalacrocoracidae	Black-faced cormorant	<i>Phalacrocorax fuscescens</i>		Open water forager	98
Piscivore	Phalacrocoracidae	Great cormorant	<i>Phalacrocorax carbo</i>	x	Open water forager	96
Piscivore	Phalacrocoracidae	Little black cormorant	<i>Phalacrocorax sulcirostris</i>	x	Open water forager	97
Piscivore	Phalacrocoracidae	Little pied cormorant	<i>Microcarbo melanoleucos</i>	x	Open water forager	100
Piscivore	Phalacrocoracidae	Pied cormorant	<i>Phalacrocorax varius</i>	x	Open water forager	99
Shorebird	Charadriidae	Banded lapwing	<i>Vanellus tricolor</i>		Small wader: Australian resident shorebird	135
Shorebird	Charadriidae	Black-fronted dotterel	<i>Elseya melanops</i>		Small wader: Australian resident shorebird	144
Shorebird	Charadriidae	Double-banded plover	<i>Charadrius bicinctus</i>		Small wader: Migratory shorebird	140
Shorebird	Charadriidae	Grey plover	<i>Pluvialis squatarola</i>	J,C,R	Small wader: Migratory shorebird	136
Shorebird	Charadriidae	Grey-headed lapwing	<i>Vanellus cinereus</i>	Vagrant	Small wader: Australian resident shorebird	9918
Shorebird	Charadriidae	Inland dotterel	<i>Charadrius australis</i>		Small wader: Australian resident shorebird	145

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Shorebird	Charadriidae	Lesser sand plover	Charadrius mongolus	E,v J,C,R	Small wader: Migratory shorebird	139
Shorebird	Charadriidae	Masked lapwing	Vanellus miles		Small wader: Australian resident shorebird	133
Shorebird	Charadriidae	Oriental plover	Charadrius veredus	J,C,R	Small wader: Migratory shorebird	142
Shorebird	Charadriidae	Pacific golden plover	Pluvialis fulva	J,C,R	Small wader: Migratory shorebird	137
Shorebird	Charadriidae	Red-capped plover	Charadrius ruficapillus		Small wader: Australian resident shorebird	143
Shorebird	Charadriidae	Red-kneed dotterel	Erythrogonys cinctus		Small wader: Australian resident shorebird	132
Shorebird	Glareolidae	Australian pratincole	Stiltia isabella		Small wader: Australian resident shorebird	173
Shorebird	Glareolidae	Oriental pratincole	Glareola maldivarum	J,C,R	Small wader: Migratory shorebird	172
Shorebird	Recurvirostridae	Banded stilt	Cladorhynchus leucocephalus		Small wader: Australian resident shorebird	147
Shorebird	Recurvirostridae	Black-winged stilt	Himantopus leucocephalus		Small wader: Australian resident shorebird	146
Shorebird	Recurvirostridae	Red-necked avocet	Recurvirostra novaehollandiae		Small wader: Australian resident shorebird	148
Shorebird	Rostratulidae	Australian painted snipe	Rostratula australis	E,e	Small wader: Australian resident shorebird	170
Shorebird	Scolopacidae	Bar-tailed godwit	Limosa lapponica	CE,v J,C,R	Small wader: Migratory shorebird	153
Shorebird	Scolopacidae	Black-tailed godwit	Limosa limosa	v J,C,R	Small wader: Migratory shorebird	152

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Shorebird	Scolopacidae	Common greenshank	<i>Tringa nebularia</i>	J,C,R	Small wader: Migratory shorebird	158
Shorebird	Scolopacidae	Common sandpiper	<i>Actitis hypoleucos</i>	J,C,R	Small wader: Migratory shorebird	157
Shorebird	Scolopacidae	Curlew sandpiper	<i>Calidris ferruginea</i>	CE,e J,C,R	Small wader: Migratory shorebird	161
Shorebird	Scolopacidae	Great knot	<i>Calidris tenuirostris</i>	CE,v J,C,R	Small wader: Migratory shorebird	165
Shorebird	Scolopacidae	Latham's snipe	<i>Gallinago hardwickii</i>	J,R	Small wader: Migratory shorebird	168
Shorebird	Scolopacidae	Little curlew	<i>Numenius minutus</i>	J,C,R	Small wader: Migratory shorebird	151
Shorebird	Scolopacidae	Long-toed stint	<i>Calidris subminuta</i>	J,C,R	Small wader: Migratory shorebird	965
Shorebird	Scolopacidae	Marsh sandpiper	<i>Tringa stagnatilis</i>	J,C,R	Small wader: Migratory shorebird	159
Shorebird	Scolopacidae	Pectoral sandpiper	<i>Calidris melanotos</i>	J,R	Small wader: Migratory shorebird	978
Shorebird	Scolopacidae	Red knot	<i>Calidris canutus</i>	E J,C,R	Small wader: Migratory shorebird	164
Shorebird	Scolopacidae	Red-necked stint	<i>Calidris ruficollis</i>	J,C,R	Small wader: Migratory shorebird	162
Shorebird	Scolopacidae	Ruddy turnstone	<i>Arenaria interpres</i>	J,C,R	Small wader: Migratory shorebird	129
Shorebird	Scolopacidae	Ruff	<i>Philomachus pugnax</i>	J,C,R vagrant	Small wader: Migratory shorebird	934
Shorebird	Scolopacidae	Sanderling	<i>Calidris alba</i>	v J,C,R	Small wader: Migratory shorebird	166

Functional group	Family	Common name	Scientific name ⁴⁹	Status/ Other	Ecohydrological group	Spp. no.
Shorebird	Scolopacidae	Sharp-tailed sandpiper	<i>Calidris acuminata</i>	J,C,R	Small wader: Migratory shorebird	163
Shorebird	Scolopacidae	Whimbrel	<i>Numenius phaeopus</i>	J,C,R	Small wader: Migratory shorebird	150
Shorebird	Scolopacidae	White-rumped sandpiper	<i>Calidris fuscicollis</i>	Vagrant	Small wader: Migratory shorebird	849
Shorebird	Scolopacidae	Wood sandpiper	<i>Tringa glareola</i>	J,C,R	Small wader: Migratory shorebird	154

Appendix 6.4: Summary of data sources used to compile waterbird records for NSW WRPAs

Data source	Description
Atlas of NSW Wildlife (NSW BioNet Atlas) 1980–2016 (NSW BioNet 2016)	BioNet contains species sightings and systematic survey data for plants and animals, including waterbirds, across NSW. While extensive, the data is patchy, with records often focused around areas of human settlement or roads. This data has been provided by ecological consultants, research scientists and others (as part of the scientific licence procedure), other agencies (Forestry NSW, the Australian Museum, Australian Bird and Bat Banding Scheme) and the general public.
Atlas of Living Australia (ALA) 1980–2016 (ALA 2017)	The ALA is a national biodiversity database that provides comprehensive and accessible data to the public that is aggregated from multiple sources including NSW BioNet and Birdlife Australia datasets.
UNSW Annual Waterbird Survey of Eastern Australia (AWSEA) 1983–2016 (Porter et al. 2016; Kingsford et al. 2020)	The AWSEA was initiated by CSIRO, Commonwealth and state governments in 1983 and then coordinated by the NSW National Parks and Wildlife Service (NPWS) to survey waterbird populations and wetlands across eastern Australia in October each year. The 1983–2012 survey data was the basis for setting quantified targets in the BWS and for identifying waterbird assets (MDBA 2014).
UNSW Specified Environmental Asset (SEA) (formerly Hydrological Indicator Surveys (HIS)) 2010–2016 (Bino et al. 2015; Kingsford et al. 2013, 2020)	The MDBA funded additional annual aerial waterbird surveys in the 33 selected waterbird assets from 2014 onwards. These surveys replaced HIS surveys conducted from 2010–2014 and Murray channel site surveys conducted from 2007–2010.
Additional aerial survey datasets including Murray-Icon surveys (The Living Murray Program (TLM)) (2007–2009), NSW Riverina surveys (2014), NSW Western Rivers (2007–08), UNSW National Waterbird Survey in 2008 (Kingsford et al. 2013, 2020) and NSW Wetland Recovery Program (2007–08) (Spencer et al. 2010)	The AWSEA program does not cover large lakes and wetland systems that provide waterbird habitat in the NSW Murray–Lower Darling (Darling Anabranch), Intersecting Streams (Narran Lakes, Yantabulla Swamp), Gwydir (Gwydir Wetlands) and Lachlan (Booligal, Cumbung, Lake Brewster, Lake Cowal) WRPAs. Additional systematic aerial survey data for other important waterbird sites outside of the AWSEA survey bands in the NSW MDB (see Figure B.4 in Part B), was available from 2007 onwards through MDBA’s TLM program (Barmah–Millewa, Gunbower–Koondrook–Perricoota only), National Waterbird Survey (all sites in 2008 only), NSW Wetland Recovery Program (Gwydir Wetlands in 2007–08 only), NSW Riverina surveys (River Murray in 2009), NSW Western Rivers surveys (Narran Lakes, Yantabulla Swamp, Paroo Lakes in 2007–08) and the MDBA funded HIS (all sites 2010–2012) and Targeted Wetlands (all sites 2013) programs.

Data source	Description
<p>Ground surveys by former NSW Office of Environment and Heritage (OEH) and partners (including the Commonwealth Environmental Water Office Long Term Intervention Monitoring (LTIM) project) 2007–2016 (Webster 2007a, 2007b, 2007c, 2007d, 2008a, 2008b, 2008c, 2008d, 2009a, 2009b, 2009c; 2009d, Spencer et al. 2014, 2016)</p>	<p>The former OEH (now DPE–EHG) and partners including the LTIM conduct ground-based surveys of key wetland regions in the NSW MDB. The timing of the ground surveys aligns where possible with the UNSW aerial survey programs. The ground survey data spans from 5–7 years in length, depending on the wetland region.</p>
<p>Colonial waterbird breeding records collated by Spencer et al. 2010, Spencer 2017 and Brandis 2010 including NPWS survey records</p>	<p>The former OEH conducted additional ground and aerial event-based surveys of waterbird breeding sites in key wetlands in NSW during the 2007–2017 period (Spencer 2017). Long-term records of waterbird breeding in the NSW MDB have been recorded by Brandis (2010) (and Spencer (2010) in the Gwydir Wetlands).</p>

Data source	Gwydir	Macquarie–Castlereagh	Lachlan	NSW Border Rivers	Barwon–Darling	Namoi	Murrumbidgee	NSW Murray–Lower Darling	Intersecting Streams
Atlas of NSW Wildlife (NSW BioNet) 1980–2016 (NSW BioNet 2016)	All WPRAs								
Atlas of Living Australia (ALA) 1980–2016 (ALA 2017)	All WPRAs								
UNSW AWSEA 1983–2016 (Porter et al. 2016; Kingsford et al. 2020)	No coverage	Upper (top third of the Macquarie Marshes) and Lower WRPA	Limited coverage (northern part of WRPA does cover mid Lachlan waterbird area)	Limited coverage (northern part of WRPA and Qld Border Rivers)	Tallywalka Lakes, Upper Darling River	Upper Namoi	Lowbidgee Wetlands, mid Murrumbidgee Wetlands and Fivebough–Tuckerbil Swamp	River Murray and Euston Lakes, Menindee Lakes	Paroo River Overflow Lakes, Cuttaburra Channels
UNSW SEA (formerly HIS) 2010–2016 (Bino et al. 2015; Kingsford et al. 2013, 2020)	Gwydir Wetlands	Macquarie Marshes	Lake Brewster, Lake Cowal, Booligal Wetlands, Great Cumbung Swamp, Banar Lake, Lake Cargelligo, Bogandillon Swamp	No coverage	Tallywalka Lakes, Upper Darling River	No coverage	Lowbidgee Wetlands and Fivebough–Tuckerbil Swamp	Menindee Lakes, Darling Anabranche, Gunbower–Koondrook–Perricoota, Barmah–Millewa	Paroo River Overflow Lakes, Yantabulla Swamp, Narran Lakes

Data source	Gwydir	Macquarie– Castlereagh	Lachlan	NSW Border Rivers	Barwon– Darling	Namoi	Murrumbidgee	NSW Murray– Lower Darling	Intersecting Streams
UNSW National Waterbird Survey 2008 (Kingsford et al. 2009)	Gwydir Wetlands, Mother of Ducks Lagoon	Macquarie Marshes	Lake Brewster, Lake Cowal, Booligal Wetlands, Great Cumbung Swamp	No coverage	Tallywalka wetlands, Upper Darling River	Upper and Lower Namoi	Lower Murrumbidgee Floodplain and Fivebough–Tuckerbil Swamp	Menindee Lakes, River Murray and Euston Lakes, Darling Anabranh, Barmah–Millewa	Narran Lakes
Additional aerial survey datasets including Murray-Iron surveys (TLM) (2007–09), NSW Riverina surveys (2014), NSW Western Rivers (2007–08), UNSW National Waterbird Survey in 2008 (Kingsford et al. 2013, 2020) and NSW Wetland Recovery Program (2007–08) (Spencer et al. 2010)	Gwydir Wetlands	Macquarie Marshes	Lake Brewster, Lake Cowal, Booligal Wetlands, Great Cumbung Swamp	No coverage	No coverage	No coverage	Lower Murrumbidgee Floodplain and Fivebough–Tuckerbil Swamp	Gunbower–Koondrook–Perricoota, Barmah–Millewa, Darling Anabranh	Narran Lakes, Paroo Lakes, Yantabulla Swamp

Data source	Gwydir	Macquarie–Castlereagh	Lachlan	NSW Border Rivers	Barwon–Darling	Namoi	Murrumbidgee	NSW Murray–Lower Darling	Intersecting Streams
Ground surveys by former NSW OEH and partners (including the LTIM project) 2007–2016 (Webster 2007a, 2007b, 2007c, 2007d, 2008a, 2008b, 2008c, 2008d, 2009a, 2009b, 2009c; 2009d; Spencer et al. 2014, 2016)	Gwydir Wetlands (2007–2016)	Macquarie Marshes (2012–2016)	Lake Brewster, Lake Cowal, Great Cumbung Swamp (2016 only)	No coverage	No coverage	No coverage	Lower Murrumbidgee Floodplain (2008–2016) and Fivebough–Tuckerbil Swamp (2012–2016), mid Murrumbidgee wetlands (2012–2016)	Barmah–Millewa (1999–2004, 2007–2016), Darling Anabanch	Narran Lakes (2012–2016), Toorale wetlands (2015–16)
Colonial waterbird breeding records collated by Spencer et al. (2010), Spencer (2017) and Brandis (2010) including NPWS survey records	Gwydir Wetlands	Macquarie Marshes	Lower and mid Lachlan (including Lake Brewster, Lake Cowal, Booligal Wetlands, Great Cumbung Swamp)	Limited records	Limited records	Limited records	Lowbidgee Floodplain, mid Murrumbidgee Wetlands	NSW Murray and Lower Darling (including Menindee Lakes, Darling Anabanch, Gunbower–Koondrook–Perricoota, Barmah–Millewa)	Paroo River Overflow Lakes, Yantabulla Swamp, Narran Lakes

Appendix 6.5: Proposed template and supporting information for waterbird objectives and targets

Ecological objective		Targets		
		2024	2029	2039 [^]
WB1	Maintain the number and type of waterbird species	Maintain a 5-year rolling average of x or more waterbird species across the 5 functional groups in the waterbird area	Identify at least x waterbird species in the waterbird area in a 10-year period	At least x waterbird species observed in the waterbird area in a 20-year period
WB2	Increase total waterbird abundance across all functional groups	Total abundance of the 5 functional groups maintained in the waterbird area compared to the 2012–2016 period	Total waterbird abundance increased by 20–25% in the waterbird area compared to the 2012–2016 period, with increases in all functional groups	Maintain or increase total waterbird abundance in the waterbird area compared to the 10-year target, with increases in all functional groups
WB3	Increase opportunities for non-colonial waterbird breeding	Total abundance of non-colonial waterbirds in the waterbird area maintained and breeding recorded in at least x non-colonial waterbird species compared to the 5-year 2012–2016 baseline period	Total abundance of non-colonial waterbirds in the waterbird area increased by 20–25% with breeding detected in at least x non-colonial waterbird species compared to the 5-year 2012–2016 baseline period	Maintain or increase total abundance of non-colonial waterbirds in the waterbird area compared to the 10-year target, with breeding detected in at least x non-colonial waterbird species
WB4	Increase opportunities for colonial waterbird breeding	Support active waterbird colonies in the waterbird area by maintaining the water depth and duration of flooding (as required) to support breeding through to completion (from egg laying through to fledging including post-fledgling care) and maintain duration of flooding in key foraging habitats to enhance breeding success and the survival of young In line with natural cues initiate and support small-scale colonial waterbird breeding in the waterbird area in x colony sites in 2 out of 5 years	In line with natural cues initiate and support small-scale colonial waterbird breeding in the waterbird area in x colony sites in 3 out of 10 years	In line with natural cues, initiate and support small-scale colonial waterbird breeding in the waterbird area in x colony sites in 3 out of 10 years
WB5	Maintain the extent and improve condition of waterbird habitats	Maintain extent and improve condition of nesting vegetation, including x and x , in known breeding locations in the waterbird area Maintain or increase extent and improve condition of waterbird foraging habitats and potential colonial waterbird breeding locations in the waterbird area (to be evaluated under targets set for native vegetation)		

Supporting information for quantified waterbird targets

WRPA	LTWP waterbird area	Number of waterbird species identified through annual spring surveys 2012–2016 ⁵⁰				Number of waterbird species identified through all records 1992–2012 ⁵⁰		Priority colony vegetation types
		Survey program coverage ⁴²	Rolling 5-year average	Median (min–max)	Minimum number of non-colonial breeding species	Number of species identified over 10-year periods	Number of species identified over 20-year period	
Gwydir	Gwydir wetlands	MDBA, OEH	41	43 (36–46)	17	41–59	60	Lignum, cumbungi, river cooba, river red gum, coolibah
Macquarie	Macquarie Marshes	AWSEA, MDBA, OEH	41	41 (33–47)	14	62–65	69	Common reed, lignum, cumbungi, river cooba, river red gum
Lachlan	Mid Lachlan	MDBA	32	32 (25–37)	7	73–77	78	Lignum, river cooba, river red gum
	Lower Lachlan	MDBA	24	24 (15–34)	3	46–49	56	Common reed, lignum, cumbungi, river cooba, river red gum
Murrumbidgee	Lowbidgee Floodplain	AWSEA, MDBA, OEH	44	44 (38–48)	11	51–56	58	Common reed, lignum, cumbungi, river cooba, river red gum
	Mid Murrumbidgee	AWSEA, OEH	25	24 (22–27)	5	51–56	61	Cumbungi, river red gum
	Fivebough–Tuckerbil	AWSEA, MDBA, OEH	42	44 (35–48)	8	68–73	76	Not applicable

⁵⁰ Not including vagrant species (see Appendix 2 and species list for each WRPA below). Aerial survey programs coordinated by UNSW include the AWSEA and MDBA funded surveys. OEH survey program consisted of complementary ground surveys. Note that the Namoi and NSW Border Rivers WRPAs have limited waterbird survey coverage. N/A indicates insufficient records.

WRPA	LTWP waterbird area	Number of waterbird species identified through annual spring surveys 2012–2016 ⁵⁰				Number of waterbird species identified through all records 1992–2012 ⁵⁰		Priority colony vegetation types
		Survey program coverage ⁴²	Rolling 5-year average	Median (min–max)	Minimum number of non-colonial breeding species	Number of species identified over 10-year periods	Number of species identified over 20-year period	
NSW Murray–Lower Darling	Mid Murray	AWSEA, MDBA, OEH-TLM	23	24 (14–30)	1	67–71	74	Common reed, lignum, cumbungi, river red gum, giant rush, black box
	Lower Murray	AWSEA, MDBA	18	19 (7–24)	N/A	53–60	61	Lignum, river cooba, black-box, river red gum
	Lower Darling	AWSEA, MDBA	25	27 (17–28)	N/A	52–66	68	Lignum, river cooba, black-box, river red gum
Intersecting Streams	Narran Lakes	MDBA, OEH	22	16 (4–37)	1	43–58	60	Lignum, cumbungi, river cooba, river red gum
	Far Western	AWSEA, MDBA	21	22 (5–33)	2	53–55	60	Lignum, river cooba, river red gum
Barwon-Darling	Upper Darling	AWSEA	10	9 (5–18)	N/A	41–46	51	Lignum, cumbungi, river red gum, river cooba
	Tallywalka System	AWSEA, MDBA	12	12 (0–23)	N/A	42–43	51	Not applicable
Namoi	N/A	AWSEA	16	17 (10–21)	N/A	29–34	38	Not applicable
NSW Border Rivers	N/A	AWSEA (limited)	6	6 (0–16)	N/A	52	59	Not applicable

Waterbird species lists for each WRPA⁵¹

Gwydir WRPA

Common name	Scientific name (status or listing)	Gwydir wetlands records 1992–2012
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	
Australasian darter	<i>Anhinga novaehollandiae</i>	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X
Australasian shoveler	<i>Anas rhynchotis</i>	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X
Australian little bittern	<i>Ixobrychus dubius</i>	
Australian painted snipe	<i>Rostratula australis</i> (E,e)	X
Australian pelican	<i>Pelecanus conspicillatus</i>	X
Australian pratincole	<i>Stiltia isabella</i>	
Australian spotted crane	<i>Porzana fluminea</i>	X
Australian white ibis	<i>Threskiornis molucca</i>	X
Australian wood duck	<i>Chenonetta jubata</i>	X
Baillon's crane	<i>Porzana pusilla</i>	X
Banded lapwing	<i>Vanellus tricolor</i>	X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)	
Black swan	<i>Cygnus atratus</i>	X
Black-fronted dotterel	<i>Elseya melanops</i>	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)	X
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)	
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X
Brolga	<i>Grus rubicunda</i> (v)	X
Buff-banded rail	<i>Gallirallus philippensis</i>	X
Caspian tern	<i>Hydroprogne caspia</i> (J)	X
Cattle egret	<i>Bubulcus ibis</i>	X
Chestnut teal	<i>Anas castanea</i>	
Comb-crested jacana	<i>Irediparra gallinacea</i> (v)	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X

⁵¹ Status or listing: CE = critically endangered, E = endangered (EPBC Act), e = endangered, v = vulnerable (BC Act), J = JAMBA, C = CAMBA, R = RoKAMBA (listed under international migratory bird agreements Australia has with Japan, China and Republic of North Korea, respectively).

Common name	Scientific name (status or listing)	Gwydir wetlands records 1992–2012
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)	
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)	
Dusky moorhen	<i>Gallinula tenebrosa</i>	X
Eastern great egret	<i>Ardea alba modesta</i>	X
Eurasian coot	<i>Fulica atra</i>	X
Freckled duck	<i>Stictonetta naevosa</i> (v)	X
Glossy ibis	<i>Plegadis falcinellus</i>	X
Great cormorant	<i>Phalacrocorax carbo</i>	X
Great crested grebe	<i>Podiceps cristatus</i>	X
Grey teal	<i>Anas gracilis</i>	X
Hardhead	<i>Aythya australis</i>	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X
Intermediate egret	<i>Ardea intermedia</i>	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)	X
Lewin's rail	<i>Lewinia pectoralis</i>	
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X
Little curlew	<i>Numenius minutus</i> (J,C,R)	
Little egret	<i>Egretta garzetta</i>	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X
Magpie goose	<i>Anseranas semipalmata</i> (v)	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X
Masked lapwing	<i>Vanellus miles</i>	X
Musk duck	<i>Biziura lobata</i>	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X
Oriental pratincole	<i>Glareola maldivarum</i> (J,C,R)	
Pacific black duck	<i>Anas superciliosa</i>	X
Pectoral sandpiper	<i>Calidris melanotos</i> (J,R)	
Pied cormorant	<i>Phalacrocorax varius</i>	X
Pied heron	<i>Egretta picata</i>	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X
Red-capped plover	<i>Charadrius ruficapillus</i>	
Red-kneed dotterel	<i>Erythrogonyx cinctus</i>	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X

Common name	Scientific name (status or listing)	Gwydir wetlands records 1992–2012
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)	
Royal spoonbill	<i>Platalea regia</i>	X
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X
Spotless crane	<i>Porzana tabuensis</i>	
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>	X
Whiskered tern	<i>Chlidonias hybrida</i>	X
White-faced heron	<i>Egretta novaehollandiae</i>	X
White-necked heron	<i>Ardea pacifica</i>	X
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)	
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)	
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X

Macquarie–Castlereagh WRPA

Common name	Scientific name (status or listing)	Macquarie Marshes records 1992–2012
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	X
Australasian darter	<i>Anhinga novaehollandiae</i>	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X
Australasian shoveler	<i>Anas rhynchotis</i>	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X
Australian little bittern	<i>Ixobrychus dubius</i>	X
Australian painted snipe	<i>Rostratula australis</i> (E,e)	X
Australian pelican	<i>Pelecanus conspicillatus</i>	X
Australian pratincole	<i>Stiltia Isabella</i>	
Australian shelduck	<i>Tadorna tadornoides</i>	X
Australian spotted crane	<i>Porzana fluminea</i>	X
Australian white ibis	<i>Threskiornis Molucca</i>	X
Australian wood duck	<i>Chenonetta jubata</i>	X
Baillon's crane	<i>Porzana pusilla</i>	X
Banded lapwing	<i>Vanellus tricolor</i>	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>	X
Black swan	<i>Cygnus atratus</i>	X
Black-fronted dotterel	<i>Elseyornis melanops</i>	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)	X

Common name	Scientific name (status or listing)	Macquarie Marshes records 1992–2012
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)	
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X
black-winged stilt	<i>Himantopus leucocephalus</i>	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X
Brolga	<i>Grus rubicunda</i> (v)	X
Buff-banded rail	<i>Gallirallus philippensis</i>	X
Cape Barren goose	<i>Cereopsis novaehollandiae</i>	
Caspian tern	<i>Hydroprogne caspia</i> (J)	X
Cattle egret	<i>Bubulcus ibis</i>	X
Chestnut teal	<i>Anas castanea</i>	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)	
Cotton pygmy-goose	<i>Nettapus coromandelianus</i> (e)	X
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)	
Double-banded plover	<i>Charadrius bicinctus</i>	
Dusky moorhen	<i>Gallinula tenebrosa</i>	X
Eastern great egret	<i>Ardea alba modesta</i>	X
Eurasian coot	<i>Fulica atra</i>	X
Freckled duck	<i>Stictonetta naevosa</i> (v)	X
Garganey	<i>Spatula querquedula</i> (J,C,R VAGRANT)	
Glossy ibis	<i>Plegadis falcinellus</i>	X
Great cormorant	<i>Phalacrocorax carbo</i>	X
Great crested grebe	<i>Podiceps cristatus</i>	X
Green pygmy-goose	<i>Nettapus pulchellus</i>	X
Grey teal	<i>Anas gracilis</i>	X
Hardhead	<i>Aythya australis</i>	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X
Intermediate egret	<i>Ardea intermedia</i>	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)	X
Lewin's rail	<i>Lewinia pectoralis</i>	X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X
Little egret	<i>Egretta garzetta</i>	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X
Magpie goose	<i>Anseranas semipalmata</i> (v)	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X
Masked lapwing	<i>Vanellus miles</i>	X

Common name	Scientific name (status or listing)	Macquarie Marshes records 1992–2012
Musk duck	<i>Biziura lobata</i>	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X
Northern shoveler	<i>Spatula clypeata</i> (VAGRANT)	
Pacific black duck	<i>Anas superciliosa</i>	X
Pacific gull	<i>Larus pacificus</i>	
Pied cormorant	<i>Phalacrocorax varius</i>	X
Pied heron	<i>Egretta picata</i>	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X
Red-capped plover	<i>Charadrius ruficapillus</i>	
Red-kneed dotterel	<i>Erythrogonys cinctus</i>	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)	
Royal spoonbill	<i>Platalea regia</i>	X
Ruff	<i>Philomachus pugnax</i> (J,C,R,VAGRANT)	
Sanderling	<i>Calidris alba</i> (J,C,R,v)	
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X
Spotless crane	<i>Porzana tabuensis</i>	X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>	X
Whiskered tern	<i>Chlidonias hybrida</i>	X
White-faced heron	<i>Egretta novaehollandiae</i>	X
White-necked heron	<i>Ardea pacifica</i>	X
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)	
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X

Lachlan WRPA

Common name	Scientific name	Lower Lachlan 1992–2012 records	Mid Lachlan 1992–2012 records
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	X	X
Australasian darter	<i>Anhinga novaehollandiae</i>	X	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X	X
Australasian shoveler	<i>Anas rhynchotis</i>	X	X

Common name	Scientific name	Lower Lachlan 1992–2012 records	Mid Lachlan 1992–2012 records
Australian gull-billed Tern	<i>Gelochelidon macrotarsa</i>	X	X
Australian little bittern	<i>Ixobrychus dubius</i>	X	X
Australian painted snipe	<i>Rostratula australis</i> (E,e)		X
Australian pelican	<i>Anhinga novaehollandiae</i>	X	X
Australian pratincole	<i>Tachybaptus novaehollandiae</i>	X	X
Australian shelduck	<i>Anas rhynchotis</i>	X	X
Australian spotted crane	<i>Porzana fluminea</i>		X
Australian white ibis	<i>Threskiornis molucca</i>	X	X
Australian wood duck	<i>Chenonetta jubata</i>	X	X
Baillon's crane	<i>Porzana pusilla</i>		X
Banded lapwing	<i>Vanellus tricolor</i>	X	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>		X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)		X
Black swan	<i>Cygnus atratus</i>	X	X
Black-fronted dotterel	<i>Elseyornis melanops</i>	X	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)		
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)		X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X	X
Brolga	<i>Grus rubicunda</i> (v)	X	X
Buff-banded rail	<i>Gallirallus philippensis</i>		X
Caspian tern	<i>Hydroprogne caspia</i> (J)	X	X
Cattle egret	<i>Bubulcus ibis</i>		X
Chestnut teal	<i>Anas castanea</i>	X	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X	X
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)		X
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)		X
Dusky moorhen	<i>Gallinula tenebrosa</i>	X	X
Eastern great egret	<i>Ardea alba modesta</i>	X	X
Eurasian coot	<i>Fulica atra</i>	X	X

Common name	Scientific name	Lower Lachlan 1992–2012 records	Mid Lachlan 1992–2012 records
Freckled duck	<i>Stictonetta naevosa</i> (v)	X	X
Glossy ibis	<i>Plegadis falcinellus</i>	X	X
Great cormorant	<i>Phalacrocorax carbo</i>	X	X
Great crested grebe	<i>Podiceps cristatus</i>	X	X
Grey teal	<i>Anas gracilis</i>	X	X
Hardhead	<i>Aythya australis</i>	X	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X	X
Intermediate egret	<i>Ardea intermedia</i>	X	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)		X
Lewin's rail	<i>Lewinia pectoralis</i>		X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X	X
Little curlew	<i>Numenius minutus</i> (J,C,R)		X
Little egret	<i>Egretta garzetta</i>	X	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X	X
Long-toed stint	<i>Calidris subminuta</i> (J,C,R)		X
Magpie goose	<i>Anseranas semipalmata</i> (v)	X	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X	X
Masked lapwing	<i>Vanellus miles</i>	X	X
Musk duck	<i>Biziura lobata</i>	X	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X	X
Pacific black duck	<i>Anas superciliosa</i>	X	X
Pectoral sandpiper	<i>Calidris melanotos</i> (J,R)		X
Pied cormorant	<i>Phalacrocorax varius</i>	X	X
Pied heron	<i>Egretta picata</i>		X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X	X
Red-capped plover	<i>Charadrius ruficapillus</i>	X	X
Red-kneed dotterel	<i>Erythrogonyx cinctus</i>	X	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)		X
Royal spoonbill	<i>Platalea regia</i>	X	X
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X	X

Common name	Scientific name	Lower Lachlan 1992–2012 records	Mid Lachlan 1992–2012 records
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X	X
Spotless crane	<i>Porzana tabuensis</i>		X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>		X
Whimbrel	<i>Numenius phaeopus</i> (J,C,R)		X
Whiskered tern	<i>Chlidonias hybrida</i>	X	X
White-faced heron	<i>Egretta novaehollandiae</i>	X	X
White-necked heron	<i>Ardea pacifica</i>	X	X
White-rumped sandpiper	<i>Calidris fuscicollis</i> (VAGRANT)		X
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)		X
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)		X
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X	X

Murrumbidgee WRPA

Common name	Scientific name (status or listing)	Lowbidgee Floodplain 1992–2012 records	Mid Murrumbidgee 1992–2012 records	Fivebough -Tuckerbil 1992–2012 records
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	X		X
Australasian darter	<i>Anhinga novaehollandiae</i>	X	X	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X	X	X
Australasian shoveler	<i>Anas rhynchotis</i>	X	X	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X	X	X
Australian little bittern	<i>Ixobrychus dubius</i>		X	X
Australian painted snipe	<i>Rostratula australis</i> (E,e)		X	X
Australian pelican	<i>Anhinga novaehollandiae</i>	X	X	X
Australian pratincole	<i>Tachybaptus novaehollandiae</i>	X	X	X
Australian shelduck	<i>Anas rhynchotis</i>	X	X	X

Common name	Scientific name (status or listing)	Lowbidgee Floodplain 1992–2012 records	Mid Murrumbidgee 1992–2012 records	Fivebough -Tuckerbil 1992–2012 records
Australian spotted crane	<i>Porzana fluminea</i>	X	X	X
Australian white ibis	<i>Threskiornis Molucca</i>	X	X	X
Australian wood duck	<i>Chenonetta jubata</i>	X	X	X
Baillon's crane	<i>Porzana pusilla</i>	X	X	X
Banded lapwing	<i>Vanellus tricolor</i>	X	X	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>	X		X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)			X
Black swan	<i>Cygnus atratus</i>	X	X	X
Black-fronted dotterel	<i>Elseyornis melanops</i>	X	X	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)			
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)			X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X	X	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X	X	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X	X	X
Brolga	<i>Grus rubicunda</i> (v)		X	X
Buff-banded rail	<i>Gallirallus philippensis</i>	X		X
Cape Barren goose	<i>Cereopsis novaehollandiae</i>			
Caspian tern	<i>Hydroprogne caspia</i> (J)	X	X	X
Cattle egret	<i>Bubulcus ibis</i>	X	X	X
Chestnut teal	<i>Anas castanea</i>	X	X	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X		X
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)			
Cotton pygmy-goose	<i>Nettapus coromandelianus</i> (e)			
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)			X
Double-banded plover	<i>Charadrius bicinctus</i>			X
Dusky moorhen	<i>Gallinula tenebrosa</i>	X	X	X

Common name	Scientific name (status or listing)	Lowbidgee Floodplain 1992– 2012 records	Mid Murrumbidgee 1992–2012 records	Fivebough -Tuckerbil 1992– 2012 records
Eastern great egret	<i>Ardea alba modesta</i>	X	X	X
Eurasian coot	<i>Fulica atra</i>	X	X	X
Freckled duck	<i>Stictonetta naevosa</i> (v)	X	X	X
Glossy ibis	<i>Plegadis falcinellus</i>	X	X	X
Great cormorant	<i>Phalacrocorax carbo</i>	X	X	X
Great crested grebe	<i>Podiceps cristatus</i>	X	X	
Grey plover	<i>Pluvialis squatarola</i> (J,C,R)			
Grey teal	<i>Anas gracilis</i>	X	X	X
Hardhead	<i>Aythya australis</i>	X	X	X
Hoary-headed grebe	<i>Poliocephalus poliocephalus</i>	X	X	X
Inland dotterel	<i>Charadrius australis</i>		X	
Intermediate egret	<i>Ardea intermedia</i>	X	X	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)		X	X
Lewin's rail	<i>Lewinia pectoralis</i>			
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X	X	X
Little curlew	<i>Numenius minutus</i> (J,C,R)			
Little egret	<i>Egretta garzetta</i>	X	X	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X	X	X
Long-toed stint	<i>Calidris subminuta</i> (J,C,R)			X
Magpie goose	<i>Anseranas semipalmata</i> v		X	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)		X	X
Masked lapwing	<i>Vanellus miles</i>	X	X	X
Musk duck	<i>Biziura lobata</i>	X	X	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X	X	X
Oriental plover	<i>Charadrius veredus</i> (J,C,R)			
Oriental pratincole	<i>Glareola maldivarum</i> (J,C,R)			X
Pacific black duck	<i>Anas superciliosa</i>	X	X	X
Pacific golden plover	<i>Pluvialis fulva</i> (J,C,R)			

Common name	Scientific name (status or listing)	Lowbidgee Floodplain 1992–2012 records	Mid Murrumbidgee 1992–2012 records	Fivebough -Tuckerbil 1992–2012 records
Pectoral sandpiper	<i>Calidris melanotos</i> (J,R)			X
Pied cormorant	<i>Phalacrocorax varius</i>	X	X	X
Pied heron	<i>Egretta picata</i>	X		
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X	X	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X	X	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X	X	X
Red knot	<i>Calidris canutus</i> (J,C,R,E)			X
Red-capped plover	<i>Charadrius ruficapillus</i>	X	X	X
Red-kneed dotterel	<i>Erythronyx cinctus</i>	X	X	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X	X	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)			X
Royal spoonbill	<i>Platalea regia</i>	X	X	X
Ruddy turnstone	<i>Arenaria interpres</i> (J,C,R)			X
Ruff	<i>Philomachus pugnax</i> (J,C,R VAGRANT)			
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X	X	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X	X	X
Spotless crane	<i>Porzana tabuensis</i>		X	X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X	X	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>			X
Whiskered tern	<i>Chlidonias hybrida</i>	X	X	X
White-faced heron	<i>Egretta novaehollandiae</i>	X	X	X
White-necked heron	<i>Ardea pacifica</i>	X	X	X
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)			X
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)			X
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X	X	X

NSW Murray–Lower Darling WRP

Common name	Scientific name (status or listing)	Mid Murray 1992–2012 records	Lower Murray 1992–2012 records	Lower Darling 1992–2012 records
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	X		X
Australasian darter	<i>Anhinga novaehollandiae</i>	X	X	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X	X	X
Australasian shoveler	<i>Anas rhynchotis</i>	X	X	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X	X	X
Australian little bittern	<i>Ixobrychus dubius</i>	X	X	
Australian painted snipe	<i>Rostratula australis</i> (E,e)	X	X	
Australian pelican	<i>Anhinga novaehollandiae</i>	X	X	X
Australian pratincole	<i>Tachybaptus novaehollandiae</i>			X
Australian shelduck	<i>Anas rhynchotis</i>	X	X	X
Australian spotted crake	<i>Porzana fluminea</i>	X	X	X
Australian white ibis	<i>Threskiornis Molucca</i>	X	X	X
Australian wood duck	<i>Chenonetta jubata</i>	X	X	X
Baillon's crake	<i>Porzana pusilla</i>	X	X	X
Banded lapwing	<i>Vanellus tricolor</i>	X	X	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>	X	X	X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)			
Black swan	<i>Cygnus atratus</i>	X	X	X
Black-faced cormorant	<i>Phalacrocorax fuscescens</i>	X		

Common name	Scientific name (status or listing)	Mid Murray 1992–2012 records	Lower Murray 1992–2012 records	Lower Darling 1992–2012 records
Black-fronted dotterel	<i>Elseyornis melanops</i>	X	X	X
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)	X		X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X	X	X
Black-winged Stilt	<i>Himantopus leucocephalus</i>	X	X	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X	X	X
Brolga	<i>Grus rubicunda</i> (v)	X		X
Buff-banded rail	<i>Gallirallus philippensis</i>	X	X	X
Cape Barren goose	<i>Cereopsis novaehollandiae</i>	X		
Caspian tern	<i>Hydroprogne caspia</i> (J)	X	X	X
Cattle egret	<i>Bubulcus ibis</i>	X		X
Chestnut teal	<i>Anas castanea</i>	X	X	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X	X	X
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)	X		X
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)	X	X	X
Double-banded plover	<i>Charadrius bicinctus</i>	X		X
Dusky moorhen	<i>Gallinula tenebrosa</i>	X	X	X
Eastern Great egret	<i>Ardea alba modesta</i>	X	X	X
Eurasian coot	<i>Fulica atra</i>	X	X	X
Franklin's gull	<i>Leucophaeus pipixcan</i> (VAGRANT)			

Common name	Scientific name (status or listing)	Mid Murray 1992–2012 records	Lower Murray 1992–2012 records	Lower Darling 1992–2012 records
Freckled duck	<i>Stictonetta naevosa</i> (v)	X	X	X
Glossy ibis	<i>Plegadis falcinellus</i>	X	X	X
Great cormorant	<i>Phalacrocorax carbo</i>	X	X	X
Great crested grebe	<i>Podiceps cristatus</i>	X	X	X
Great knot	<i>Calidris tenuirostris</i> (J,C,R,CE,v)			
Grey plover	<i>Pluvialis squatarola</i> (J,C,R)			
Grey teal	<i>Anas gracilis</i>	X	X	X
Hardhead	<i>Aythya australis</i>	X	X	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X	X	X
Inland dotterel	<i>Charadrius australis</i>			X
Intermediate egret	<i>Ardea intermedia</i>	X	X	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)	X		X
Lesser sand plover	<i>Charadrius mongolus</i> (J,C,R,E,v)			
Lewin's rail	<i>Lewinia pectoralis</i>	X		
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X	X	X
Little curlew	<i>Numenius minutus</i> (J,C,R)			
Little egret	<i>Egretta garzetta</i>	X	X	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X	X	X
Long-toed stint	<i>Calidris subminuta</i> (J,C,R)	X		
Magpie goose	<i>Anseranas semipalmata</i> (v)	X		
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X	X	X
Masked lapwing	<i>Vanellus miles</i>	X	X	X
Musk duck	<i>Biziura lobata</i>	X	X	X

Common name	Scientific name (status or listing)	Mid Murray 1992–2012 records	Lower Murray 1992–2012 records	Lower Darling 1992–2012 records
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X	X	X
Pacific black duck	<i>Anas superciliosa</i>	X	X	X
Pectoral sandpiper	<i>Calidris melanotos</i> (J,R)	X	X	X
Pied cormorant	<i>Phalacrocorax varius</i>	X	X	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X	X	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X		
Purple swamphen	<i>Porphyrio porphyrio</i>	X	X	X
Red knot	<i>Calidris canutus</i> (J,C,R,E)			
Red-capped plover	<i>Charadrius ruficapillus</i>	X	X	X
Red-kneed dotterel	<i>Erythrogonys cinctus</i>	X	X	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X	X	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)	X	X	X
Royal spoonbill	<i>Platalea regia</i>	X	X	X
Ruddy turnstone	<i>Arenaria interpres</i> (J,C,R)		X	
Ruff	<i>Philomachus pugnax</i> (J,C,R VAGRANT)			
Sanderling	<i>Calidris alba</i> (J,C,R,v)	X		
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)		X	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X	X	X
Spotless crane	<i>Porzana tabuensis</i>	X		X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X	X	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>			

Common name	Scientific name (status or listing)	Mid Murray 1992–2012 records	Lower Murray 1992–2012 records	Lower Darling 1992–2012 records
Whimbrel	<i>Numenius phaeopus</i> (J,C,R)			
Whiskered tern	<i>Chlidonias hybrida</i>	X	X	X
White-faced heron	<i>Egretta novaehollandiae</i>	X	X	X
White-necked heron	<i>Ardea pacifica</i>	X	X	X
White-rumped sandpiper	<i>Calidris fuscicollis</i> (VAGRANT)			
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)	X	X	
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)			
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X	X	X

Intersecting Streams WRPA

Common name	Scientific name (status or listing)	Narran Lakes 1992–2012 records	Far Western 1992–2012 records
Australasian bittern	<i>Botaurus poiciloptilus</i> (E,e)	X	
Australasian darter	<i>Anhinga novaehollandiae</i>	X	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X	X
Australasian shoveler	<i>Anas rhynchotis</i>	X	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X	X
Australian little bittern	<i>Ixobrychus dubius</i>		
Australian painted snipe	<i>Rostratula australis</i> (E,e)		
Australian pelican	<i>Pelecanus conspicillatus</i>	X	X
Australian pratincole	<i>Stiltia Isabella</i>		X
Australian shelduck	<i>Tadorna tadornoides</i>	X	X
Australian spotted crake	<i>Porzana fluminea</i>		X
Australian white ibis	<i>Threskiornis Molucca</i>	X	X
Australian wood duck	<i>Chenonetta jubata</i>	X	X

Common name	Scientific name (status or listing)	Narran Lakes 1992–2012 records	Far Western 1992–2012 records
Baillon's crake	<i>Porzana pusilla</i>		
Banded lapwing	<i>Vanellus tricolor</i>	X	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>		X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)		
Black swan	<i>Cygnus atratus</i>	X	X
Black-fronted dotterel	<i>Elseyornis melanops</i>	X	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)	X	
Black-tailed godwit	<i>Limosa limosa</i> (J,C,R,v)	X	
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X	X
Brolga	<i>Grus rubicunda</i> (v)	X	X
Cape Barren goose	<i>Cereopsis novaehollandiae</i>		
Caspian tern	<i>Hydroprogne caspia</i> (J)	X	X
Cattle egret	<i>Bubulcus ibis</i>	X	
Chestnut teal	<i>Anas castanea</i>	X	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)		X
Common sandpiper	<i>Actitis hypoleucos</i> (J,C,R)		
Curlew sandpiper	<i>Calidris ferruginea</i> (J,C,R,CE,e)	X	
Double-banded plover	<i>Charadrius bicinctus</i>		
Dusky moorhen	<i>Vanellus tricolor</i>		X
Eastern great egret	<i>Ardea alba modesta</i>	X	X
Eurasian coot	<i>Fulica atra</i>	X	X
Freckled duck	<i>Stictonetta naevosa</i> (v)	X	X
Glossy ibis	<i>Plegadis falcinellus</i>	X	X
Great cormorant	<i>Phalacrocorax carbo</i>	X	X
Great crested grebe	<i>Podiceps cristatus</i>	X	X
Grey teal	<i>Anas gracilis</i>	X	X
Hardhead	<i>Aythya australis</i>	X	X
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	X	X
Inland dotterel	<i>Charadrius australis</i>		X
Intermediate egret	<i>Ardea intermedia</i>	X	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)	X	X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X	X
Little curlew	<i>Numenius minutus</i> (J,C,R)		

Common name	Scientific name (status or listing)	Narran Lakes 1992–2012 records	Far Western 1992–2012 records
Little egret	<i>Egretta garzetta</i>	X	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X	X
Magpie goose	<i>Anseranas semipalmata</i> (v)	X	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X	X
Masked lapwing	<i>Vanellus miles</i>	X	
Musk duck	<i>Biziura lobata</i>	X	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X	X
Oriental plover	<i>Charadrius veredus</i> (J,C,R)		
Oriental pratincole	<i>Glareola maldivarum</i> (J,C,R)		
Pacific black duck	<i>Anas superciliosa</i>	X	X
Pied cormorant	<i>Phalacrocorax varius</i>	X	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X	X
Red-capped plover	<i>Charadrius ruficapillus</i>	X	X
Red-kneed dotterel	<i>Erythrogonys cinctus</i>	X	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)		
Royal spoonbill	<i>Platalea regia</i>	X	X
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X	X
Spotless crake	<i>Porzana tabuensis</i>	X	X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>		X
Whiskered tern	<i>Chlidonias hybrida</i>	X	X
White-faced heron	<i>Egretta novaehollandiae</i>	X	X
White-necked heron	<i>Ardea pacifica</i>	X	X
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)	X	X
Wood sandpiper	<i>Tringa glareola</i> (J,C,R)	X	
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X	X

Barwon–Darling WRPA

Common name	Scientific name (status or listing)	Tallywalka system 1992–2012 records	Upper Darling 1992–2012 records
Australasian darter	<i>Anhinga novaehollandiae</i>	X	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X	X
Australasian shoveler	<i>Anas rhynchotis</i>	X	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X	X
Australian little bittern	<i>Ixobrychus dubius</i>		
Australian painted snipe	<i>Rostratula australis</i>		
Australian pelican	<i>Anhinga novaehollandiae</i>	X	X
Australian pratincole	<i>Stiltia Isabella</i>		
Australian shelduck	<i>Anas rhynchotis</i>	X	X
Australian spotted crane	<i>Porzana fluminea</i>	X	
Australian white ibis	<i>Threskiornis Molucca</i>	X	X
Australian wood duck	<i>Chenonetta jubata</i>	X	X
Baillon's crane	<i>Porzana pusilla</i>	X	
Banded lapwing	<i>Vanellus tricolor</i>	X	X
Banded stilt	<i>Cladorhynchus leucocephalus</i>	X	
Black swan	<i>Cygnus atratus</i>	X	X
Black-fronted dotterel	<i>Euseyonis melanops</i>	X	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i>		X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X	X
Blue-billed duck	<i>Oxyura australis (v)</i>		X
Brolga	<i>Grus rubicunda (v)</i>		X
Buff-banded rail	<i>Gallirallus philippensis</i>	X	
Caspian tern	<i>Hydroprogne caspia (J)</i>	X	X
Cattle egret	<i>Bubulcus ibis</i>		
Chestnut teal	<i>Anas castanea</i>	X	X
Common greenshank	<i>Tringa nebularia (J,C,R)</i>		X
Common sandpiper	<i>Actitis hypoleucos</i>		
Double-banded plover	<i>Charadrius bicinctus</i>		
Dusky moorhen	<i>Gallinula tenebrosa</i>	X	X
Eastern great egret	<i>Ardea alba modesta</i>	X	X
Eurasian coot	<i>Fulica atra</i>	X	X
Freckled duck	<i>Stictonetta naevosa (v)</i>	X	X

Common name	Scientific name (status or listing)	Tallywalka system 1992–2012 records	Upper Darling 1992–2012 records
Glossy ibis	<i>Plegadis falcinellus</i>	X	X
Great cormorant	<i>Phalacrocorax carbo</i>	X	X
Great crested grebe	<i>Podiceps cristatus</i>	X	
Grey teal	<i>Anas gracilis</i>	X	X
Hardhead	<i>Aythya australis</i>	X	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X	X
Inland dotterel	<i>Charadrius australis</i>		X
Intermediate egret	<i>Ardea intermedia</i>		X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X	X
Little egret	<i>Egretta garzetta</i>		X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X	X
Masked lapwing	<i>Vanellus miles</i>	X	X
Musk duck	<i>Biziura lobata</i>	X	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X	X
Oriental pratincole	<i>Glareola maldivarum</i> (J,C,R)		X
Pacific black duck	<i>Anas superciliosa</i>	X	X
Pied cormorant	<i>Phalacrocorax varius</i>	X	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>		X
Purple swamphen	<i>Porphyrio porphyrio</i>	X	X
Red-capped plover	<i>Charadrius ruficapillus</i>	X	
Red-kneed dotterel	<i>Erythronyctes alba</i>	X	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X	X
Red-necked stint	<i>Calidris ruficollis</i> (J,C,R)	X	
Royal spoonbill	<i>Platalea regia</i>	X	X
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X	X
Spotless crane	<i>Porzana tabuensis</i>	X	
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>		X
Whiskered tern	<i>Chlidonias hybrida</i>	X	X
White-faced heron	<i>Egretta novaehollandiae</i>	X	X
White-necked heron	<i>Ardea pacifica</i>	X	X
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X	X

Namoi WRPA

Common name	Scientific name (status or listing)	Namoi 1992–2012 records
Australasian darter	<i>Anhinga novaehollandiae</i>	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X
Australasian shoveler	<i>Anas rhynchotis</i>	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X
Australian pelican	<i>Pelecanus conspicillatus</i>	X
Australian shelduck	<i>Tadorna tadornoides</i>	
Australian white ibis	<i>Threskiornis molucca</i>	X
Australian wood duck	<i>Chenonetta jubata</i>	X
Banded lapwing	<i>Vanellus tricolor</i>	X
Black swan	<i>Cygnus atratus</i>	X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X
Brolga	<i>Grus rubicunda</i> (v)	X
Caspian tern	<i>Hydroprogne caspia</i> (J)	X
Chestnut teal	<i>Anas castanea</i>	X
Eastern great egret	<i>Ardea alba modesta</i>	X
Eurasian coot	<i>Fulica atra</i>	X
Glossy ibis	<i>Plegadis falcinellus</i>	X
Great cormorant	<i>Phalacrocorax carbo</i>	X
Great crested grebe	<i>Podiceps cristatus</i>	X
Grey teal	<i>Anas gracilis</i>	X
Hardhead	<i>Aythya australis</i>	X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X
Masked lapwing	<i>Vanellus miles</i>	X
Musk duck	<i>Biziura lobata</i>	
Pacific black duck	<i>Anas superciliosa</i>	X
Pied cormorant	<i>Phalacrocorax varius</i>	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X
Royal spoonbill	<i>Platalea regia</i>	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X

Common name	Scientific name (status or listing)	Namoi 1992–2012 records
Wandering whistling-duck	<i>Dendrocygna arcuata</i>	X
Whiskered tern	<i>Chlidonias hybrida</i>	X
White-faced heron	<i>Egretta novaehollandiae</i>	X
White-necked heron	<i>Ardea pacifica</i>	X
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X

NSW Border Rivers WRPA

Common name	Scientific name	NSW Border Rivers 1992–2012 records
Australasian darter	<i>Anhinga novaehollandiae</i>	X
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	X
Australasian shoveler	<i>Anas rhynchotis</i>	X
Australian gull-billed tern	<i>Gelochelidon macrotarsa</i>	X
Australian pelican	<i>Pelecanus conspicillatus</i>	X
Australian shelduck	<i>Tadorna tadornoides</i>	X
Australian white ibis	<i>Threskiornis molucca</i>	X
Australian wood duck	<i>Chenonetta jubata</i>	X
Banded lapwing	<i>Vanellus tricolor</i>	X
Bar-tailed godwit	<i>Limosa lapponica</i> (J,C,R,CE,v)	X
Black swan	<i>Cygnus atratus</i>	X
Black-fronted dotterel	<i>Elseyaornis melanops</i>	X
Black-necked stork	<i>Ephippiorhynchus asiaticus</i> (e)	X
Black-tailed native-hen	<i>Tribonyx ventralis</i>	X
Black-winged stilt	<i>Himantopus leucocephalus</i>	X
Blue-billed duck	<i>Oxyura australis</i> (v)	X
Brolga	<i>Grus rubicunda</i> (v)	X
Buff-banded rail	<i>Gallirallus philippensis</i>	X
Caspian tern	<i>Hydroprogne caspia</i> (J)	X
Cattle egret	<i>Bubulcus ibis</i>	X
Chestnut teal	<i>Anas castanea</i>	X
Common greenshank	<i>Tringa nebularia</i> (J,C,R)	X
Dusky moorhen	<i>Gallinula tenebrosa</i>	X
Eastern great egret	<i>Ardea alba modesta</i>	X
Eurasian coot	<i>Fulica atra</i>	X
Freckled duck	<i>Stictonetta naevosa</i> (v)	X
Glossy ibis	<i>Plegadis falcinellus</i>	X

Common name	Scientific name	NSW Border Rivers 1992–2012 records
Great cormorant	<i>Phalacrocorax carbo</i>	X
Great crested grebe	<i>Podiceps cristatus</i>	X
Grey teal	<i>Anas gracilis</i>	X
Hardhead	<i>Aythya australis</i>	X
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	X
Intermediate egret	<i>Ardea intermedia</i>	X
Latham's snipe	<i>Gallinago hardwickii</i> (J,R)	X
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	X
Little egret	<i>Egretta garzetta</i>	X
Little pied cormorant	<i>Microcarbo melanoleucos</i>	X
Magpie goose	<i>Anseranas semipalmata</i> (v)	X
Marsh sandpiper	<i>Tringa stagnatilis</i> (J,C,R)	X
Masked lapwing	<i>Vanellus miles</i>	X
Musk duck	<i>Biziura lobata</i>	X
Nankeen night-heron	<i>Nycticorax caledonicus</i>	X
Pacific black duck	<i>Anas superciliosa</i>	X
Pectoral sandpiper	<i>Calidris melanotos</i> (J,R)	X
Pied cormorant	<i>Phalacrocorax varius</i>	X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	X
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	X
Purple swamphen	<i>Porphyrio porphyrio</i>	X
Red-capped plover	<i>Charadrius ruficapillus</i>	
Red-kneed dotterel	<i>Erythronyctes alba</i>	X
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	X
Royal spoonbill	<i>Platalea regia</i>	X
Sharp-tailed sandpiper	<i>Calidris acuminata</i> (J,C,R)	X
Silver gull	<i>Chroicocephalus novaehollandiae</i>	X
Straw-necked ibis	<i>Threskiornis spinicollis</i>	X
Wandering whistling-duck	<i>Dendrocygna arcuata</i>	
Whiskered tern	<i>Chlidonias hybrida</i>	X
White-faced heron	<i>Egretta novaehollandiae</i>	X
White-necked heron	<i>Ardea pacifica</i>	X
White-winged black tern	<i>Chlidonias leucopterus</i> (J,C,R)	X
Yellow-billed spoonbill	<i>Platalea flavipes</i>	X

Chapter 7 appendices: Priority ecosystem functions

Appendix 7.1: Priority ecosystem function objectives and targets included in NSW LTWPs

Border Rivers ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	<p>Water depth and quality in pools (in-channel), core wetlands and lakes</p> <p>Condition of vegetation in core wetlands and riparian zones</p>	Maintain dissolved oxygen and salinity levels in key refuge pools at ecologically tolerable levels		
EF2	Create quality instream, floodplain and wetland habitat	<p>Regulation of dissolved oxygen, salinity and water temperature</p> <p>Flow variability and hydrodynamic diversity</p> <p>Provision of diverse wetted areas</p> <p>Appropriate wetting and drying cycles</p> <p>Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats</p> <p>Appropriate rates of fall to avoid excessive bank erosion</p> <p>Control of woody-vegetation encroachment into river channels and wetlands</p>	Rates of rise and fall do not exceed the 5th and 95th percentiles (respectively) of natural rates during regulated water deliveries		

Ecological objectives		Description and key contributing processes	Targets			
			5 years (2024)	10 years (2029)	20 years (2039)	
EF3	Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles and disperse into new habitats	<p>a. within catchments</p> <p>b. between catchments</p>	<p>Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats</p> <p>Migration to fulfil life-history requirements</p> <p>Foraging of aquatic species</p> <p>Recolonisation following disturbance</p>	<p>Protect or improve frequency of events that allow fish passage in target planning units/gauges</p> <p>Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units</p> <p>Increase in passage of key moderate to long-lived riverine and moderate to long-lived flow pulse specialists through key fish passages in the Border Rivers compared to passage rates detected in 2014–2019</p> <p>Protect or improve the number of events that enable movement of fish between catchments within 12 months of major breeding events and dry spells</p>		
EF4	Support instream and floodplain productivity	<p>Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)</p> <p>Terrestrial primary productivity (vegetation)</p> <p>Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish)</p> <p>Decomposition of organic matter</p>	<p>Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels</p> <p>Maintain/improve the abundance and distribution of decapod crustaceans</p>	<p>No decline in key native fish species condition metrics (e.g. weight:length ratio)</p>	<p>Improve key native fish species metrics (e.g. weight:length ratio)</p>	
EF5	Support nutrient, carbon and sediment transport along channels, and exchange	Sediment delivery to downstream reaches and	<p>Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events</p> <p>Maintain extent and condition of floodplain vegetation</p>			

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
	between channels and floodplains/wetlands	<p>to/from anabranches, floodplains and wetlands</p> <p>Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats</p> <p>Dilution of carbon and nutrients that have returned to rivers</p>	Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	<p>Groundwater recharge and discharge</p> <p>Dilution of saline/acidic groundwater</p> <p>Salt export from the MDB</p>	<p>Maintain the 2016 mapped extent of groundwater-dependent vegetation communities</p> <p>Maintain groundwater levels within the natural range of variability over the long term</p>		
EF7	Increase the contribution of flows into the Murray and Barwon–Darling from tributaries	Provision of end-of-system flows to support ecological objectives in downstream catchments	<p>No reduction in rolling 5-year average flows at each end of planning unit gauge and end-of-catchment gauge</p> <p>No increase in the long-term average number of days of cease-to-flow conditions</p>		

Barwon–Darling ecological objectives and targets for PEFs

Ecological objective		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	<p>Water depth and quality in pools (in-channel), core wetlands and lakes</p> <p>Condition of vegetation in core wetlands and riparian zones</p>	<p>Adequate water depth is maintained in key refuge pools during dry times; strategies may include ensuring cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs</p> <p>Maintain dissolved oxygen >4 mg/L (and salinity levels at ecologically tolerable levels) in key refuge pools</p>		
EF2	Create quality instream, floodplain and wetland habitat	<p>Regulation of dissolved oxygen, salinity and water temperature</p> <p>Flow variability and hydrodynamic diversity</p> <p>Provision of diverse wetted areas</p> <p>Appropriate wetting and drying cycles</p> <p>Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats</p> <p>Appropriate rates of fall to avoid excessive bank erosion</p> <p>Control of woody-vegetation encroachment into river channels and wetlands</p>	<p>Rates of fall in flow or water height do not exceed the 95th percentile of natural rates, for example in pools or areas of high hydrological stress</p> <p>Implement (through protection or creation) flows in all flow categories to provide variability in the flow regime along the system to inundate a variety of in-channel and floodplain wetland habitats</p>		
EF3a	Provide movement and dispersal opportunities for water-dependent biota to	<p>within catchments</p> <p>Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats</p> <p>Migration to fulfil life-history requirements</p> <p>Foraging of aquatic species</p>	<p>Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units</p> <p>Protect the recommended frequency and duration of flows providing lateral connectivity with anabranches, wetlands and floodplains</p> <p>Increase in passage of key moderate to long-lived riverine and flow pulse specialists through key fish passages in the Barwon–Darling compared to passage rates detected in 2014–2019</p>		

Ecological objective			Description and key contributing processes	Targets		
				5 years (2024)	10 years (2029)	20 years (2039)
EF3b	complete lifecycles and disperse into new habitats	between catchments	Recolonisation following disturbance	Protect dispersal opportunities between catchments for native fish species, with a focus on moderate to long-lived flow pulse specialist native fish species, within 12 months of major breeding events and dry spells.		
EF4	Support instream and floodplain productivity		<p>Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)</p> <p>Terrestrial primary productivity (vegetation)</p> <p>Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish)</p> <p>Decomposition of organic matter</p>	<p>Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition over a 5-year rolling period</p> <p>Maintain native fish population structure that indicates successful transition from young-of-year to juveniles</p> <p>Protect riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients</p>	<p>No decline in key native fish species condition metrics</p> <p>Maintain the abundance and distribution of decapod crustaceans</p>	<p>Improve key native fish species condition metrics</p> <p>Improve the abundance and distribution of decapod crustaceans</p>
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands		<p>Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands</p> <p>Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats</p> <p>Dilution of carbon and nutrients that have returned to rivers</p>	<p>Protect lateral connectivity with anabranches, wetlands and floodplains, as specified in EWRs for large freshes, bankfull events and overbank flows</p> <p>Maintain extent and condition of floodplain vegetation</p>	<p>N/A</p>	<p>Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events</p>
				<p>N/A</p>		<p>Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels</p>

Ecological objective		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Groundwater recharge and discharge Dilution of saline/acidic groundwater Salt export from the MDB	Maintain the 2016 mapped extent of groundwater-dependent vegetation communities Maintain groundwater levels within the natural range of variability over the long term		
EF7	Increase the contribution of flows into the Lower-Darling and Murray	Provision of end-of-system flows to support ecological objectives in downstream catchments	No reduction in rolling 5-year average flows at each end of planning unit gauge and end-of-catchment gauge No increase in the long-term average number of days of cease-to-flow conditions		

Gwydir ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Water depth and quality in pools (in-channel), core wetlands and lakes Condition of vegetation in core wetlands and riparian zones	Very low flows (VFs), baseflows (BF1) and wetland inundation flows (WL1) are provided at target magnitudes and durations as specified in planning unit EWRs Cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs Adequate water depth is maintained in key refuge pools during dry times Maintain dissolved oxygen >4 mg/L in key refuge pools		
EF2	Create quality instream, floodplain and wetland habitat	Regulation of dissolved oxygen, salinity and water temperature Flow variability and hydrodynamic diversity Provision of diverse wetted areas	Rates of rise and fall do not fall outside the 5th and 95th percentiles of natural rates during regulated water deliveries Period for which instream freshes are held at constant level ($\pm 5\%$) does not exceed natural durations At least 1 overbank/wetland inundating event 9 years in 10 in relevant planning units At least 3 fresh events per year to inundate in-channel habitat in relevant planning units		

Ecological objectives		Description and key contributing processes	Targets			
			5 years (2024)	10 years (2029)	20 years (2039)	
		<p>Appropriate wetting and drying cycles</p> <p>Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats</p> <p>Appropriate rates of fall to avoid excessive bank erosion</p> <p>Control of woody-vegetation encroachment into river channels and wetlands</p>				
EF3a	Provide movement and dispersal opportunities for water-dependent biota to complete lifecycles and disperse into new habitats	within catchments	<p>Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats</p> <p>Migration to fulfil life-history requirements</p> <p>Foraging of aquatic species</p>	<p>Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units</p> <p>The recommended frequency and duration of flows providing lateral connectivity with anabranches, low-lying wetlands and floodplains are met (see EWRs for large freshes and above, and wetland inundating flows)</p> <p>Provide longitudinal connectivity and integrity of flows to end-of-system, including flow pulses (regulated, natural or augmented natural)</p>		
EF3b		between catchments	<p>Recolonisation following disturbance</p>	<p>Increase dispersal opportunities between catchments for native fish species, with a focus on moderate to long-lived flow pulse specialist native fish species between the Gwydir and the Barwon–Darling a minimum 2–3 years in 10</p>		
EF4	Support instream and floodplain productivity		<p>Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)</p> <p>Terrestrial primary productivity (vegetation)</p> <p>Aquatic secondary productivity (zooplankton,</p>	<p>Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition over a 5-year rolling period</p> <p>Maintain native fish population structure that indicates successful transition from young-of-year to juveniles</p> <p>Enhance riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients</p>		

Ecological objectives	Description and key contributing processes	Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
	<p>macroinvertebrates, fish larvae, adult fish)</p> <p>Decomposition of organic matter</p>	<p>No decline in key native fish species condition metrics</p> <p>Maintain the abundance and distribution of decapod crustaceans</p>		<p>Improve key native fish species condition metrics</p> <p>Improve the abundance and distribution of decapod crustaceans</p>
EF5	<p>Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands</p>	<p>Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands</p> <p>Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats</p> <p>Dilution of carbon and nutrients that have returned to rivers</p>	<p>Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events</p> <p>Increase lateral connectivity with anabranches, low-lying wetlands and floodplains, as specified in EWRs for large freshes, bankfull events, wetland inundating flows and overbank flows</p> <p>Maintain extent and condition of floodplain vegetation</p> <p>Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels</p>	
EF6	<p>Support groundwater conditions to sustain groundwater-dependent biota</p>	<p>Groundwater recharge and discharge</p> <p>Dilution of saline/acidic groundwater</p> <p>Salt export from the MDB</p>	<p>Maintain the 2016 mapped extent of groundwater-dependent vegetation communities</p> <p>Maintain groundwater levels within the natural range of variability over the long term</p>	
EF7	<p>Increase the contribution of flows into the Barwon–Darling from tributaries</p>	<p>Provision of end-of-system flows to support ecological objectives in downstream catchments</p>	<p>Provide flows from Mehi Creek and Gil Gil Creek to the Barwon–Darling catchment, including baseflows a minimum of 5–10 years in 10 and in-channel freshes a minimum of 2–3 years in 10</p> <p>Protect larger flows across the Gwydir catchment that can reach the Barwon–Darling catchment a minimum of 2–3 years in 10</p>	

Intersecting Streams ecological objectives and targets for PEFs

Ecological objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Maintain dissolved oxygen and salinity levels in key refuge pools at ecologically tolerable levels		
EF2	Create quality instream, floodplain and wetland habitat	Rates of rise and fall do not exceed the 5th and 95th percentiles (respectively) of natural rates in areas of high hydrological stress Rates of rise and fall do not exceed the 5th and 95th percentiles (respectively) of natural rates during regulated water deliveries		
EF3	Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles and disperse into new habitats	a. within catchments b. between catchments	Maintain frequency of events that allow fish passage in target planning units and gauges Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units Increase in passage of key moderate to long-lived riverine and flow-pulse specialist native fish through key fish passages in the Intersecting Streams compared to passage rates detected in 2014–2019	
EF4	Support instream and floodplain productivity	Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels		
EF5	Support nutrient, carbon and sediment transport along channels, and exchange between channels and floodplains/wetlands	Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events Maintain extent and condition of floodplain vegetation Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels No decline in key native fish species condition metrics (e.g. weight:length ratio)		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Improve key native fish species metrics (e.g. weight:length ratio)		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Maintain the 2016 mapped extent of groundwater-dependent vegetation communities Maintain groundwater levels within the natural range of variability over the long term		
EF7	Increase contribution from Intersecting Streams to Barwon–Darling	No reduction in rolling 5-year average flows at each end of planning unit gauge and end-of-catchment gauge No increase in the long-term average number of days of cease-to-flow conditions		

Lachlan ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	<p>Water depth and quality in pools (in-channel), core wetlands and lakes</p> <p>Condition of vegetation in core wetlands and riparian zones</p>	<p>Very low flows (VF1) and baseflows (BF1) and wetland inundating flows (WL1) are provided at target magnitudes and durations as specified in planning unit EWRs</p> <p>Cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs</p> <p>Adequate water depth is maintained in key refuge pools during dry times</p> <p>Maintain dissolved oxygen >4 mg/L in key refuge pools (approximately 50% saturation in 25°C water)</p>		
EF2	Create quality instream, floodplain and wetland habitat	<p>Regulation of dissolved oxygen, salinity and water temperature</p> <p>Flow variability and hydrodynamic diversity</p> <p>Provision of diverse wetted areas</p> <p>Appropriate wetting and drying cycles</p> <p>Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats</p> <p>Appropriate rates of fall to avoid excessive bank erosion</p> <p>Control of woody-vegetation encroachment into river channels and wetlands</p>	<p>Rates of rise and fall do not fall outside the 5th and 95th percentiles of natural rates during regulated water deliveries</p> <p>Period for which instream freshes are held at constant level ($\pm 5\%$) does not exceed natural durations</p> <p>At least 1 overbank/wetland inundating event 9 years in 10 in relevant planning units</p> <p>At least 3 fresh events per year to inundate in-channel habitat in relevant planning units</p>		

Ecological objectives			Description and key contributing processes	Targets		
				5 years (2024)	10 years (2029)	20 years (2039)
EF3a	Provide movement and dispersal opportunities for water-dependent biota to complete lifecycles and disperse into new habitats	within catchments	Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats Migration to fulfil life-history requirements Foraging of aquatic species	Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units The recommended frequency and duration of flows providing lateral connectivity with anabranches, low-lying wetlands and floodplains are met (see EWRs for large freshes and above, and wetland inundating flows) Provide longitudinal connectivity and integrity of flows to end-of-system, including flow pulses (regulated, natural or augmented natural)		
EF3b		between catchments	Recolonisation following disturbance	A long-term average frequency of 2 connecting events in 10 years between Lachlan and Murrumbidgee		
EF4	Support instream and floodplain productivity		Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton) Terrestrial primary productivity (vegetation) Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish) Decomposition of organic matter	Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition over a 5-year rolling period Maintain native fish population structure that indicates successful transition from young-of-year to juveniles Enhance riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients No decline in key native fish species condition metrics Improve key native fish species condition metrics Maintain the abundance and distribution of decapod crustaceans Improve the abundance and distribution of decapod crustaceans		
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands		Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands Mobilisation of carbon and nutrients from in-channel	Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events Increase lateral connectivity with anabranches, low-lying wetlands and floodplains, as specified in EWRs for large freshes, bankfull events, wetland inundating flows and overbank flows		

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
		surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats Dilution of carbon and nutrients that have returned to rivers	Maintain extent and condition of floodplain vegetation Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Groundwater recharge and discharge Dilution of saline/acidic groundwater Salt export from the MDB	Maintain the 2016 mapped extent of groundwater-dependent vegetation communities Maintain groundwater levels within the natural range of variability over the long term		

Macquarie–Castlereagh ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Water depth and water quality in pools (in-channel), core wetlands and lakes Condition of vegetation in core wetlands and riparian zones	Core wetland habitats ⁵² are protected ⁵³ during dry times Cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs Adequate water depth is maintained in key refuge pools ⁵⁴ during dry times In key refuge pools ⁵⁴ maintain daily average dissolved oxygen >4 mg/L and hourly levels >2 mg/L		

⁵² Core wetland habitats are those identified by Thomas et al. (in prep) as the ‘purple zone’ in the Macquarie Marshes, which is inundated with an average return interval of 1–2 years.

⁵³ Maintained in a state that will provide habitat for biota and allow recovery to good condition with a wet season.

⁵⁴ To be identified. Monitored at selected sites only.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF2	Create quality instream, floodplain and wetland habitat	<p>Regulation of dissolved oxygen, salinity and water temperature</p> <p>Flow variability and hydrodynamic diversity</p> <p>Provision of diverse wetted areas</p> <p>Appropriate wetting and drying cycles</p> <p>Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats</p> <p>Appropriate rates of fall to avoid excessive bank erosion</p> <p>Control of woody-vegetation encroachment into river channels and wetlands</p>	<p>Recession management: Rate of fall does not exceed the 95th percentile of natural rates⁵⁵ during regulated water deliveries</p> <p>Minimum flow variability: Period for which small and large freshes are held at constant level ($\pm 5\%$) does not exceed 20 days to avoid bank slumping and support instream function⁵⁶</p> <p>Channel form: Watering requirements for overbank flows are met (refer to fish/veg/bird watering requirements)⁵⁷</p> <p>Bench and pool formation and fine sediment scouring: Watering requirements for freshes are met (refer to fish/veg/bird watering requirements)</p> <p>Create hydrodynamic complexity for large-bodied fish: Flows with velocities of 0.3–0.4 m/s provided as per watering requirements for freshes (refer to fish watering requirements)</p>		

⁵⁵ Calculation of these percentiles will be required for relevant planning units. ‘Natural’ rates estimated from pre-1966 observed data where a multi-decal record exists or, where this is not available, modelled natural data.

⁵⁶ Note: There may be some instances where, for ecological reasons, relatively constant flows are required, such as keeping water levels below nesting colonies. In these cases exceptions may be required at the relevant planning unit. However, even these deliveries may still be able to be subtly altered to provide variability.

⁵⁷ Held environmental water cannot generally be delivered at the high flow levels required to meet some of the key needs of riparian river red gum vegetation communities (e.g. ground-cover condition), for woodlands and shrublands outside the actively managed floodplain, nor for some channel forming processes. Planned environmental water services these needs. Policy changes which affect these flows will risk the health of these vegetation communities and processes.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF3	Provide movement and dispersal opportunities within catchments for water-dependent biota to complete lifecycles: a. within catchment b. between catchments	Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats	Increase, compared to 2004–2017 ⁵⁸ , dispersal opportunities between sub-catchments and between river reaches for moderate to long-lived flow riverine and pulse specialist native fish through key fish passages ⁵⁹		
		Migration to fulfil life-history requirements Foraging of aquatic species Recolonisation following disturbance	Long-term observed frequency of connectivity sufficient to allow native fish movement, with a focus on moderate to long-lived flow pulse specialists, between the Barwon River and the Lower Macquarie and Lower Marthaguy is improved, and between the Barwon River and the unregulated Castlereagh and Bogan rivers and Marra Creek are maintained ⁵⁶ , compared to the 2004–2017 baseline scenario		
EF4	Support instream and floodplain productivity	Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)	Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition ⁶⁰ over a 5-year rolling period		
		Terrestrial primary productivity (vegetation)	No decline in key native fish species ⁶¹ condition metrics	Improve key native fish species condition metrics	
		Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish)	Maintain the abundance and distribution of decapod crustaceans	Improve the abundance and distribution of decapod crustaceans	
		Decomposition of organic matter			

⁵⁸ To be assessed against a combination of observed data and the modelled baseline scenario that represents the consumptive use and the rules and sharing arrangements as at June 2009. Once environmental flow behaviours are updated in the models, this version should be used. Comparisons will need to take into account any limitations in the model and, for the observed data, the comparability of the weather during the baseline period and target period.

⁵⁹ Key fish passages to be identified by DPI Fisheries.

⁶⁰ In line with condition targets set for the native vegetation objectives.

⁶¹ Key fish species that are relevant in each planning unit, as described in the targets for the native fish objectives.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands	Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats Dilution of carbon and nutrients that have returned to rivers	Maintain the frequency and duration of events that drive nutrient and carbon (DOC) processes (at selected evaluation sites) along channels (freshes and overbank events) Maintain extent and condition of floodplain vegetation (measured under vegetation theme targets)		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Groundwater recharge and discharge Dilution of saline/acidic groundwater Salt export from the MDB	Maintain the current mapped extent of groundwater-dependent vegetation communities and specifically maintain the freshwater lens in Macquarie Marshes ⁶² Maintain groundwater levels within the natural range of variability over the long-term (monitored in selected sites only)		
EF7	Increase the contribution of flows into the Murray and Barwon–Darling from tributaries	Provision of end-of-system flows to support ecological objectives in downstream catchments	End-of-system flow volumes to the Barwon River increase by 10% compared to 2004–2017 ⁵⁸		

⁶² Note: Groundwater systems in the Marshes (and generally) are not well understood and there may be a need for more information gathering before this can be meaningfully measured. These targets are one way of measuring but may not be able to be done in the first instance. In the meantime, it is known that large floods recharge the groundwater systems and flush salts from the soils. These cannot be delivered with held environmental water. Hence there is a need to protect these larger events when they do occur.

Murray–Lower Darling ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Water depth and quality in pools (in-channel), core wetlands and lakes Condition of vegetation in core wetlands and riparian zones	<p>Very low flows (VFs) and baseflows (BF1) are provided at target magnitudes and durations as specified in planning unit EWRs</p> <p>Cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs</p> <p>Adequate water depth is maintained in key refuge pools during dry times</p> <p>Maintain permanent inundation of acid sulphate soils in key areas</p> <p>Maintain dissolved oxygen >4 mg/L in surface water and down to 2 m below the surface at key gauges and in key refuge pools⁶³ for 95% of the time and >2 mg/L for 99% of the time. Monitoring should incorporate overnight data collection between 3am and 6am from November–March each year</p> <p>End-of-system salinity targets⁶⁴</p> <p>Maintain salinity at <830 EC µS/cm in the Lower Darling River at Burtundy, 95% of the time</p> <p>Maintain salinity at <580 EC µS/cm in the Murray River d/s Lock 6, 95% of the time</p> <p>Maintain salinity at <453 EC µS/cm in the Murray River at the SA border, 80% of the time</p> <p>Other salinity targets⁶⁵</p>		

⁶³ At key refuge pools, especially those susceptible to stratification and supporting native fish populations.

⁶⁴ Existing end-of-system salinity targets of most relevance to the Darling River and NSW Murray River end-of-systems (from Basin Plan 9.15(5) and Schedule B, Appendix 1 of the Commonwealth Water Act (2007).

⁶⁵ Additional salinity targets allow for periodic variation in salinity levels at local scales, which should not impact the end-of-valley targets. There are several saline or brackish environmental assets in the Murray–Lower Darling, which when watered will result in local and short-term increases in salinity. Periodic watering of these sites is important for maintaining a healthy salt balance in the wetland/creek and contributes to Basin Plan salt export targets. Saline/brackish wetlands provide an important habitat for the critically endangered Murray hardyhead.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
			Maintain salinity at <410 EC $\mu\text{S}/\text{cm}$ in October and November at key river gauges and refuge pools in permanent streams to promote survival of native fish larvae during breeding seasons ⁶⁶ Maintain salinity at <1,000/1,300 EC $\mu\text{S}/\text{cm}$ at key river gauges and in key instream refuge pools for 95% of the time and <4,000 ⁶⁷ EC $\mu\text{S}/\text{cm}$, 99% of the time		
EF2	Create quality instream, floodplain and wetland habitat	Regulation of dissolved oxygen, salinity and temperature Protect/enhance existing densities of snags Flow variability and hydrodynamics Provision of diverse wetted areas Appropriate wetting and drying cycles Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats	Rates of fall do not exceed the 5th percentile of modelled natural rates during regulated water deliveries Period for which instream freshes are held at constant level ($\pm 5\%$) does not exceed modelled natural durations At least 2 fresh events per year in relevant planning units to inundate in-channel habitat and provide movement and breeding cues for native fish and other aquatic biota Floodplain wetlands to undergo a drying phase (partial or full draw down) for at least 60 days, 6–10 years in 10 years (including Lower Murray wetlands and floodplains influenced by weir pools) Flow velocities ⁶⁸ in lower Murray River weir pools to exceed 0.3 m/s in at least 20% or 50% of each weir pool in dry and moderate/wet years, respectively, for at least 30 days (ideally 60–150 days) during Aug–Dec and at least 60 days (ideally 120 days) in Jan–May		

⁶⁶ Recommended EC represents the critical minimum threshold level for larvae of the native fish species, Murray cod (Ye et al. 2010). Note that juvenile and adult native fish have much higher salt tolerances of up to 10,000 ppm (approximately 16,700 $\mu\text{S}/\text{cm}$ EC), although salt tolerance information is only available for a limited number of species (Ye et al. 2010).

⁶⁷ Recommended ECs are within the salinity tolerance range for critical life stages of most aquatic biota and native vegetation species (Nielson et al. 2003; Ye et al. 2010); 1,300 $\mu\text{S}/\text{cm}$ (2500 ppm) is the salt tolerance for native fish eggs (based on a limited number of species); 4,000 $\mu\text{S}/\text{cm}$ is the tolerance of many native vegetation species.

⁶⁸ Cross-section averaged velocities.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
		Appropriate rates of fall to avoid excessive bank erosion Control of woody-vegetation encroachment into rivers/wetlands	Incorporate habitat mapping and re-snagging activities into broad-scale MER and riverbank remediation works for native fish management and recovery		
EF3a	Provide movement and dispersal opportunities for water-dependent biota to complete lifecycles and disperse into new habitats within catchments	Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats Migration to fulfil life-history requirements Foraging of aquatic species Recolonisation after disturbance	Annual detection of species and life stages representative of the whole fish community through key fish passages in specified planning units The recommended frequency and duration of flows providing lateral connectivity with anabranches, low-lying wetlands and floodplains are met (see EWRs for large freshes, bankfull and overbank flows See also target for longitudinal connectivity under objective EF3b		
EF3b	Provide movement and dispersal opportunities for water-dependent biota to complete lifecycles and disperse into new habitats between catchments	As above for EF3a	Provide longitudinal connectivity and integrity of flows ⁶⁹ to end-of-system, including flow pulses (regulated, natural or augmented natural) occurring in: <ul style="list-style-type: none"> the River Murray main stem (including flows originating from the Goulburn and Murrumbidgee and Lower Darling rivers) maintained from key source to SA border and including through lower Murray River weir pools Edward–Wakool system rivers (including flows originating from the Murray River via Barmah–Millewa forest) Lower Darling River (from the Barwon–Darling River to Weir 32, and continuing to the Murray River at the SA border) 		

⁶⁹ Maintaining the 'integrity' of flows means preserving the overall shape, magnitude and hydraulic properties (e.g. velocity) of a flow pulse as it moves downstream (not just the volume). This is a particular issue in the lower Murray River between Locks 7 and 9, due to significant diversions into Lake Victoria that result in discontinuity of a flow pulse and hence potential capture of nutrients, sediment, plant seeds/propagules and fish larvae into Lake Victoria, to the detriment of ecological outcomes in the SA Murray.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
			<ul style="list-style-type: none"> Darling Anabranh from Lake Cawndilla to the Murray River (maintaining a simultaneous connection at the source, i.e. lakes and Murray/Anabranh for at least 30 days, at a minimum frequency of least 3 years in 10) 		
			Provide in-channel connecting flows to the SA River Murray 8–10 years in 10 (>20,000 ML/d at the SA border), including at least 5 events with major contributions from the Lower Darling system (including longitudinal connectivity from source to SA border)		
			N/A		Provide small overbank (>45,000 ML/d) connecting flows to the SA River Murray in at least 6 years in 10
EF4	Support instream and floodplain productivity	<p>Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)</p> <p>Terrestrial primary productivity (vegetation)</p> <p>Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish)</p> <p>Decomposition of organic matter</p>	<p>Enhance riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients</p> <p>Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition over a 5-year rolling period</p> <p>Maintain native fish population structure that indicates successful transition from young-of-year to juveniles</p> <p>Incorporate habitat mapping and resnagging activities into broad-scale MER and riverbank remediation works for native fish management and recovery</p>	<p>No decline in key native fish species condition metrics</p> <p>Maintain the abundance and distribution of decapod crustaceans</p>	<p>Improve key native fish species condition metrics</p> <p>Improve the abundance and distribution of decapod crustaceans</p>

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/ wetlands	<p>Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands</p> <p>Entrainment of carbon and nutrients from dry in-channel surfaces (e.g. benches/banks), floodplains and wetlands to support production by aquatic species</p> <p>Dilution of carbon and nutrients that have returned to rivers</p>	<p>Maintain nutrient and carbon (DOC) pulses at multiple locations along rivers during freshes, bankfull and overbank events, especially those associated with flows occurring in the River Murray main stem (to SA border), Lower Darling River (connecting to the Murray River at the SA border), and the Edward and Wakool river systems.</p> <p>Increase lateral connectivity with anabranches, low-lying wetlands and floodplains, as specified in EWRs for large freshes, bankfull and overbank flows</p> <p>Maintain or improve the organic matter storage capacity of wetland and floodplain soils (baseline to be established)</p>		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	<p>Groundwater recharge and discharge</p> <p>Dilution of saline groundwater</p> <p>Salt export from the MDB</p>	<p>Maintain the 2016 mapped extent of groundwater-dependent vegetation communities</p> <p>Maintain groundwater levels within the natural range of variability over the long term</p>		
EF7	Increase the contribution of flows into the SA lower Murray River	Provision of end-of-system flows (NSW lower Murray and Lower Darling River) to support ecological objectives in downstream catchments (SA River Murray)	Provide in-channel connecting flows to the SA River Murray 8–10 years in 10 (>20,000 ML/d at the SA border), including at least 5 events with major contributions from the Lower Darling system (including longitudinal connectivity from source to SA border)		Provide small overbank (>45,000 ML/d) connecting flows to the SA River Murray in at least 6 years in 10.

Murrumbidgee ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Water depth and quality in pools (in-channel), core wetlands and lakes Condition of vegetation in core wetlands and riparian zones	Core wetland habitats ⁷⁰ are protected ⁷¹ , including during dry times		
			Cease-to-flow periods do not exceed maximum durations as specified in planning unit EWRs		
			Adequate water depth is maintained in key refuge pools ⁷² during dry times		
			In key refuge pools ⁷² maintain daily average dissolved oxygen >4 mg/L and hourly levels >2 mg/L		
EF2	Create quality instream, floodplain and wetland habitat ⁷³	Regulation of dissolved oxygen, salinity and water temperature Flow variability and hydrodynamic diversity Provision of diverse wetted areas Appropriate wetting and drying cycles Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats Appropriate rates of fall to avoid excessive bank erosion	Recession management: Rate of fall does not exceed the 95th percentile of natural rates ⁷⁴ during regulated water deliveries		
			Minimum flow variability: Period for which small and large freshes are held at constant level (±5%) does not exceed 20 days to avoid bank slumping and support instream function		
			Channel form: Watering requirements for overbank flows are met (refer to fish/vegetation/bird watering requirements)		
			Bench and pool formation and fine sediment scouring: Watering requirements for freshes are met (refer to fish/vegetation/bird watering requirements)		
			Create hydrodynamic complexity for large-bodied fish: Flows with velocities of 0.3–0.4 m/s provided as per watering requirements for freshes (refer to fish watering requirements)		

⁷⁰ Core wetland habitats are to be identified (see priority further work in Table 26 of the Murrumbidgee LTWP Part A).

⁷¹ Maintained in a state that will provide habitat for biota and allow recovery to good condition with wet season.

⁷² Key refuge pools are to be identified (see priority further work in Table 26 of the Murrumbidgee LTWP Part A).

⁷³ Also supports/supported by BWS expected outcome of 'a 30 to 60% increase in the frequency of freshes, bank-full and lowland floodplain flows in the... Murrumbidgee'

⁷⁴ 'Natural' rates generally estimated from pre-1950 observed data where a multi-decal record exists or, where this is not available, modelled natural data.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
		Control of woody-vegetation encroachment into river channels and wetlands			
EF3	Provide movement and dispersal opportunities for water-dependent biota to complete lifecycles and disperse into new habitats ^{75,73} : a. within catchment b. between catchments	Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats Migration to fulfil life-history requirements Foraging of aquatic species Recolonisation following disturbance	Increase, compared to 2004–2017 ⁷⁶ , dispersal opportunities between sub-catchments and between river reaches for moderate to long-lived flow pulse specialist native fish through key fish passages ⁷⁷ EWRs that support major life stages of biota in target habitat areas are met (refer to fish and vegetation EWRs for the end-of-system planning units) Minimum daily end-of-system flows (as specified in the WRP) maintained		
EF4	Support instream and floodplain productivity ⁷³	Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton) Terrestrial primary productivity (vegetation)	Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition ⁷⁸ over a 5-year rolling period Enhance riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients (specific targets and indicators to be developed) ⁷⁹		

⁷⁵ In line with BWS objective (under the heading ‘moderate to long-lived species’) of ‘annual detection of species and life stages representative of the whole fish community through key fish passages; with an increase in passage of Murray cod, trout cod, golden perch, silver perch. [and] short-headed lamprey through key fish passages to be detected in 2019–2024; compared to passage rates detected in 2014–2019’.

⁷⁶ To be assessed against a combination of observed data and the modelled baseline scenario that represents the consumptive use and the rules and sharing arrangements as at June 2009. Comparisons will need to take into account any limitations in the model and, for the observed data, the comparability of the weather during the baseline period and target period.

⁷⁷ Key fish passages to be identified by DPI Fisheries.

⁷⁸ In line with condition targets set for the native vegetation objectives.

⁷⁹ See priority further work in Table 26 of the Murrumbidgee LTWP Part A.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
		Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish) Decomposition of organic matter	No decline in key native fish species ⁸⁰ condition metrics Maintain the abundance and distribution of decapod crustaceans	Improve key native fish species condition metrics ⁸⁰ Improve the abundance and distribution of decapod crustaceans	
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands ⁷³	Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats Dilution of carbon and nutrients that have returned to rivers	Maintain the frequency and duration of events that drive nutrient and carbon (DOC) processes (at selected evaluation sites) along channels (refer to freshes and overbank EWRs) Maintain extent and condition of floodplain vegetation (measured under vegetation theme targets)		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	Groundwater recharge and discharge Dilution of saline/acidic groundwater	Maintain the 2016 mapped extent of groundwater-dependent vegetation communities ⁸¹ Maintain groundwater levels within the natural range of variability over the long-term		

⁸⁰ Key fish species that are relevant in each planning unit, as described in and assessed under the targets for the native fish objectives.

⁸¹ Note: Groundwater systems are not well understood and there may be a need for more information gathering before this can be meaningfully measured. These targets are one way of measuring but may not be able to be done in the first instance. In the meantime, it is known that large floods recharge the groundwater systems and flush salts from the soils. These cannot be delivered with held environmental water. Hence there is a need to protect these larger events when they do occur.

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF7	Increase the contribution of flows into the Murray and Barwon–Darling from tributaries ⁸²	Provision of end-of-system flows to support ecological objectives in downstream catchments Salt export from the MDB	A 30% overall increase in flows in the River Murray: from increased tributary contributions from the Murrumbidgee, Goulburn, Campaspe, Loddon and Lower Darling catchments collectively (with the Murrumbidgee contributing proportionally)		

Namoi ecological objectives and targets for PEFs

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
EF1	Provide and protect a diversity of refugia across the landscape	Water depth and quality in pools (in-channel), core wetlands and lakes Condition of vegetation in core wetlands and riparian zones	Key wetlands and billabongs and effluent streams (both instream and anabranch) habitats are protected during dry times Very low flows (VFs) and baseflows (BF1) are provided at target magnitudes and durations as specified in planning unit EWRs Cease-to-flow periods do not exceed maximum durations in line with the natural modelled data Adequate water depth is maintained in key instream and anabranch refuge pools during dry times Maintain dissolved oxygen >4 mg/L in key refuge pools		
EF2	Create quality instream, floodplain and wetland habitat	Regulation of dissolved oxygen, salinity and water temperature Flow variability and hydrodynamic diversity	Rates of fall do not exceed the 5th percentile of modelled natural rates during regulated water deliveries Period for which instream freshes are held at constant level (±5%) does not exceed modelled natural durations (when not in conflict with the spawning flow requirement)		

⁸² In line with BWS expected outcome of ‘30% overall increase in flows in the River Murray: from increased tributary contributions from the Murrumbidgee, Goulburn, Campaspe, Loddon and Lower Darling catchments collectively’. The Barwon–Darling is mentioned here to keep the wording of objectives across the NSW consistent.

Ecological objectives			Description and key contributing processes	Targets		
				5 years (2024)	10 years (2029)	20 years (2039)
			Provision of diverse wetted areas Appropriate wetting and drying cycles Geomorphic (erosion/deposition) processes that create and maintain diverse physical habitats Appropriate rates of fall to avoid excessive bank erosion Control of woody-vegetation encroachment into river channels and wetlands, including willows	At least 1 overbank/wetland inundating event 9 years in 10 in relevant planning units At least 3 fresh events per year to inundate in-channel habitat in relevant planning units		
EF3a	Provide movement and dispersal opportunities within catchments for water-dependent biota to complete lifecycles:	a. within catchment	Dispersal of eggs, larvae, propagules and seeds downstream and into off-channel habitats	Annual detection of relevant species and life stages representative of the whole fish community through key areas and specified planning units		
EF3b		b. between catchments	Migration to fulfil life-history requirements Foraging of aquatic species Recolonisation following disturbance	Support fish passage through key fish passages (e.g. Mollee, Gunidgera, Walgett on the Namoi and Jewry Street causeway, Paradise Bridge water supply pipeline and Calala water gauge on the Peel River) Increased dispersal opportunities between sub-catchments The recommended frequency and duration of flows providing lateral connectivity with anabranches, low-lying wetlands and floodplains are met (see EWRs for large freshes and above) Provide longitudinal connectivity and integrity of flows to end-of-system, including flow pulses (regulated, natural or augmented natural). Increase dispersal opportunities between the Namoi and the Barwon–Darling catchments		
EF4	Support instream and floodplain productivity		Aquatic primary productivity (algae, macrophytes, biofilms, phytoplankton)	Maintain or increase the proportion of wetland and floodplain vegetation that is in good condition over a 5-year rolling period Maintain native fish population structure that indicates successful transition from young-of-year to juveniles		

Ecological objectives		Description and key contributing processes	Targets		
			5 years (2024)	10 years (2029)	20 years (2039)
		<p>Terrestrial primary productivity (vegetation)</p> <p>Aquatic secondary productivity (zooplankton, macroinvertebrates, fish larvae, adult fish)</p> <p>Decomposition of organic matter</p>	<p>Enhance riverine productivity to support increased food availability for aquatic food webs by increasing the supply of autochthonous and allochthonous carbon and nutrients</p>	<p>No decline in key native fish species condition metrics</p> <p>Maintain the abundance and distribution of decapod crustaceans</p>	<p>Improve key native fish species condition metrics</p> <p>Improve the abundance and distribution of decapod crustaceans</p>
EF5	Support nutrient, carbon and sediment transport along channels, and between channels and floodplains/wetlands	<p>Sediment delivery to downstream reaches and to/from anabranches, floodplains and wetlands</p> <p>Mobilisation of carbon and nutrients from in-channel surfaces (e.g. benches/banks), floodplains and wetlands and transport to downstream reaches and off-channel habitats</p> <p>Dilution of carbon and nutrients that have returned to rivers</p>	<p>Maintain nutrient and carbon (DOC) pulses at multiple locations along a channel during freshes, bankfull and overbank events</p> <p>Increase lateral connectivity with anabranches, low-lying wetlands and floodplains, as specified in EWRs for large freshes, bankfull events, wetland inundating flows and overbank flows</p> <p>Maintain extent and condition of floodplain vegetation</p> <p>Maintain soil nitrogen, phosphorus and carbon levels at long-term natural levels</p>		
EF6	Support groundwater conditions to sustain groundwater-dependent biota	<p>Groundwater recharge and discharge</p> <p>Dilution of saline/acidic groundwater</p> <p>Salt export from the MDB</p>	<p>Maintain the 2016 mapped extent of groundwater-dependent vegetation communities</p> <p>Maintain groundwater levels within the natural range of variability over the long term</p>		
EF7	Maintain and improve the contribution of flows into	Provision of end-of-system flows to support ecological	Maintain at least 60% of natural level baseflows from the Namoi into the Barwon-Darling		

Ecological objectives	Description and key contributing processes	Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
the Barwon-Darling from tributaries	objectives in downstream catchments	Provide (protect, increase and maintain) low flows (including baseflows) from the Namoi River to the Barwon-Darling catchment a minimum of 5–10 years in 10 and in-channel freshes a minimum of 2–3 years in 10 Protect larger flows across the Namoi catchment that can reach the Barwon–Darling catchment A 10% overall increase in flows in the Barwon–Darling from increased tributary contributions from the Namoi and other northern basin catchments (Condamine–Balonne, Border Rivers, Gwydir and Macquarie–Castlereagh) ⁸³		

⁸³ This longitudinal connectivity target is adopted from the Basin-wide Environmental Water Strategy. Note this is not a direct 10% increase from the Namoi catchment alone but a 10% increase of flows into the Barwon–Darling.

Chapter 8 appendices: Frogs and other species

Appendix 8.1: Summary of frog species and their hydrology, habitat and breeding requirements

Hydro-ecological functional group	Common name	Scientific name	Broad habitat description	Breeding activity timing group
Flow-ambivalent	Desert froglet	<i>Crinia deserticola</i>	Ground non-burrowing lowland	Rain – spring–summer
	Green tree frog	<i>Litoria caerulea</i>	Arboreal–lowland	Rain – spring–summer
	Bleating tree frog	<i>Litoria dentata</i>	Arboreal–midland–upland	Rain – spring–summer
	Desert tree frog	<i>Litoria rubella</i>	Arboreal–lowland	Rain – spring–summer
	Bibron’s toadlet	<i>Pseudophryne bibronii</i>	Ground non-burrowing midland–upland	Rain – flexible
	Red-backed toadlet	<i>Pseudophryne coriacea</i>	Ground non-burrowing midland–upland	Rain – flexible
	Smooth toadlet	<i>Uperoleia laevigata</i>	Ground non-burrowing midland–upland	Rain – flexible
Flow-oblivious	Striped burrowing frog	<i>Cyclorana alboguttata</i>	Burrowing	Rain – spring–summer
		<i>Cyclorana brevipes</i>	Burrowing	Rain – spring–summer
		<i>Cyclorana cultripes</i>	Burrowing	Rain – spring–summer
	New holland frog	<i>Cyclorana novaehollandiae</i>	Burrowing	Rain – spring–summer
	Water-holding frog	<i>Cyclorana platycephala</i>	Burrowing	Rain – spring–summer
	Warty water-holding frog	<i>Cyclorana verrucosa</i>	Burrowing	Rain – spring–summer
	Sudell’s frog	<i>Neobatrachus sudelli</i>	Burrowing	Rain – winter–summer
	Crucifix frog	<i>Notaden bennettii</i>	Burrowing	Rain – spring–summer
	Ornate burrowing frog	<i>Platyplectrum ornatum</i>	Burrowing	Rain – spring–summer
	Southern corroboree frog	<i>Pseudophryne corroboree</i>	Ground non-burrowing alpine	Spring–summer non–flexible

Hydro-ecological functional group	Common name	Scientific name	Broad habitat description	Breeding activity timing group
	Southern toadlet	<i>Pseudophryne dendyi</i>	Ground non-burrowing upland	Spring–summer non–flexible
	Northern corroboree frog	<i>Pseudophryne pengilleyi</i>	Ground non-burrowing alpine	Spring–summer non–flexible
	Small-headed toadlet	<i>Uperoleia capitulata</i>	Burrowing	Rain – spring–summer
	Wrinkled toadlet	<i>Uperoleia rugosa</i>	Burrowing	Rain – spring–summer
Flow-dependent	Eastern sign-bearing froglet	<i>Crinia parinsignifera</i>	Ground non-burrowing lowland	Flexible
	Common eastern froglet	<i>Crinia signifera</i>	Ground non-burrowing midland–upland	Flexible
	Sloane’s froglet	<i>Crinia sloanei</i>	Ground non-burrowing midland–upland	Autumn–winter–spring
	Eastern banjo frog	<i>Limnodynastes dumerilii</i>	Burrowing	Flexible
	Barking marsh frog	<i>Limnodynastes fletcheri</i>	Ground non-burrowing lowland	Flexible
	Giant banjo frog	<i>Limnodynastes interioris</i>	Burrowing	Flexible
	Striped marsh frog	<i>Limnodynastes peronii</i>	Ground non-burrowing midland–upland	Flexible
	Salmon striped frog	<i>Limnodynastes salmini</i>	Ground non-burrowing lowland	Flexible
	Spotted grass frog	<i>Limnodynastes tasmaniensis</i>	Ground non-burrowing lowland	Flexible
	Northern banjo frog	<i>Limnodynastes terraereginae</i>	Burrowing	Flexible
	Brown tree frog	<i>Litoria ewingii</i>	Arboreal–midland–upland	Autumn–winter–spring
	Eastern dwarf sedge frog	<i>Litoria fallax</i>	Arboreal–upland	Spring–summer flexible
	Broad-palmed frog	<i>Litoria latopalmata</i>	Ground non-burrowing lowland	Spring–summer flexible
	Victorian frog	<i>Litoria paraewingii</i>	Arboreal–midland–upland	Autumn–winter–spring

Hydro-ecological functional group	Common name	Scientific name	Broad habitat description	Breeding activity timing group
	Peron's tree frog	<i>Litoria peronii</i>	Arboreal–lowland	Spring–summer flexible
	Southern bell frog	<i>Litoria raniformis</i>	Ground non-burrowing lowland	Spring–summer flexible
	Tyler's tree frog	<i>Litoria tyleri</i>	Arboreal–upland	Spring–summer flexible
	Verreaux's frog	<i>Litoria verreauxii</i>	Ground non-burrowing midland–upland	Flexible
Flow-stream	Booroolong frog	<i>Litoria booroolongensis</i>	Stream–upland	Spring–summer non–flexible
	Stoney creek frog	<i>Litoria lesueuri</i>	Stream–upland	Spring–summer non–flexible
	Leaf green river tree frog	<i>Litoria nudidigita</i>	Stream–upland	Spring–summer non–flexible
	Green stream frog	<i>Litoria phyllochroa</i>	Stream–upland	Spring–summer non–flexible

Appendix 8.2: Baseline data used to set objectives and targets for flow-dependent frog species in the LTWPs

WRPA	Wetland region	Baseline data period	Number of monitoring sites	Source	Notes
Gwydir	Gwydir Wetlands	2015–2017	16 sites	Ocock and Spencer (2018a), Walcott et al. (2020)	
Macquarie	Macquarie Marshes	2015–2017	14 sites	Ocock and Spencer (2018b), Walcott et al. (2020)	
Lachlan ⁸⁴	Lower Lachlan	2012–2016	31 sites	Amos (2017) and Amos et al. (2013)	Current baseline data limited to lower Lachlan as no ongoing

⁸⁴ Note that while there are records for the southern bell frog in the lower Lachlan (Amos et al. 2014), it is not included in the OS1 list of flow-dependent frog species as the population is not thought to be currently viable. This could be reviewed in later versions of the plan.

WRPA	Wetland region	Baseline data period	Number of monitoring sites	Source	Notes
			14 sites	Dyer et al. (2016)	survey coverage for the mid Lachlan. <i>Neobatrachus sudelli</i> not included as it is not a reliably flow-dependent species and is hard to detect with regular monitoring.
			12 sites	Amos et al. (2014)	
Murrumbidgee	Lowbidgee Floodplain	2014–2019	8 sites	Wassens et al. (2019)	
			8–11 sites	Known southern bell frog sites based on SoS work – (Waudby et al. 2020)	Monitoring from 2017–18 onwards. Informs OS3a.
	Mid Murrumbidgee	2014–2019	4 sites	Wassens et al. (2019)	
			7–8 sites	Known southern bell frog sites based on SoS work – (Waudby et al. 2020)	Monitoring from 2017–18 onwards. Informs OS3a. Includes sites in the Coleambally Irrigation Area. These are not within the mid Murrumbidgee planning units
NSW Murray–Lower Darling	Lower Darling	2010–2014	17 sites	Bogenhuber et al. (2013), Bogenhuber et al. (2014) Lower Darling work based on DAAMP project 2010–2014	

WRPA	Wetland region	Baseline data period	Number of monitoring sites	Source	Notes
	Lower Murray	2012–2017	3–8 sites	Based on Wilson and Healy (unpublished data) 2012–2017	Data gap for OS2 – breeding and recruitment baseline not available for lower Murray and mid Murray
			3–6 sites	Known southern bell frog sites based on SoS work – (Waudby et al. 2020)	Monitoring from 2017–18 onwards. Informs OS3a.
	Mid Murray	2012–2017	3–12 sites	Based on Wilson and Healy (unpublished data) 2012–2017	Data gap for OS2 – breeding and recruitment baseline not available for lower Murray and mid Murray
			9–16 sites	Known southern bell frog sites based on SoS work (Waudby et al. 2020)	Monitoring from 2017–18 onwards. Informs OS3a.
Intersecting Streams	N/A				
Barwon–Darling	N/A				
Namoi	N/A				
NSW Border Rivers	N/A				

Appendix 8.3: Other water-dependent species objectives and targets included in NSW LTWPs

Gwydir ecological objectives and targets for other species (OS) (DPIE EES 2020a)

Objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
OS1	Maintain species richness and distribution of flow-dependent frog communities	Detect all 6 flow-dependent frog species known from the Gwydir Wetlands based on comprehensive surveys over the 2015–2017 period		
OS2	Maintain successful ⁸⁵ breeding opportunities for flow-dependent frog species	Maintain proportion of wetland sites where breeding activity ⁸⁶ of flow-dependent frog species is detected in the Gwydir Wetlands compared to the 2015–2017 period		
OS4 ⁸⁷	Maintain water-dependent species richness	Over the long term (20 years) no reduction in the number and range of water-dependent species that are found throughout the catchment Platypus present in the Gwydir River downstream of Copeton Dam planning unit and relevant Zone B planning units ⁸⁸ Evidence of platypus burrows and successful breeding detected		

Macquarie–Castlereagh ecological objectives and targets for OS (DPIE EES 2020b)

Objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
OS1	Maintain species richness and distribution of flow-dependent frog communities	Over a 5-year rolling period, detect, in each assessment period, all 6 flow-dependent frog species known from the Macquarie Marshes based on comprehensive surveys over the 2015–2017 period		
OS2	Maintain successful ⁸⁵ breeding opportunities for flow-dependent frog species	Over a 5-year rolling period, maintain proportion of wetland sites where breeding activity ⁸⁶ of flow-dependent frog species is detected in the Macquarie Marshes compared to the 2015–2017 period		

⁸⁵ 'Successful' relates to opportunities for species to complete the breeding lifecycle i.e. laying eggs, to development of tadpoles, through to metamorphs (juvenile frogs), which relates to water requirements for minimum duration of inundation.

⁸⁶ 'Breeding activity' defined as evidence of male frog callings, frog spawn observed, tadpoles detected and/or recently metamorphosed juvenile frogs as evidence of potential recruitment of new individuals into the breeding population.

⁸⁷ OS3 refers to objectives relating to southern bell frogs and Sloane's froglets which are not relevant in the catchment.

⁸⁸ Refer to Part B of the relevant LTWP for the planning units where platypus have been recorded.

Lachlan ecological objectives and targets for OS (DPIE EES 2020c)

Objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
OS1	Maintain species richness and distribution of flow-dependent frog communities	Detect all 5 flow-dependent frog species known from the lower Lachlan area based on comprehensive surveys over the 2012–2016 period		
OS2	Maintain successful ⁸⁵ breeding opportunities for flow-dependent frog species	Maintain proportion of wetland sites where breeding activity ⁸⁶ of flow-dependent frog species is detected in the lower Lachlan area compared to the 2012–2016 period		
OS4 ⁸⁷	Maintain water-dependent species richness	<p>Over the long term (20 years) no reduction in the number and range of water-dependent species that are found throughout the catchment</p> <p>Maintain the current range of platypus across the Lachlan catchments⁸⁸</p> <p>Evidence of platypus burrows and successful breeding detected</p>		

Murrumbidgee ecological objectives and targets for OS (DPIE EES 2020d)

Objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
OS1	Maintain species richness and distribution of flow-dependent frog communities	Detect all 6 flow-dependent frog species known from the Lowbidgee and mid Murrumbidgee wetlands based on comprehensive surveys over the 2014–2019 period		
OS2	Maintain successful ⁸⁵ breeding opportunities for flow-dependent frog species	Maintain proportion of wetland sites where breeding activity ⁸⁶ of flow-dependent frog species is detected in the Lowbidgee and mid Murrumbidgee wetlands compared to the 2014–2019 period		
OS3a	Maintain and increase number of wetland sites occupied by the threatened southern bell frog	Proportion of known sites ⁸⁹ where southern bell frogs are detected is maintained on a 3-year rolling average	Proportion of known sites ⁸⁹ where southern bell frogs are detected is 10% above baseline on a 3-year rolling average	
		Detected in the catchment 5 years in 5	Detected in the catchment 5 years in 5	
		Proportion of known sites ⁸⁹ where potential recruitment is detected is maintained on a 3-year rolling average	Proportion of known sites ⁸⁹ where potential recruitment ⁸⁶ is detected is increased by 10% on a 3-year rolling average	

⁸⁹ Surveyed sites in the Lowbidgee floodplain, mid Murrumbidgee and the Murrumbidgee infrastructure floodplain wetlands planning unit.

NSW Murray–Lower Darling ecological objectives and targets for OS (DPIE EES 2020e)

Objectives		Targets		
		5 years (2024)	10 years (2029)	20 years (2039)
OS1	Maintain species richness and distribution of flow-dependent frog communities	Detect all flow-dependent frog species known from the lower Darling (5 species), lower Murray (8 species), and mid Murray (9 species) regions based on comprehensive surveys over the 2010–2017 period		
OS2	Maintain successful ⁸⁵ breeding opportunities for flow-dependent frog species	Establish baseline data on the number and distribution of wetlands with breeding activity ⁸⁶ of flow-dependent frog species	Maintain proportion of wetland sites where breeding activity ⁸⁶ of flow-dependent frog species is detected in the lower Darling, lower Murray and mid Murray regions compared to comprehensive surveys in the 2019–2024 period	
OS3a ⁹⁰	Maintain and increase number of wetland sites occupied by the threatened southern bell frog	Detect southern bell frogs at 80% of known sites in the lower and mid Murray regions in the 2019–2024 period Detect potential recruitment ⁸⁶ of southern bell frogs in at least 80% of targeted watered wetland sites in the LTWP area in 5 years in 5	Detect southern bell frog at 90% of known sites in the lower and mid Murray regions Detect potential recruitment ⁸⁶ of southern bell frog in at least 90% of targeted watered wetland sites in the LTWP area 5 years in 5	
OS3b ⁹⁰	Maintain and increase number of wetland sites occupied by the threatened Sloane’s froglet	Detect Sloane’s froglet at 80% of known sites in the upper and mid Murray in the 2019–2024 period	Detect the Sloane’s froglet at 90% of known sites in the upper and mid Murray regions	
OS4	Maintain water-dependent species richness	Over the longer term (20 years) no reduction in the number and range of water-dependent species that are found throughout the catchment		

⁹⁰ Southern bell frog and Sloane’s froglet targets align with the NSW *Saving Our Species* program, with 80% maintenance and improvement to 90% occupancy at surveyed sites.

Appendix 8.4: Water-dependent species in the class Aves recorded in the NSW MDB for each relevant WRPA

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
Regent honeyeater	<i>Anthochaera phrygia</i>			X	X	X
Fork-tailed swift	<i>Apus pacificus</i>		X			
Unidentified egret	<i>Ardea/Egretta</i> sp.		X			
Dusky woodswallow	<i>Artamus cyanopterus</i>	X	X	X	X	X
White-breasted woodswallow	<i>Artamus leucorhynchus</i>	X	X	X	X	X
Pacific baza	<i>Aviceda subcristata</i>	X				
Sulphur-crested cockatoo	<i>Cacatua galerita</i>	X		X	X	X
Little corella	<i>Cacatua sanguinea</i>	X		X	X	X
Little corella	<i>Cacatua sanguinea gymnopsis</i>			X	X	
Sanderling	<i>Calidris alba</i>				X	
Great knot	<i>Calidris tenuirostris</i>				X	
Red-tailed black-cockatoo (inland subspecies)	<i>Calyptorhynchus banksii samueli</i>		X		X	
Pheasant coucal	<i>Centropus phasianinus</i>	X				
Azure kingfisher	<i>Ceyx azureus</i>	X	X	X	X	X
Horsfield's bronze-cuckoo	<i>Chalcites basalis</i>			X	X	X
Lesser sand-plover	<i>Charadrius mongolus</i>				X	
Swamp harrier	<i>Circus approximans</i>		X	X	X	X
Golden-headed cisticola	<i>Cisticola exilis</i>	X	X	X	X	X
Brown treecreeper	<i>Climacteris picumnus</i>			X	X	

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
Brown treecreeper	<i>Climacteris picumnus picumnus</i>			X	X	X
Brown treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>			X	X	X
White-bellied cuckoo-shrike	<i>Coracina papuensis</i>		X	X	X	X
Cicadabird	<i>Coracina tenuirostris</i>	X		X	X	X
Laughing kookaburra	<i>Dacelo novaeguineae</i>	X	X	X	X	X
Black-shouldered kite	<i>Elanus axillaris</i>	X				
Letter-winged kite	<i>Elanus scriptus</i>	X				
White-fronted chat	<i>Epthianura albifrons</i>	X	X	X	X	X
Dollarbird	<i>Eurystomus orientalis</i>	X		X	X	X
Black falcon	<i>Falco subniger</i>		X			
Crested shrike-tit	<i>Falcunculus frontatus</i>			X	X	X
Eastern shrike-tit	<i>Falcunculus frontatus frontatus</i>		X			
Peaceful dove	<i>Geopelia striata</i>		X			
White-throated gerygone	<i>Gerygone olivacea</i>			X	X	X
Oriental pratincole	<i>Glareola maldivarum</i>			X		X
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	X	X	X	X	X
Brahminy kite	<i>Haliastur indus</i>	X				
Whistling kite	<i>Haliastur sphenurus</i>	X	X	X	X	X
Black-breasted buzzard	<i>Hamirostra melanosternon</i>	X				
Little eagle	<i>Hieraaetus morphnoides</i>		X			
White-throated needletail	<i>Hirundapus caudacutus</i>		X			

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
Welcome swallow	<i>Hirundo neoxena</i>	X	X	X	X	X
Swift parrot	<i>Lathamus discolor</i>	X				
White-plumed honeyeater	<i>Lichenostomus penicillatus</i>				X	
Chestnut-breasted mannikin	<i>Lonchura castaneothorax</i>	X				
Little grassbird	<i>Megalurus gramineus</i>	X		X	X	X
Tawny grassbird	<i>Megalurus timoriensis</i>	X				X
Budgerigar	<i>Melopsittacus undulatus</i>	X				
Rainbow bee-eater	<i>Merops ornatus</i>	X	X	X	X	X
Satin flycatcher	<i>Myiagra cyanoleuca</i>	X				
Restless flycatcher	<i>Myiagra inquieta</i>	X	X	X	X	X
Scarlet honeyeater	<i>Myzomela sanguinolenta</i>	X				
Plum-headed finch	<i>Neochmia modesta</i>	X	X	X	X	X
Red-browed finch	<i>Neochmia temporalis</i>	X	X	X	X	X
Blue-winged parrot	<i>Neophema chrysostoma</i>	X				
Turquoise parrot	<i>Neophema pulchella</i>	X				
Cotton pygmy-goose	<i>Nettapus coromandelianus</i>		X			
Green pygmy-goose	<i>Nettapus pulchellus</i>		X			
Barking owl	<i>Ninox connivens</i>	X		X	X	X
Southern boobook	<i>Ninox novaeseelandiae</i>			X	X	X
Eastern osprey	<i>Pandion cristatus</i>	X	X	X	X	X
Yellow rosella/turquoise parrot	Parrot Hybrid				X	
Fairy martin	<i>Petrochelidon ariel</i>	X	X	X	X	X

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
Tree martin	<i>Petrochelidon nigricans</i>	X		X	X	X
Rose robin	<i>Petroica rosea</i>		X	X	X	X
Regent parrot (eastern subspecies)	<i>Polytelis anthopeplus monarchoides</i>			X	X	
Superb parrot	<i>Polytelis swainsonii</i>			X	X	X
White-plumed honeyeater	<i>Ptilotula penicillatus</i>		X	X	X	X
White-plumed honeyeater	<i>Ptilotula penicillatus penicillatus</i>			X	X	X
Small grebe	small grebe sp.		X			
Tern	<i>Sterna</i> sp.		X			
Australian pratincole	<i>Stiltia isabella</i>	X		X	X	X
Double-barred finch	<i>Taeniopygia bichenovii</i>		X			
Zebra finch	<i>Taeniopygia guttata</i>		X			
Forest kingfisher	<i>Todiramphus macleayii</i>	X	X	X		X
Red-backed kingfisher	<i>Todiramphus pyrrhopygius</i>	X	X	X	X	X
Sacred kingfisher	<i>Todiramphus sanctus</i>	X	X	X	X	X
Masked owl	<i>Tyto novaehollandiae</i>	X	X	X	X	X
Masked lapwing	<i>Vanellus miles</i>	X	X	X	X	X
Banded lapwing	<i>Vanellus tricolor</i>	X	X	X	X	X

Appendix 8.5: Water-dependent species in the class Mammalia recorded in the NSW MDB for each relevant WRPA

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
White-striped freetail-bat	<i>Austronomus australis</i>	X		X	X	X
Large-eared pied bat	<i>Chalinolobus dwyeri</i>	X				
Gould’s wattled bat	<i>Chalinolobus gouldii</i>	X		X	X	X
Chocolate wattled bat	<i>Chalinolobus morio</i>	X		X	X	X
Little pied bat	<i>Chalinolobus picatus</i>	X		X	X	X
Water-rat	<i>Hydromys chrysogaster</i>	X	X	X	X	X
Eastern bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	X	X	X	X	X
Beccari’s freetail-bat	<i>Mormopterus beccarii</i>	X				
Inland free-tailed bat	<i>Mormopterus petersi</i>	X		X	X	X
Little mastiff-bat	<i>Mormopterus planiceps</i>	X		X	X	X
Eastern free-tailed bat	<i>Mormopterus ridei</i>	X		X	X	X
Southern myotis	<i>Myotis macropus</i>			X	X	X
Corben’s long-eared bat	<i>Nyctophilus corbeni</i>	X		X	X	X
Lesser long-eared bat	<i>Nyctophilus geoffroyi</i>	X		X	X	X
Gould’s long-eared bat	<i>Nyctophilus gouldi</i>	X		X	X	X
Platypus	<i>Ornithorhynchus anatinus</i>	X	X	X	X	X
Unidentified glider	<i>Petaurus/Petauroides sp.</i>		X			
Swamp rat	<i>Rattus lutreolus</i>		X	X		

Common name	Scientific name	WRPA				
		Gwydir	Macquarie- Castlereagh	Murrumbidgee	NSW Murray- Lower Darling	Lachlan
Eastern horseshoe-bat	<i>Rhinolophus megaphyllus</i>	X		X		X
Yellow-bellied sheath-tail-bat	<i>Saccolaimus flaviventris</i>	X		X	X	X
Greater broad-nosed bat	<i>Scoteanax rueppellii</i>	X	X	X		X
Inland broad-nosed bat	<i>Scotorepens balstoni</i>	X	X	X	X	X
Little broad-nosed bat	<i>Scotorepens greyii</i>	X	X	X	X	X
Eastern broad-nosed bat	<i>Scotorepens orion</i>	X		X	X	X
North-eastern sheath-tail-bat	<i>Taphozous australis</i>			X	X	
Inland forest bat	<i>Vespadelus baverstocki</i>			X	X	X
Large forest bat	<i>Vespadelus darlingtoni</i>	X		X	X	X
Eastern forest bat	<i>Vespadelus pumilus</i>			X		X
Southern forest bat	<i>Vespadelus regulus</i>	X		X	X	X
Eastern cave bat	<i>Vespadelus troungtoni</i>	X				
Little forest bat	<i>Vespadelus vulturnus</i>	X		X	X	X
Swamp wallaby	<i>Wallabia bicolor</i>		X			

Appendix 8.6: Water-dependent species in the class Reptilia recorded in the NSW MDB for each relevant WRPA

Common name	Scientific name	WRPA				
		Gwydir	Macquarie– Castlereagh	Murrumbidgee	NSW Murray– Lower Darling	Lachlan
Broad-shelled turtle	<i>Chelodina expansa</i>	X	X	X	X	
Eastern snake-necked turtle	<i>Chelodina longicollis</i>	X		X	X	X
Bell's turtle	<i>Elseya belli</i>	X				
Macquarie turtle	<i>Emydura macquarii</i>	X		X	X	X
Macquarie river turtle	<i>Emydura macquarii macquarii</i>	X	X	X	X	
Yellow-bellied water-skink	<i>Eulamprus heatwolei</i>		X	X	X	X
Eastern water-skink	<i>Eulamprus quoyii</i>	X	X		X	X
Southern water-skink	<i>Eulamprus tympanum</i>		X	X	X	
Pale-headed snake	<i>Hoplocephalus bitorquatus</i>	X				
Eastern water dragon	<i>Intellagama lesueurii</i>	X	X	X	X	X
Gippsland water dragon	<i>Intellagama lesueurii howitti</i>			X	X	X
Eastern robust slider	<i>Lerista punctatovittata</i>		X			
Burns' dragon	<i>Lophognathus burnsi</i>	X				
Red-bellied black snake	<i>Pseudechis porphyriacus</i>	X	X	X	X	X
Swampland cool-skink	<i>Pseudemoia rawlinsoni</i>			X		

Chapter 10 appendices: Environmental water requirements (EWRs)

Appendix 10.1: Role of different flow categories in supporting native fish lifecycles

Flow category	Role of flow in native fish lifecycle
Very low flow	<p>Small flow in the very low flow class that joins river pools thus providing partial or complete connectivity in a reach.</p> <p>Improve dissolved oxygen saturation and may help prevent thermal stratification in pools. In many locations, higher flows are required to prevent stratification.</p> <p>Protect pools from drying down for extended periods.</p> <p>Prevent contraction of the river to discreet pools (i.e. minimise the duration of cease-to-flow events).</p>
Baseflows	<p>Confined to the deeper low-lying parts of the channel, and would typically inundate pools and riffle areas between pools.</p> <p>Baseflows (and cease-to-flows) also allow for the accumulation of allochthonous carbon and vegetation on benches and dry river channel sediments, which then contribute to ecosystem productivity during subsequent flow events.</p> <p>They would generally occur on an ongoing basis in perennial systems and precede cease-to-flow events in ephemeral streams.</p> <p>They may be important in maintaining aquatic habitat for fish, plants and invertebrates when low inflow conditions prevail, retain longitudinal connectivity for small-bodied fish, and maintain reasonable water quality.</p> <p>Baseflows maintain drought refuges during dry periods and contribute to nutrient dilution during wet periods or after a flood event.</p> <p>Baseflows may also support winter conditioning and oxygenation through riffle habitats, and historically may have benefited small-bodied native species in terminal wetlands.</p>
Small fresh	<p>Generally short increases in flow that provide longitudinal connectivity and may provide productivity benefits by replenishing soil water for riparian vegetation, inundating low-lying benches and cycling nutrients between different parts of the river channel.</p> <p>Small pulses are generally considered to be relatively slow flowing (e.g. <0.3 m/s).</p> <p>Provide recruitment opportunities for river specialists (e.g. Murray cod).</p> <p>They can contribute to the maintenance of refugia and key aquatic habitat such as snags and aquatic vegetation, which supports diverse heterotrophic biofilm generation, with high nutritional value to higher organisms.</p> <p>Small within-channel pulses would have generally occurred annually throughout most of the Basin, and several times in a year for perennial systems.</p>

Flow category	Role of flow in native fish lifecycle
Large fresh	<p>More substantial increases in flow that provide inundation of within-channel features such as benches and longitudinal connectivity and may connect floodplain wetlands and anabranches with low commence-to-flow thresholds.</p> <p>Large within-channel pulses are distinct from small pulses in that they provide fast flowing in-channel habitats (e.g. velocity >0.3 m/s).</p> <p>Enhance productivity and nutrient exchange, promote dispersal and recruitment for all species and can trigger spawning in flow-dependent species (i.e. golden perch and silver perch).</p> <p>Important for maintaining refuges and minimising geomorphological impacts of regulation (e.g. sedimentation). Maintaining natural rates of change in water level may be important for nesting species, such as Murray cod, freshwater catfish and purple spotted gudgeon, as water level fluctuations that are out of sync with natural patterns and climatic cues can have adverse impacts (e.g. rapid decreases in water levels over short time periods leading to nest abandonment).</p> <p>Would have generally occurred annually across most of the Basin, and several times a year in some systems.</p>
Overbank events and wetland inundating flows	<p>Inundate floodplain and off-channel habitats and are important in providing lateral connectivity, large-scale nutrient and sediment cycling and an increase in productivity.</p> <p>Overbank events can enhance breeding opportunities for many species by creating additional spawning habitat and floodplain productivity benefits, which contribute to increased condition and recruitment.</p> <p>Generally, would have occurred every 1–10 years (depending on the magnitude of the event, sometimes less frequent) for both intermittent and perennial systems.</p> <p>These events are generally unregulated, although there may be scenarios where environmental water activities could augment within-channel flows to create overbank events in which case the shape of these events should reflect the natural rates of flow increase or decrease corresponding to position in the catchment.</p>

Appendix 10.2: Ideal generic EWRs to support all native fish groups

Flow category	Native fish functional group	Primary ecological objective ⁹¹	Ideal environmental water requirement				Other requirements and comments
			Timing ⁹²	Minimum duration ⁹³	Frequency ⁹⁴	Maximum inter-event period ⁹⁵	
Cease-to-flow	All native fish groups	Maintenance / Survival	In line with natural	In line with natural (unless key refuges endangered)	N/A	N/A	

⁹¹ Objectives related to spawning of in-channel specialists in the northern Basin (i.e. SF2) should be assessed based on the determined rates for the specific flow category (i.e. within the associated flow thresholds). Objectives related to spawning of in-channel specialists in the southern Basin may be able to be assessed based on exceedance of flow rates (i.e. above the associated minimum flow threshold) due to the different hydrological conditions that prevail in the extensive lowland systems of the southern Basin (i.e. increases in discharge generally do not result in substantial increases in water velocity, posing less of a potential impact on disrupting spawning outcomes when compared to the more dynamic mid and upland systems commonly found in the northern Basin). All other objectives, including those related to spawning of flow specialists, recruitment, dispersal and/or productivity may be able to be assessed based on exceedance of flow rates (i.e. above the associated minimum flow threshold), as the associated outcomes would still be expected for native fish.

⁹² Recommended ideal timing is linked to maximising spawning and recruitment outcomes based on known spawning seasons for native fish. Ideal timing for objectives related to dispersal and/or productivity have also been recommended; however, these may occur anytime with a movement and/or condition outcome still expected for native fish.

⁹³ Recommended minimum duration is linked to maximising spawning and recruitment outcomes based on known egg hatch time and morphology; these may be able to be increased based on flow data analysis and/or real time monitoring of fish larval presence, but they should not be reduced (e.g. extending the SF2 duration would reduce the likelihood of nests being disturbed or abandoned during the critical 14-day incubation period). The duration for objectives related to dispersal and/or productivity may be able to be adjusted based on flow data analysis.

⁹⁴ Recommended ideal frequency is linked to providing conditions that protect and improve native fish populations in heavily impacted systems. To achieve this recovery more frequent events that maximise native fish outcomes may be required.

⁹⁵ Recommended ideal period between events for spawning and recruitment objectives is linked to the longevity of species, providing a guide to the maximum period between these outcomes before risk of significant population decline. For short-lived floodplain specialist species in the southern MDB (e.g. Murray hardyhead) additional activities such as pumping to remnant wetlands may be required to maintain habitat and support recruitment in intervening years between floodplain connectivity events. Objectives related to in-channel dispersal and/or productivity have been set at annual frequencies to provide conditions that protect and improve native fish populations in heavily impacted systems.

Flow category	Native fish functional group	Primary ecological objective ⁹¹	Ideal environmental water requirement				Other requirements and comments
			Timing ⁹²	Minimum duration ⁹³	Frequency ⁹⁴	Maximum inter-event period ⁹⁵	
Very low flow	All native fish groups	Maintenance / Survival	Any time	No less than modelled natural	No less than modelled natural	No greater than modelled natural	
Baseflow 1	All native fish groups	Maintenance / Survival	Any time	Maintain refuge habitat and support connectivity	No less than modelled natural	As required during dry periods	Minimum depth of 0.3 m to allow fish passage
Baseflow 2	River specialists / Generalists	Recruitment	September – March	14 days (during spawning season)	1 event every 1–2 years	2 years	Minimum depth of 0.3 m to allow fish passage
Small fresh 1 (SF1)	All native fish groups	Dispersal / Productivity / Condition	Ideally October – April (but can occur any time)	10 days	1 event every year	1 year	>20°C for Oct. to April Australian smelt >11°C Minimum depth of 0.5 m to allow movement of large fish Can follow large fresh 2 for increased likelihood of successful recruitment of fish, productivity and dispersal Flow ideally up to 0.3–0.4 m/s (depending on channel form)
Small fresh 2 (SF2)	River specialists / Generalists	Spawning	September – April (north) October – April (south)	14 days	1 event every 1–2 years	2 years	>20°C; for river blackfish >16°C; for Murray cod Sept. to Dec. >18°C Minimum depth of 0.5 m to allow movement of large fish Flow ideally up to 0.3–0.4 m/s (depending on channel form)

Flow category	Native fish functional group	Primary ecological objective ⁹¹	Ideal environmental water requirement				Other requirements and comments
			Timing ⁹²	Minimum duration ⁹³	Frequency ⁹⁴	Maximum inter-event period ⁹⁵	
Large fresh 1 (LF1)	All native fish groups	Dispersal / Productivity / Condition	Ideally July – September (but can occur any time)	5 days	1 event every 1–2 years	2 years	Flow for pre-spawning condition Minimum depth of 2 m to cover instream features and trigger response from fish Flow ideally 0.3–0.4 m/s (depending on channel form)
Large fresh 2 (LF2)	Flow specialists	Spawning	October – April	5 days	1 event every 2–3 years	4 years	Rapid rise (comparative to natural rates) >17°C Can be followed by SF1 for increased likelihood of successful recruitment of fish, productivity and dispersal Minimum depth of 2 m to cover instream features and trigger response from fish Flow ideally 0.3–0.4 m/s (depending on channel form)
Overbank / Wetland 1	Floodplain specialists	Spawning	October – April	10 days	1 event every 2 years	2 years (south) 4 years (north)	22°C Ideally, recruitment flow 2–4 weeks after spawning flow
Overbank / Wetland 2	All native fish groups	Dispersal / Productivity / Condition	Ideally September – February (but can occur any time)	5 days	1 event every 3–5 years	5 years	For enhanced productivity and movement opportunities for fish

Appendix 10.3: Ideal generic EWRs to support water-dependent vegetation⁹⁶

Ideal EWRs to support maintenance and recruitment of water-dependent vegetation

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
Non-woody vegetation communities occurring in channels, wetlands and on floodplains	Rush, sedge and reed stands (e.g. cumbungi, common reed, giant rush) and submerged aquatic macrophyte beds (e.g. ribbonweed)	23, 53, 166, 181, 182, 204, 205, 238, 242, 336	Maintenance / recruitment	Large freshes – wetland inundating flows – bankfull – overbank (small)	June – February	7–12 months (retention)	8–10 in 10 years (1:1–1.5)	1.5 years
	Aquatic grass meadows, rush/sedge beds (e.g. water couch, cane grass, moira grass) and aquatic macrophyte beds (e.g. milfoils)		Maintenance / recruitment	Bankfull – overbank (small)	June – February	5–10 months (retention)	7–9 in 10 years (1:1–2)	2 years

⁹⁶ Information in these 2 tables was sourced from various peer-reviewed papers and reports including Roberts and Marston 2011, Wen et al. 2009, Johns et al. 2009, Doody et al. 2015, Jensen, Walker and Paton 2008, Jensen, Walker and Paton 2006, George, Walker and Lewis 2005, and Bond et al. 2018.

⁹⁷ Duration refers to the retention of surface water (and/or waterlogged soil conditions) and not necessarily the duration time of a specific flow event.

⁹⁸ Maintenance flows are required to maintain current condition and/or extent of existing populations. For non-woody vegetation, recruitment is associated with a partial drawdown phase to expose soils and encourage regeneration. For longer-lived woody species, recruitment is associated with a clustered sequenced flow regime across multiple years to promote regeneration.

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
	Rush and sedge stands (e.g. marsh clubrush, common spikerush, tall spike rush and aquatic macrophyte beds (e.g. water primrose)		Maintenance / recruitment	Overbank (small–large)	June – February	3–8 months (retention)	3–6 in 10 years (1:2–3)	3–4 years
	Rush/sedgeland and herb fields (e.g. jerry-jerry, dirty dora) and aquatic macrophytes		Maintenance / recruitment	Overbank (small–large)	N/A	2–6 months (retention)	2–5 in 10 years (1: 2–5)	7 years
	Sedges, rushes, grasses, herb fields (e.g. spiny sedge, rats tail couch, sneezeweed, joyweeds, heliotropes, nardoo, blue-rod)		Maintenance / recruitment	Large freshes (wetland inundating flows), – bankfull – overbank (small–large)	N/A	1–3 months (retention)	1.5–5 in 10 years (1:2–7)	2–7 years
Flood-dependent shrubland	Lignum: low-lying swamps and higher elevation shrublands	25, 247, 241, 63	Maintenance	Large freshes (wetland inundating flows), bankfull – overbank (small–large)	N/A	3–7 months	4–10 in 10 years (1:1–3) to 1–2 in 10 years (1: 7–10)	3–10 years

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
			Recruitment	Large freshes (wetland inundating flows), bankfull – overbank (small–large)	April–July	2–4 months	Over 10 years, have 2 sets of clustered, sequenced of flows (over 2–3 years) to promote recruitment and regeneration processes	Follow-up flows may occur within the year (8–10 months) to support establishment of seedlings (where desired)
Flood-dependent forest	River red gum forest	2, 5, 7, 11, 36	Maintenance	Overbank (small)	August – February	5–7 months	3–10 in 10 years (1:1–3)	3 years
			Recruitment	Overbank (small)	August–November	1–2 months	Over a 10-year period, have 2 sets of clustered, sequenced flows (1–3-year flow regime) to promote recruitment and regeneration processes	Supplementary/ follow-up flows may occur the following summer (<5 months) or following year (~12 months) to support establishment of seedlings (where desired)
	River red gum woodlands	8, 9, 10, 71, 74,	Maintenance	Overbank (large)	August – February	2–4 months	3–5 in 10 years (1:2–4)	5–7 years

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
Flood-dependent woodland		78, 208, 249, 454	Recruitment	Overbank (large)	August – November	1–2 months	Over 10 years, have at least one clustered sequence of flows (over 1–3-year flow regime) to promote recruitment and regeneration processes	Supplementary/ follow-up flows may occur the following summer (<5 months) or the following year (~12 months) to support establishment of seedlings (where desired)
	River Cooba swamps and woodlands	?	Maintenance	Overbank (small–large)	N/A	2–3 months	2–4 in 10 years (1:3–7)	3–7 years
				Recruitment	Overbank (small–large)	August – November	1–2 months	Over 10 years, have at least one clustered sequence of flows (1–3-year flow regime) to promote recruitment and regeneration processes

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
	Coolibah wetland woodland	39, 375	Maintenance	Overbank (large)	N/A	2–3 months	3–5 years in 10 (1:3)	5 years
			Recruitment	Overbank (large)	August – February	1–2 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote recruitment and regeneration processes	Supplementary/ follow-up flows may occur within 1–2 years of first flow to support establishment of seedlings (where desired)
	Black box: low-lying floodplain to high elevation floodplain	13, 15, 16, 37, 38	Maintenance	Overbank (large)	N/A	2–6 months	2–4 in 10 years (1:3–7) to 1–2 in 10 years (1:5–10)	3–7 years
			Recruitment	Overbank (large)	August – November	1–2 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote recruitment and regeneration processes	Supplementary/ follow-up flows may occur within 1–2 years of first flow to support establishment of seedlings (where desired)
	Coolibah woodlands	40, 87	Maintenance	Overbank (large)	N/A	0–1 month	1 in 10 years+ (1:10+)	10–15 years

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁸	Max. inter-event dry period
			Recruitment	Overbank (large)	August – February	Unknown	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote recruitment and regeneration processes	Supplementary/ follow-up flows may occur within 1–2 years of first flow to support establishment of seedlings (where desired)
Floodplain	Grey clay (grasslands, weeping myall, rosewood, chenopod)	27, 43, 49, 52, 62, 87, 161, 198, 214, 1324	Maintenance / recruitment	Overbank (large)	Unknown	Unknown	1 in 10 years+ (1:10+)	Unknown
	Paleo channels (belah, carbeen, poplar box, eurah)	55, 115, 206, 207	Maintenance / recruitment	Overbank (large)	Unknown	Unknown	1 in 10 years+ (1:10+)	Unknown

Ideal EWRs to support recovery, improvement and/or vegetative expansion of water-dependent vegetation

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁹	Max. inter-event dry period
Non-woody vegetation communities occurring in channels, wetlands and on floodplains	Rush, sedge and reed stands (e.g. cumbungi, common reed, giant rush) and submerged aquatic macrophyte beds (e.g. ribbonweed)	23, 53, 166, 181, 182, 204, 205, 238, 242, 336	Recovery/vegetation expansion	Overbank (small–large)	July – February	8–12 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote improvement in condition and/or improve extent through vegetation expansion	1–4 months
	Aquatic grass meadows, rush/sedge beds (e.g. water couch, cane grass, moira grass, tall spike rush) and submerged aquatic macrophyte beds (e.g. milfoils)		Recovery/vegetation expansion	Overbank (small–large)	August – February	7–10 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote improvement in condition and/or improve extent through vegetation expansion	2–5 months

⁹⁹ Increased vigour and condition recovery is associated with a clustered, sequenced flow regime across multiple years. To increase extent of non-woody vegetation (and lignum shrublands) and achieve vegetation expansion, a clustered, sequenced flow regime across multiple years and of greater magnitude may be required.

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁹	Max. inter-event dry period
	Rush and sedge stands (e.g. marsh clubrush, common spikerush, rushes and submerged aquatic beds (e.g. water primrose)		Recovery/vegetation expansion	Overbank (small–large)	June – February	5–8 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote improvement in condition and/or improve extent through vegetation expansion	4–7 months
Flood-dependent shrubland and wetland	Lignum: low-lying swamps and higher elevation shrublands	25, 247, 241, 63	Vegetation expansion/recovery	Overbank (small–large)	N/A	3–7 months	Over 10 years, have at least one clustered sequence of flows (2–3-year flow regime) to promote improvement in condition and/or improve extent through vegetation expansion	5–9 months
Flood-dependent forest	River red gum forest	2, 5, 7, 11, 36	Recovery/improvement	Overbank (small)	August – February	5–7 months	8–10 in 10 years (1:1–2)	1–1.5 years
Flood-dependent woodland	River red gum woodlands	8, 9, 10, 71, 74, 78, 208, 249, 454	Recovery/improvement	Overbank (large)	August – February	2–4 months	7–9 in 10 years (1:1–2)	1–2 years

Hydro-ecological functional group	Description of vegetation communities	PCTs included	Outcome	Ideal environmental watering requirements				
				Flow category	Timing – inundation	Duration ⁹⁷	Frequency ⁹⁹	Max. inter-event dry period
	River Cooba swamps and woodlands		Recovery/improvement	Overbank (small–large)	N/A	2–3 months	7–10 in 10 years (1:1–2)	1–2 years
	Coolibah wetlands	39, 375	Recovery/improvement	Overbank (large)	N/A	2–3 months	6–9 in 10 years (1:2–3)	2–3 years
	Black box: low-lying floodplain to high elevation floodplain	13, 15, 16, 37, 38	Recovery/improvement	Overbank (large)	N/A	2–6 months	6–9 in 10 years (1:2–3)	2–3 years
	Coolibah woodlands	40, 87	Recovery/improvement	Overbank (large)	N/A	0–1 month	2–3 in 10 years (1:3–5)	3–5 years

Appendix 10.4: Ideal generic EWRs to support all waterbird groups

Flow category	Waterbird objectives	Secondary waterbird outcomes	Functional group	Timing	Duration of habitat inundation	Frequency	Max inter-flow period	Rate of fall	Habitat requirements
Large freshes and bankfull flows ¹⁰⁰ (low-lying wetlands connecting flows)	Maintain waterbird populations (maintain species richness and abundance) and the condition of breeding and foraging habitat	Secondary benefits of these flows could include support for small-scale breeding in some waterbird areas	Ducks and grebes	Jun – Mar	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and lagoons
			Piscivores	Sep – May	3–8 months	Annual	2 years	Gradual	Inundate open deep waterbodies
			Herbivores	Jul – Apr	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and lagoons
			Large waders	Sep – Mar	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and shallow open waterbodies
Overbank and wetland inundating flows (small floodplain)	Maintain waterbird populations (maintain species	Secondary benefits of these flows could include	Shorebirds (migratory and resident species)	Aug – Apr	3–8 months	Annual	2 years	Gradual	Inundate shallow open waterbodies and allow slow drawdown to create muddy margins
			Ducks and grebes	Jun – Mar	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and lagoons
			Piscivores	Sep – May	3–8 months	Annual	2 years	Gradual	Inundate open deep waterbodies

¹⁰⁰ In some areas, bankfull flows and large freshes can inundate low-lying wetlands that support waterbirds.

Flow category	Waterbird objectives	Secondary waterbird outcomes	Functional group	Timing	Duration of habitat inundation	Frequency	Max inter-flow period	Rate of fall	Habitat requirements
connecting flows)	richness and abundance)	small-scale breeding in some waterbird areas and maintaining health of waterbird habitat	Herbivores	Jul – Apr	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and lagoons
			Large waders	Sep – Mar	3–8 months	Annual	2 years	Gradual	Inundate non-woody floodplain vegetation and shallow open waterbodies
			Shorebirds (migratory and resident species)	Aug – Apr	3–8 months	Annual	2 years	Gradual	Inundate shallow open waterbodies and allow slow drawdown to create muddy margins
Overbank flows (medium to large floodplain connecting flows)	Increase waterbird populations (provide opportunities for breeding to increase waterbird abundance)		Ducks and grebes	Jun – Mar	2–4 months	5 years in 10	2.5 years	Gradual	As above
			Piscivores (colonial)	Sep – May	3–5 months	3 years in 10	4 years	Gradual	Inundate known colony sites in addition to feeding habitats above
			Herbivores	Jul – Apr	2–4 months	5 years in 10	2.5 years	Gradual	As above
			Large waders (colonial)	Sep – Mar	3–5 months	3 years in 10	4 years	Gradual	Inundate known colony sites in addition to feeding habitats above
			Shorebirds (resident species only)	Jun – Apr	2–3 months	5 years in 10	2.5 years	Gradual	As above

Appendix 10.5: Ideal generic EWRs to support frogs

Hydro-ecological groupings	Common name	Ideal environmental watering requirements					
		Flow objective	Flow component	Frequency	Delivery timing	Duration	Rate of rise and fall
Flow-ambivalent	Desert froglet, green tree frog, bleating tree frog, desert tree frog, Bibron's toadlet, southern toadlet, smooth toadlet	Maintenance, dispersal. Breeding and recruitment (i.e. laying eggs & tadpole metamorphosis) occasionally	Overbank flows	1–2 years	September – February	4 months	Gradual rise and fall
		Maintenance, dispersal. Breeding and recruitment (i.e. laying eggs & tadpole metamorphosis) occasionally	Large freshes	2–3 years	September – February	6 months	Gradual rise and fall
Flow-oblivious	Striped burrowing frog, New Holland frog, water-holding frog, warty water-holding frog, Sudell's frog, crucifix frog, ornate burrowing frog, small-headed toadlet, wrinkled toadlet	Maintenance, dispersal. Breeding and recruitment (i.e. laying eggs & tadpole metamorphosis) occasionally	Overbank flows	1–2 years	September – February	4 months	Gradual rise and fall
Flow-responsive – flexible breeding	Eastern sign-bearing froglet, common eastern froglet, eastern banjo frog, barking marsh frog, giant banjo frog, striped marsh frog, salmon striped frog, spotted grass frog, northern banjo frog, Verreaux's frog	Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Overbank flows	1–2 years	July – April	6 months	Gradual rise and fall
		Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Large freshes	1–2 years	July – April	6 months	Gradual rise and fall

Hydro-ecological groupings	Common name	Ideal environmental watering requirements					
		Flow objective	Flow component	Frequency	Delivery timing	Duration	Rate of rise and fall
Flow-responsive – autumn–winter breeding	Sloane’s froglet, brown tree frog, Victorian frog	Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Overbank flows	1–2 years	July – October	6 months	Gradual rise and fall
		Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Large freshes	1–2 years	July – October	6 months	Gradual rise and fall
Flow-responsive – spring–summer	Broad-palmed frog, Peron’s tree frog, southern bell frog, Tyler’s tree frog, eastern dwarf sedge frog	Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Overbank flows	1–2 years	October – March	6 months	Gradual rise and fall
		Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Large freshes	1–2 years	October – March	6 months	Gradual rise and fall
Flow-stream	Booroolong frog, stoney creek frog	Maintenance	Overbank flows	2–3 years	June – December	6 months	Gradual rise and fall
		Maintenance, dispersal, breeding and recruitment (i.e. laying eggs & tadpole metamorphosis)	Large freshes	1–2 years	June – December	8 months	gradual rise and fall

Appendix 10.6: Ideal generic EWRs to support platypus

Flow component	Flow objective	Frequency	Ideal timing	Additional water requirements ¹⁰¹
Cease-to-flow	Maintenance	No greater than natural ¹⁰²	Any time	Recommend drought refuge pools ideally measure at least 80 m in length and comprise 200 m ² of surface area (although ideally more). Smaller pools that collectively comprise at least 500 m ² of pool habitat in a chain of ponds may be sufficient.
Very-low-flow	Maintenance	Annual	Any time	Minimum flows to prevent detrimental declines in water quality in pools.
Baseflow	Maintenance, dispersal, feeding	Annual (at least 1–2 years)	August – June (but can occur any time)	Minimum flows to prevent detrimental declines in water quality in pools. 0.3–0.5 m minimum depth to support movement of platypus through riffle areas and between pools. Important for dispersal of juveniles. Important for maintaining riffle areas and maintaining invertebrate productivity.
Small fresh	Maintenance, dispersal, breeding and recruitment, feeding	1–2 years	Any time	Minimums flows to maintain and improve water quality in pools. Prefer to feed in relatively shallow water (ideally 1–3 m deep). Gradual rate of rise and fall.
Large fresh	Maintenance, dispersal, breeding and recruitment, feeding	1–2 years	March – July (but can occur any time)	Connectivity between pools is critical for platypus survival. 1–3 m minimum depth required to protect platypus from predators. Prefer to feed in relatively shallow water (ideally 1–3 m deep) Flows should ideally be at least 1 m below bankfull between August and January to prevent drowning young platypus in burrows. Gradual rate of rise and fall.

¹⁰¹ Information to support these EWR recommendations was sourced from Serena and Grant 2017, Serena and Williams 2010, and CSIRO.

¹⁰² Occurs at a similar frequency as observed before development or is modelled as occurring ‘without development’ using IQQM hydrological models.

Flow component	Flow objective	Frequency	Ideal timing	Additional water requirements ¹⁰¹
Bankfull	Maintenance, dispersal, breeding and recruitment, feeding	In line with natural ¹⁰²	Avoid extended flows between September and November	Required to drown out higher weirs and other barriers as platypus struggle to scale barriers higher than 3 m. Gradual rate of rise and fall
Overbank	Maintenance, dispersal, feeding	In line with natural ¹⁰²	Any time	Required to drown out higher weirs and other barriers as platypus struggle to scale barriers higher than 3 m. Supports nutrient and sediment cycling, and improves productivity in the system and therefore platypus food sources. Gradual rate of rise and fall.

Appendix 10.7: Priority ecosystem functions and processes, their location in the environment and the flows required to support them

Priority ecosystem function	Key contributing processes	Where is it likely to occur?	Supporting flow categories	Hydrological indicators
Refuge for water-dependant biota during dry periods or drought	<ul style="list-style-type: none"> Regulation of water quality and depth Sediment transport (e.g. to maintain pool depth) 	Everywhere <ul style="list-style-type: none"> Rivers channels (especially pools) Wetlands Lakes (perennial) 	<ul style="list-style-type: none"> Cease-to-flow Very low flow Baseflow Small fresh Large fresh Bankfull Wetland inundating and overbank 	<ul style="list-style-type: none"> Duration and frequency of cease-to-flow events are not exceeded Minimum required duration of baseflow Water quality (esp. dissolved oxygen (DO)) in refuge pools

Priority ecosystem function	Key contributing processes	Where is it likely to occur?	Supporting flow categories	Hydrological indicators
Diversity of quality wetted habitat for feeding, breeding and nursery sites	<ul style="list-style-type: none"> • Inundation of instream, wetland and floodplain habitat • Longitudinal and lateral connectivity: <ul style="list-style-type: none"> ○ at range of spatial scales (in channel features – inter-catchment) ○ between different aquatic and terrestrial assets ○ on floodplains: inundation of a diversity of wetland types and forest-woodland–non-woody vegetation types • Appropriate magnitude of flows and connectivity with habitat features that create turbulence, slackwater, fast velocities, etc. • Creation of flooding–drying phases and disturbance through drying • sediment transport processes that maintain geomorphic features in the main channel, lateral channels and riparian zone • recruitment of snags into channels (supporting riparian veg. recruitment for future supply of snags) 	<ul style="list-style-type: none"> • Wetlands • Floodplains • River channels • Lateral channels • Weir pools 	<ul style="list-style-type: none"> • Cease-to-flow • Very low flow • Baseflow • Small fresh • Large fresh • Bankfull • Wetland inundating and overbank 	<ul style="list-style-type: none"> • Inundation extent (area) and duration in wetlands, in-channel or at channel margins (where there is a hydraulic model available) • Frequency and duration of flows of critical flow categories met • Water quality measures (e.g. temperature, DO, dissolved organic carbon)

Priority ecosystem function	Key contributing processes	Where is it likely to occur?	Supporting flow categories	Hydrological indicators
<p>Erosion and deposition of sediment</p> <p>Energy and nutrient cycling</p> <p>Soil carbon accretion</p>	<ul style="list-style-type: none"> Erosion and deposition processes in-channel (bed, banks, bars, benches) Avulsion Transport of sediment to floodplain Maintenance of waterways / effluent streams Flows and connectivity (within and between catchments) Sediment supply and transport, especially from unregulated tributaries (many nutrients are transported adsorbed onto fine sediment particles) Transport and retention of nutrients in channels Wetting–drying of channel features Decomposition of organic matter Accretion of carbon on floodplain (e.g. through macrophyte growth) 	<ul style="list-style-type: none"> All channels Lateral channels Wetlands Floodplains 	<ul style="list-style-type: none"> Small fresh Large fresh Bankfull Wetland inundating and overbank 	<ul style="list-style-type: none"> Rate of drawdown Daily flow variability Maintain inundation for sufficient duration to trigger growth of macrophytes (surrogate) Period for which flows are held at constant level ($\pm 5\%$) does not exceed maximum duration Duration of inundation Depth of inundation Velocity of in-channel flows Frequency and duration of flows above cease-to-flows for in-channel benches, wetlands and floodplains Longitudinal connectivity (that a flow continued from point A to B and that its magnitude, shape and duration was preserved (allowing for natural attenuation))
<p>Dispersal and movement of aquatic biota</p>	<ul style="list-style-type: none"> Longitudinal and lateral connectivity, including between catchments 	<ul style="list-style-type: none"> Channels Floodplains Wetlands Between catchments 	<ul style="list-style-type: none"> Baseflow Small fresh Large fresh Bankfull Wetland inundating and overbank 	<ul style="list-style-type: none"> Specific EWRs to support movement and dispersal of water-dependent species

Priority ecosystem function	Key contributing processes	Where is it likely to occur?	Supporting flow categories	Hydrological indicators
Aquatic and terrestrial primary productivity	<ul style="list-style-type: none"> Algal production Phytoplankton production Macrophyte growth Biofilm growth Growth and recruitment of amphibious and inundation tolerant vegetation (macrophytes and understory veg.) 	<ul style="list-style-type: none"> Floodplains Channels: bed, bars, benches, banks (esp. lateral margins wetted area) Wetlands Weir pools Ephemeral/lateral channels Riparian zone Wetland margins 	<ul style="list-style-type: none"> Large fresh Bankfull Wetland inundating and overbank 	<ul style="list-style-type: none"> Frequency, duration and timing of flows of adequate magnitude to support productivity in channels and floodplain wetlands
Surface-groundwater interactions	<ul style="list-style-type: none"> Groundwater recharge and discharge Dilution of saline groundwater Export of salt from MDB 	<ul style="list-style-type: none"> Riparian areas Floodplains 	<ul style="list-style-type: none"> Large fresh Bankfull Wetland inundating and overbank 	<ul style="list-style-type: none"> Frequency and magnitude of relevant EWRs met

Appendix 10.8: Hydrological triggers to support native fish movement between the Barwon–Darling catchment and its tributaries

Priority ecosystem function	LTWP outcomes supported	Details of flow(s) required
Longitudinal connectivity	Dispersal of native fish across the whole of the Barwon–Darling River after major breeding events and dry spells	<ul style="list-style-type: none"> Upstream dispersal of fish requires weir drown outs. The largest 2 barriers are Collarenebri Weir No 5 (18,000 ML/day) and Calmundi Weir No 8 (18,000 ML/day). This is particularly important following major breeding events and to reconnect populations after dry times. Known breeding events for golden perch, as informed by fish monitoring and hydrology include flows >10,000 ML/day at Wilcannia¹⁰³.
	Dispersal of young native fish recruits from Menindee along the Barwon–Darling River	<ul style="list-style-type: none"> A reconnective flow for young fish to move back out of the Menindee nursery to the Barwon–Darling is needed within 18 months of the above dispersal/breeding flow. This requires flows greater than barrier drown out values along the Barwon–Darling, ideally annually to allow for sequential movement of new recruits upstream.
	Dispersal of adult native fish between Barwon–Darling and its upstream tributaries after major spawning events	<ul style="list-style-type: none"> A small fresh or greater at both the last tributary gauge and the downstream gauge on the Barwon–Darling is required for dispersal of fish into tributaries (the relationship between Barwon–Darling flows could possibly allow a gauge trigger as far upstream as needed to allow travel times). A flow within one year of the large fresh spawning flow in the Barwon–Darling is ideal.
	Maintain and improve tributary contribution to flows within the Barwon–Darling River	<ul style="list-style-type: none"> Protecting the historical frequency and duration of connective flows from the tributaries to the Barwon–Darling is required (flow analysis dependent). This should include a minimum base flow or greater at both the last tributary gauge and the downstream gauge on the Barwon–Darling any time of year (the relationship between Barwon–Darling flows could possibly allow a gauge trigger as far upstream as needed to allow travel times).

¹⁰³ Stuart and Sharpe (2017) (see Appendix 12: Northern golden perch population recovery) identified 3 known recruitment events of golden perch where spawning originated in the Barwon–Darling River upstream of Brewarrina. These events equated to flows >15,800 ML/day in 2004, 10,000 ML/day in 2009, and 28,000 ML/day in 2016 at Wilcannia.

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