Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Murray-Darling and Bulloo Basins

Flora, Fauna and Ecology Expert Panel Report

Version 2.1

Queensland Government

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Citation

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Cover photo

Highly turbid Wallam Creek, near Bulloo. Photo supplied by Gary Cranitch, © Queensland Museum.

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Version History

Version	Type	Release Date	Description
1.4	riverine, non-riverine	12/11/2011	Aquatic Conservation Assessments (ACA) using AquaBAMM for wetlands of the Queensland Murray-Darling Basin.
2.1	riverine, non-riverine	08/12/2022	Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Murray-Darling and Bulloo Basins.

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Figures

Acronyms and abbreviations

ACA	Aquatic Conservation Assessment
AquaBAMM	Aquatic Biodiversity Assessment and Mapping Methodology
ASL	Above Sea Level
BAMM	Biodiversity Assessment and Mapping Methodology
CAMBA	China–Australia Migratory Bird Agreement
CE	Critically endangered
CIM	Criteria, Indicators and Measures (used in AquaBAMM)
DES	Department of Environment and Science
DIWA	Directory of Important Wetlands Australia
E	Endangered
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
GAB	Great Artesian Basin
JAMBA	Japan–Australia Migratory Bird Agreement
NCA	*Nature Conservation Act 1992*
NET	New England Tableland bioregion
NP	National Park
NR	Non-riverine
NT	Near threatened
QMDBB	Queensland Murray-Darling and Bulloo Basins
R	Riverine
Ramsar	Ramsar Convention on Wetlands
RE	Regional Ecosystem
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
SEQ	Southeast Queensland bioregion
V	Vulnerable
WISL	Wetland Indicator Species List

1 Introduction

The Department of Environment and Science (DES) has undertaken freshwater Aquatic Conservation Assessments (ACA) for the Border Rivers, Moonie, Condamine-Balonne, Maranoa, Wallam, Warrego, Paroo and Bulloo basins. The combined assessments are titled – Queensland Murray-Darling and Bulloo Basins Aquatic Conservation Assessments (QMDBB ACA). Aquatic Conservation Assessments are a non-social, non-economic and tenure blind assessment of wetland ecological values at the individual wetland scale. They are based on the Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM; Clayton et al. 2006) and incorporate a comprehensive set of criteria, indicators and measures founded upon a large body of national and international literature.

The AquaBAMM uses expert knowledge to acquire data for a number of criteria measures (Clayton et al. 2006). This data is elicited during expert panel workshops comprised of individuals with knowledge and expertise in local aquatic dependent species, wetland ecology, water quality, hydrology, geomorphology and vegetation. AquaBAMM expert panel processes aim to add flexibility and a reality check to the AquaBAMM assessment process. They are based on the premise of scientific reasoning, multiple lines of evidence and consensus building, allowing the incorporation of unpublished or anecdotal data.

This report describes results and recommendations stemming from expert panel workshops held for the Queensland Murray-Darling and Bulloo Basins Aquatic Conservation Assessment Version 2.1. Three workshops (flora, fauna, and ecology) were held in Brisbane in May and June 2021. Terms of Reference for these workshops can be found in Appendix I – Expert Panel Terms of Reference.

The report should be read in conjunction with the accompanying summary report – Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Murray-Darling and Bulloo Basins Summary Report Version 2.1 (DES 2022).

2 Method

2.1 Assessment Boundary Area

The Queensland Murray-Darling and Bulloo Basins study area covers an area of 314,582 km^2 and includes the Border Rivers, Moonie Basin, Condamine-Balonne, Maranoa, Wallam, Warrego, Paroo and Bulloo basins. Each catchment constitutes a unique study area, and separate, stand-alone assessments have been completed for each study area.

Summary descriptions of the geographic, geomorphic and ecologic characteristics of the study areas can be found in the accompanying summary report (Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Murray-Darling and Bulloo Basins, Summary Report Version 2.1 (DES 2022)).

2.2 Panel composition

The expert panels for the Queensland Murray-Darling and Bulloo Basins ACA were comprised of the persons listed in Table 1. They included individuals with local knowledge and expertise in aquatic dependent flora and fauna, and non-riverine and riverine wetland ecology including fish, macro invertebrates, water quality, hydrology, geomorphology and vegetation. Members who were unavailable to attend the workshop were consulted prior to, or after, the workshop.

Prior to attending the workshops all participants were provided with background material including a Terms of Reference (Appendix I – Expert Panel Terms of Reference), relevant definitions (Appendix II – Expert Panel Definitions), and taxon lists for flora and fauna recorded within each study area.

Organisation and technical support for the panels was provided by Mark Kelton, Linda Lawrence, Shane Chemello and Lindsey Lenneberg. The fauna and ecology panels were facilitated by Dr Darren Fielder (Redleaf Environmental). The flora panel was facilitated by Shane Chemello (DES).

2.3 Workshop format

Three expert panel workshops were held in Brisbane in mid-2021. The flora panel was held 28 May, the fauna panel 07 June, and the ecology panel 08 June. The workshops used ArcGIS Desktop software to display datasets, such as species sightings records and background topographic data, to help identify wetland components and processes of interest. Where possible, region-specific datasets were sourced from technical reports and scientific publications.

Table 1. Composition and details of the expert panel

Name	Organisation	Area of Expertise	Flora panel	Fauna panel	Ecology panel
Bruce Wilson	Consultant Botanist	Vegetation communities	Attended		
Chris Appelman	Principal Botanist, Department of Environment and Science	Vegetation communities, aquatic flora, aquatic ecology	Attended		
Darren Fielder (Dr)	Ecologist, Redleaf Environmental	Fauna, Ecology, Flora	Attended	Attended (Facilitator)	Attended (Facilitator)
David Stewart	Department of Environment and Science	Senior Conservation officer (Fauna)		Attended	Attended
Doug Harding	Department of Regional Development Manufacturing and Water (RDMW)	Project officer (Aquatic Ecology)		Attended	Attended
Harald Hofmann	University of Queensland	Groundwater hydrogeology			Attended

Name	Organisation	Area of Expertise	Flora panel	Fauna panel	Ecology panel
James Fawcett	Department of Natural Resources - Basin Water Planning	Aquatic ecology		Attended	Attended
Janice Kerr	Department of Environment and Science	Project officer (Aquatic Ecology)		Attended	Attended
Jonathan Marshall	Department of Environment and Science	Principal Scientist (aquatic ecosystems)		Attended	Attended
Jaye Lobegeiger	Department of Environment and Science	Senior Scientist (Water Planning Ecology)			Attended
Michael Hutchinson	Department of Agriculture and Fisheries	Aquatic ecology		Attended	
Paul Webb	SQL NRM	Hydrology	Attended	Attended	Attended
Peter Negus	Department of Environment and Science	Senior Scientist (Water Planning Ecology)		Attended	Attended
Richard Kingsford (Prof.)	University of New South Wales	River ecology, water use in Australia, wetland ecology, waterbirds, river policy, dam building effect, Rewilding, Adaptive Management of ecosystems, conservation biology			Attended
Rod Hobson	QPWS	Ecology		Attended	
Support Staff (DES)					
Mark Kelton	Department of Environment and Science	ACA Project Manager Principal Spatial Analyst	Attended	Attended	Attended
Linda Lawrence	Department of Environment and Science	Senior Spatial Analyst	Attended	Attended	Attended
Shane Chemello	Department of Environment and Science	Senior Biodiversity Program Officer	Attended		Attended
Lindsey Lenneberg	Department of Environment and Science	Program Coordinator		Attended	
Chris Sanderson	Department of Environment and Science	Senior Zoologist	Attended		
Steven Howell	Department of Environment and Science	Manager	Attended		

3 Flora

The role of the flora expert panel is to provide expert advice on the aquatic flora values of the waterways and wetlands within each study area.

Flora records were compiled from corporate databases including WildNet (30/03/2021), HERBRECS (within WildNet database), CORVEG (16/12/2020). Records were filtered by precision (<=2,000m) and year (>=1950). Duplicate records, defined as same species collected in same location in same year, were removed.

3.1 Exotic flora

Exotic flora are plants that cause, or have the potential to cause, significant detrimental impact on natural systems within a non-riverine, riverine landscape. The panel recommended to only include exotic plants known to cause significant detrimental impacts on natural wetland systems within the Queensland Murray-Darling and Bulloo Basins study areas.

The panel identified 29 aquatic and 15 non-aquatic exotic flora taxa impacting riverine or non-riverine wetlands within the study areas (Table 2). Point records for the listed species were used to identify spatial units containing exotic flora species for AquaBAMM Measure 2.1.1 (Presence of exotic terrestrial (i.e., non-aquatic) plants in the assessment unit).

Table 2. Exotic flora taxa impacting study area wetland values

Scientific Name	Common Name	NR	R	Expert Panel Comments	M1.1.2	M2.1.1
Anredera cordifolia	Madeira vine	Y	Y			Y
Arundo donax			Y	Restricted to locations with flowing water. Usually grows along river banks or cultivated in parks and gardens.	Y	
Bryophyllum delagoense		Y	Y	Threatening process for some wetland types in the Condamine. Likes hard country and doesn't grow in shade.		Y
Celtis sinensis	Chinese elm	Y	Y			Y
Cinnamomum camphora	camphor laurel	Y	Y			Y
Cotula coronopifolia	water buttons	Y	Y	Grows in damp, often saline disturbed communities, widespread. Native of South Africa.	Y	
Cryptostegia grandiflora	rubber vine	Y	Y	Indication of condition.		Y
Cyperus aggregatus		Y	Y	Native of south America.	Y	
Cyperus brevifolius	Mullumbimby couch	Y	Y		Y	
Cyperus compressus		Y	Y		Y	
Cyperus eragrostis		Y	Y	Weed of rice crops and ephemerally wet, open, disturbed situations; widespread. Native of north and south America.	Y	
Cyperus flavescens		Y	Y	Grows in disturbed damp, open situations.	Y	
Cyperus involucratus		Y	Y	Native of South Africa.	Y	

Scientific Name	Common Name	NR	R	Expert Panel Comments	M1.1.2	M2.1.1
Cyperus metzii		Y			Y	
Cyperus papyrus	papyrus	Y	Y	It is known from one location at Myall Creek, Dalby.	Y	
Cyperus rotundus	nutgrass	Y	Y	Native of Africa and Asia.	Y	
Cyperus tuberosus		Y	Y		Y	
Dolichandra unguis-cati	cat's claw creeper	Y	Y			Y
Egeria densa	dense waterweed	Y	Y	Grows extremely rapidly to depth of 2m and then floats.	Y	
Eichhornia crassipes	water hyacinth	Y	Y	It is one weed that should be closely monitored, and any outbreaks quickly eradicated.	Y	
Gleditsia triacanthos	honey locust	Y	Y			Y
Hymenachne amplexicaulis cv. Olive		Y			Y	
Juncus acuminatus	tapertip rush	Y	Y		Y	
Juncus articulatus		Y	Y	Naturalised in damp situations; widespread. Native of Europe, Asia, north Africa and North America.	Y	
Juncus bufonius	toad rush	Y	Y	Mostly in seasonally wet, disturbed habitats.	Y	
Juncus capitatus	dwarf rush	Y			Y	
Juncus cognatus		Y	Y	Native of south America.	Y	
Juncus imbricatus		Y	Y		Y	
Juncus tenuis					Y	
Leucaena leucocephala	Leucaena		Y	Present along riparian areas in the Condamine catchment.		Y
Ligustrum lucidum	large-leaved privet	Y	Y			Y
Ligustrum sinense	small-leaved privet	Y	Y	Native of China.		Y
Ligustrum vulgare		Y	Y	Native of southern Europe and North Africa.		Y
Megathyrsus maximus	Guinea grass		Y			Y
Myriophyllum aquaticum	Brazilian water milfoil	Y	Y	Grows in waterways. Native of central South America.	Y	
Phyla canescens	Lippia	Y	Y			Y
Pistia stratiotes	Water lettuce		Y		Y	

Scientific Name	Common Name	NR	R	Expert Panel Comments	M1.1.2	M2.1.1
Polygonum aviculare	wireweed	Y	Y	Native of Europe.	Y	
Polygonum bellardii		Y	Y	Native of western and southern Europe.	Y	
Salix babylonica	weeping willow	Y	Y	The panel suggested that other willow species may be considered in the QMDBB in terms of threat and ability to spread.		Y
Salvinia molesta	salvinia	Y	Y	Often floating on dams and ponds; introduced from south America.	Y	
Schoenus apogon		Y	Y	Grows in seasonally wet habitats.	Y	
Urochloa mutica	Para grass	Y		Similar to *Hymenachne*, it does grow within water - however, para grass can grow outside water as well.	Y	Y

3.2 Flora species richness

Flora species richness (total number of species) was calculated using the wetland indicator species list compiled by the Queensland Herbarium and other species nominated by the expert panel. The panel defined flora wetland indicator species to mean:

> *Species that are adapted to and dependent on living in wet conditions for at least part of their life and are found either within or immediately adjoining a riverine, non-riverine or estuarine wetland.*

When applied to flora species this definition extends beyond the more traditional definition of submerged and floating aquatic plants as it includes plants inhabiting the littoral zone (water's edge) and plants that usually have 'wet feet' on the toe of the bank. This meaning was chosen because it was considered to best capture the intent of the AquaBAMM Measure of species richness (M3.1.5). The Criterion 3.1 Indicator is a measure of the floristic richness of a particular spatial unit's aquatic environment, and hence, a broader definition of aquatic species better depicts the flora richness values at a given location.

The panel identified 386 flora wetland indicator species relevant to the riverine and non-riverine wetlands of the study areas (Table 3). Taxa were accessed from the corporate databases of WildNet, HERBRECS and CORVEG.

Point records for the listed species were used to a calculate wetland flora indicator species richness scores for AquaBAMM Measure 3.1.5 (Richness of native aquatic plants).

Table 3. Aquatic dependent native flora taxa

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Acacia stenophylla	belalie			Y	Y	Grows near rivers, creeks and swampy areas, in heavy clay soils[1]. Good bird nesting habitat in the Bulloo. In the east doesn't form as big a stands (in Queensland, does form big stands to south of border in Barwon etc catchments). Roger Jaensch mapped some stands for the Cooper[2].
Althenia bilocularis				Y		Grows in non-coastal fresh or saline lakes or slowly flowing water[1].
Ammannia multiflora	jerry-jerry			Y	Y	Grows in shallow water or damp situations on heavy soils, uncommon[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Aphanochaete repens				Y	Y	
Aponogeton queenslandicus				Y	Y	Rooted, submerged and floating, perennial aquatic[1].
Arthraxon hispidus		V	V	Y	Y	
Arthropodium strictum				Y	Y	
Azolla pinnata	ferny azolla			Y	Y	Freshwater aquatic[2].
Azolla rubra				Y	Y	Mostly found covering the surface of still or slowly moving water[1].
Bacopa monnieri				Y	Y	Freshwater aquatic/fringing[2].
Baloskion fimbriatum				Y	Y	
Baloskion pallens				Y	Y	
Baloskion stenocoleum				Y	Y	
Baloskion tenuiculme				Y	Y	
Bergia pedicellaris				Y		
Bergia trimera				Y	Y	
Blyxa aubertii					Y	
Bolboschoenus caldwellii				Y	Y	Occasional, in swamps or inland along artesian bore drains[1].
Bolboschoenus fluviatilis				Y		Scattered, in open swamps[1].
Botryococcus braunii				Y		
Bulbochaete rhadinospora				Y	Y	
Bulbostylis densa				Y	Y	Scattered, usually in rocky sites (hillsides or streams)[1] Also found in seepage areas[2].
Bulbostylis pyriformis				Y	Y	Grows in seasonally wet situations in woodland[1]. Also found in seepage areas[2].
Callitriche muelleri				Y	Y	Usually grows in damp shady habitats[1].
Callitriche sonderi				Y	Y	Grows in damp areas liable to inundation[1].
Carex appressa				Y	Y	Widespread in damp places[1]. Also found around watercourses[2].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Carex brunnea				Y	Y	Grows in rainforests, wet sclerophyll, often along water courses[2].
Carex fascicularis	tassel sedge			Y	Y	
Carex gaudichaudiana				Y	Y	Grows in swamps and creek banks[1].
Carex inversa	knob sedge			Y	Y	
Carex lobolepis				Y	Y	
Carex polyantha				Y	Y	Grows in swamps and creek banks[1].
Casuarina cunninghamiana					Y	
Casuarina cunninghamiana subsp. cunninghamiana					Y	
Centrolepis exserta				Y	Y	
Centrolepis fascicularis				Y	Y	
Centrolepis strigosa				Y	Y	
Ceratophyllum demersum	hornwort				Y	Freshwater aquatic[2].
Chara fibrosa				Y	Y	
Chara globularis var. globularis				Y	Y	
Chara vulgaris				Y	Y	
Chenopodium auricomum				Y		
Chorizandra cymbaria				Y	Y	Grows in swampy places[1]
Cladium procerum	leafy twigrush			Y		Grows in coastal swamps and margins of lakes; sporadic[1].
Coleochaete irregularis					Y	
Coleochaete orbicularis				Y	Y	
Coleochaete pulvinata				Y	Y	
Crinum flaccidum	Murray lily			Y		
Cycnogeton dubius				Y		

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Cycnogeton microtuberosus				Y	Y	
Cycnogeton multifructus				Y		
Cycnogeton procerus				Y	Y	
Cyperus alterniflorus				Y	Y	Grows in semi-permanent moist situations such as stream banks and rocky gullies[1].
Cyperus aquatilis				Y	Y	Grows in open ephemerally wet situations[1].
Cyperus betchei				Y	Y	Grows in seasonally wet situations, such as stream banks and roadside drains[1].
Cyperus betchei subsp. betchei				Y	Y	
Cyperus bifax	western nutgrass			Y	Y	Grows on floodplains on heavy clay soils[1].
Cyperus bowmanni				Y	Y	Opportunistic sedge in seasonally wet places[2].
Cyperus bulbosus				Y	Y	Grows near claypans[1]. Also found in inland claypans, shores of lakes and in sand dunes, seasonally wet grasslands[2].
Cyperus castaneus				Y	Y	Grows in open, ephemerally wet situations, on sandy soils[1].
Cyperus concinnus					Y	Grows in seasonally wet sites[1]. Also found in inland, lake shores, edges of swamps[2].
Cyperus conicus				Y	Y	Grows in sandy soil, commonly on levee and creek banks and in sandy water courses[2].
Cyperus cyperinus				Y	Y	Grows in heath on coastal dunes[1]. Also grows in damp places, on hillsides, in grassland or water margins[2].
Cyperus dactylotes				Y	Y	Grows in seasonally wet situations, such as stream banks and roadside drains[1].
Cyperus difformis	rice sedge			Y		
Cyperus exaltatus	tall flatsedge			Y	Y	Grows in shallow water and on banks of streams and lagoons[1].
Cyperus flaccidus				Y	Y	Grows in wet places, such as margins of ephemeral pools[1].
Cyperus flavidus				Y	Y	Grows in open swampy situations[1]. Along creeks in swamps, boggy ground[2].
Cyperus gilesii				Y	Y	Grows in ephemerally wet situations, such as inland stream banks and roadside drains[1]. Grasslands, Gidgee, Eucalyptus woodland on heavier clay soils, seasonally wet places[2].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Cyperus gunnii				Y	Y	Occur in swamps and along river/creek margins[2].
Cyperus gunnii subsp. gunnii				Y	Y	Occur in swamps and along river/creek margins[2].
Cyperus gunnii subsp. novae-hollandiae				Y	Y	Occur in swamps and along river/creek margins[2].
Cyperus gymnocaulos	spiny flatsedge			Y	Y	Grows on banks of streams, lakes and artesian bores[2].
Cyperus haspan				Y	Y	Semi-aquatic[3].
Cyperus haspan subsp. haspan				Y	Y	
Cyperus iria				Y	Y	Grows in ephemerally wet, open, often disturbed situations[1].
Cyperus isabellinus				Y		
Cyperus laevigatus				Y	Y	Grows in brackish situations, near seashores and saltmarshes, inland in soakage from artesian bores[1]. Also found around saline springs[2].
Cyperus leptocarpus				Y	Y	Grows in open damp places such as sandy stream banks[1].
Cyperus lucidus				Y	Y	Grows in swampy areas and on stream banks[1].
Cyperus nervulosus				Y	Y	Found on banks of receding lakes, creek/river banks[2].
Cyperus nutans ssp. eleusinoides				Y	Y	
Cyperus polystachyos				Y	Y	Semi-aquatic[3].
Cyperus polystachyos var. polystachyos				Y	Y	
Cyperus procerus				Y		Grows in swamps and seasonally wet sites[1].
Cyperus pygmaeus	dwarf sedge			Y	Y	Grows on open stream banks and seasonally wet open floodways, on clay soils[1].
Cyperus rigidellus				Y		Grows in ephemerally wet situations, such as floodways and roadside drains[1].
Cyperus sanguinolentus				Y	Y	Grows in swamps, on roadsides and stream banks[1].
Cyperus sphaeroideus				Y	Y	Usually grows in undisturbed damp habitats, often in woodland[1]. Found in swamps, water courses and drains[2].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Cyperus squarrosus	bearded flatsedge			Y	Y	Grows in ephemerally wet situations, commonly on sand or alluvium[1].
Cyperus subulatus				Y		Grows in sand, in coastal dunes, or swampy situations inland[2].
Cyperus trinervis				Y	Y	Grows in moist shaded places in woodland[1].
Cyperus vaginatus				Y	Y	Grows along creeks[1].
Cyperus victoriensis					Y	Grows on floodplains and stream banks inland, usually on clayey soils[1]. Found in similar habitat to *C. bifax*, but prefers stream banks[2].
Damasonium minus	starfruit			Y	Y	Grows in shallow freshwater in a range of habitats[1].
Diplachne fusca				Y		
Diplachne fusca var. fusca				Y		
Diplachne fusca var. muelleri				Y		
Drosera auriculata				Y	Y	
Drosera binata	forked sundew			Y	Y	Grows in wet sand and sandy peat in swamps, on creek banks and seepage lines in rock-faces[1].
Drosera burmanni				Y		Grows in wet situations[1].
Drosera finlaysoniana				Y		
Drosera glanduligera				Y	Y	Grows in swamps in grasslands or woodlands[1].
Drosera peltata	pale sundew			Y		Widespread in moist situations[1].
Drosera spatulata				Y		Grows in wetlands and heath[1].
Drosera spatulata var. spatulata				Y	Y	
Duma florulenta				Y	Y	
Echinochloa telmatophila	swamp barnyard grass			Y	Y	
Echinochloa turneriana	channel millet			Y		
Elatine gratioloides	waterwort			Y	Y	Grows in or on the margins of stationary or slow-flowing water to about 40 cm deep[1].
Eleocharis acuta				Y	Y	Grows in moist situations[1].
Eleocharis atricha	tuber spikerush			Y	Y	Grows in moist situations[1]

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Eleocharis atropurpurea				Y		
Eleocharis blakeana				Y	Y	Grows in ephemerally wet situations, such as gilgais[1].
Eleocharis brassii				Y		
Eleocharis cylindrostachys				Y	Y	Grows in moist situations[1].
Eleocharis dietrichiana				Y	Y	Grows in moist situations[1].
Eleocharis dulcis				Y		
Eleocharis equisetina				Y		Grows in swampy areas[1].
Eleocharis gracilis	slender spikerush			Y	Y	Grows in seasonally wet situations[1].
Eleocharis macbarronii				Y		
Eleocharis pallens	pale spikerush			Y	Y	Grows in seasonally wet situations such as floodways[1].
Eleocharis philippinensis				Y		Grows in swampy areas[1].
Eleocharis plana	ribbed spikerush			Y		Grows in moist situations[1].
Eleocharis pusilla	small spikerush			Y	Y	Grows in moist situations[1].
Eleocharis sphacelata	tall spikerush			Y		Grows in more or less still fresh water to at least 5 m deep[1].
Elytrophorus spicatus				Y	Y	
Eragrostis australasica				Y	Y	Commonly grows in periodically wet claypans in the drier half of the State[1].
Eragrostis fenshamii		E			Y	
Eremophila bignoniiflora	eurah			Y	Y	
Eriocaulon carsonii		E		Y	Y	
Eriocaulon carsonii subsp. Orientale		E	E	Y		Grows in running water[2].
Eriocaulon nanum				Y		
Eriocaulon scariosum				Y		Grows in bog communities and drainage areas, often in running water[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Eucalyptus camaldulensis				Y	Y	Grows in grassy woodland or forest on deep Rich alluvial soils adjacent to large permanent water bodies[1].
Eucalyptus camaldulensis subsp. acuta				Y	Y	
Eucalyptus camaldulensis subsp. arida				Y	Y	
Eucalyptus camaldulensis subsp. camaldulensis					Y	
Eucalyptus camphora subsp. camphora				Y	Y	
Eucalyptus coolabah	coolabah			Y	Y	Locally dominant, in grassy woodland on heavy clay soils near permanent water[1].
Eucalyptus largiflorens	black box			Y	Y	Grows in grassy woodland on heavy black clay soils in seasonally flooded areas[1].
Eucalyptus ochrophloia	yapunyah			Y		
Euphrasia orthocheila				Y	Y	Grows in moist open situations[1].
Euphrasia orthocheila subsp. Peraspera	Tenterfield eyebright	NT			Y	Grows in moist open sites such as swamps[2].
Ficus coronata	creek sandpaper fig			Y	Y	Often along creeks, in rainforest and open country[1].
Fimbristylis aestivalis				Y	Y	Grows in damp places[1]. Creek banks, edge of dams, edge of water courses[2].
Fimbristylis bisumbellata				Y	Y	Grows on stream banks, on sandy soil[1].
Fimbristylis depauperata					Y	Grows in ephemeral wet places[2].
Fimbristylis dichotoma	common fringe-rush			Y	Y	This species has many forms, some probably worthy of recognition that may not be wetland indicators[2].
Fimbristylis ferruginea				Y		
Fimbristylis littoralis				Y	Y	
Fimbristylis microcarya				Y	Y	

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Fimbristylis nuda				Y	Y	
Fimbristylis nutans				Y	Y	
Fimbristylis vagans		E		Y		Edge of lakes, lagoons[2].
Fimbristylis velata				Y	Y	Grows in moist areas[1] Edge of lakes, lagoons[2].
Fuirena incrassata				Y	Y	Grows along streamlines and in seasonally wet situations in woodland[1].
Gahnia sieberiana	sword grass			Y		Freshwater aquatic[1].
Glossostigma cleistanthum				Y	Y	Grows in silt in rock-pools, in clay on creek beds, on swamp margins or river flats or in dams, submerged or exposed[1].
Glossostigma diandrum				Y	Y	Grows in damp drying sand to clay in ephemeral pools, creek beds, depressions on river flats, sometimes submerged in creeks and pools[1].
Glycyrrhiza acanthocarpa	native liquorice			Y	Y	Grows on heavy soils prone to flooding[1].
Goodenia macbarronii	narrow goodenia			Y	Y	Grows in damp sandy soils[1].
Gratiola pedunculata				Y	Y	Grows on river/lagoon banks, and other damp places[1].
Gratiola peruviana				Y	Y	Grows in silt and mud of swamps, stream banks, in shallow water[1].
Hemarthria uncinata var. uncinata				Y	Y	
Hydrilla verticillata	hydrilla				Y	
Hydrocotyle verticillata	shield pennywort			Y	Y	
Isachne globosa	swamp millet			Y		
Isoetes drummondii				Y	Y	
Isoetes muelleri	quillwort			Y	Y	
Isolepis cernua	nodding club rush			Y	Y	Grows in moist places[1].
Isolepis crassiuscula				Y	Y	Aquatic in swamps at high altitudes, ie. Stanthorpe[2].
Isolepis fluitans	floating club rush			Y		
Isolepis habra				Y	Y	Wet places on edge of creeks, not common in Queensland[2].
Isolepis hookeriana				Y	Y	Grows in moist situations[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Isolepis inundata	swamp club rush			Y	Y	Widespread in moist places[1].
Isolepis subtilissima				Y	Y	Wet places on edge of creeks, not common in Queensland[2].
Isotoma fluviatilis				Y	Y	
Isotoma fluviatilis subsp. borealis				Y		
Juncus aridicola	tussock rush			Y	Y	Widespread in western divisions in seasonally or permanently wet situations[1].
Juncus articulatus	jointed rush			Y	Y	Gilgai[2].
Juncus bufonius	toad rush			Y	Y	
Juncus cognatus				Y	Y	
Juncus continuus				Y		Usually on sandy, moist soils[1].
Juncus firmus				Y	Y	Found on basic soils in wet situations, not common[1].
Juncus flavidus				Y	Y	Grows in seasonally and briefly wet situations[1].
Juncus ochrocoleus				Y	Y	Grows in seasonally wet situations, commonly in sandy soils[1].
Juncus planifolius				Y	Y	
Juncus polyanthemus				Y		Usually grows in swampy situations[1].
Juncus prismatocarpus	branching rush			Y	Y	Widespread in wet situations[1].
Juncus psammophilus				Y	Y	Grows along creeks that have at least a surface layer of sand[1].
Juncus radula				Y	Y	
Juncus remotiflorus				Y	Y	Commonly grows in only temporarily wet situations such as minor watercourses[1].
Juncus sp. (Nindigully R.Roe AQ139509)				Y	Y	
Juncus subglaucus				Y	Y	Grows near permanent water and in seasonally wet situations[1].
Juncus usitatus				Y		Lake/river banks[2].
Juncus vaginatus				Y	Y	Grows in damp to wet situations in the eastern half of the State[1].
Lamprothamnium macropogon				Y	Y	

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Leersia hexandra	swamp rice grass			Y	Y	Freshwater aquatic[1].
Lemna aequinoctialis	common duckweed			Y		
Lemna trisulca				Y		Grows in or at the edge of fast flowing freshwater in mud or attached to rocks[1].
Lepidium peregrinum	Wandering pepper grass		E	Y	Y	Occurs on the banks of creeks[2].
Lepidosperma laterale				Y	Y	
Lepidosperma limicola				Y	Y	Swamps on the granite belt. New England Tablelands[2].
Lepidosperma tuberculatum				Y	Y	
Lepironia articulata				Y	Y	Grows in open swamps[1].
Leptochloa digitata				Y	Y	
Lepyrodia anarthria				Y	Y	Grows in or near swamps and in wet or damp peaty soils[1].
Lepyrodia leptocaulis				Y	Y	Grows in swampy heath[1].
Limosella australis	mudwort			Y	Y	Grows in fine silt of rockholes, and swamps, mudflats and sandbars[1].
Limosella curdieana	large mudwort			Y	Y	Grows on margins of rivers, streams or freshwater swamps, or in ephemeral rockpools[1].
Lobelia fenshamii		E		Y		
Lomandra hystrix				Y	Y	
Lophostemon suaveolens	swamp box			Y	Y	
Ludwigia octovalvis	willow primrose			Y	Y	Aquatic[2].
Ludwigia peploides subsp. montevidensis				Y	Y	Freshwater lake/streams[2].
Luzula flaccida				Y	Y	
Lycopus australis	water horehound			Y	Y	
Lythrum hyssopifolia	lesser loosestrife			Y	Y	Widespread in moist places or near water[1].
Lythrum paradoxum				Y	Y	Grows in damp places on heavy soils[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Lythrum salicaria	purple loosestrife			Y	Y	Widespread in moist places or near water, often in swamps[2].
Machaerina articulata				Y	Y	The species is found mainly on freshwater swamp/soaks[1].
Machaerina nuda				Y	Y	Grows in swampy ground alongside steams[2].
Machaerina planifolia					Y	Grows in swampy ground, seepage areas alongside streams[2].
Machaerina rubiginosa				Y		Wet heath[1].
Marsilea costulifera	narrow-leaved nardoo			Y		Widespread in moist sites[1].
Marsilea crenata				Y		
Marsilea drummondii	common nardoo			Y		Widespread in inland areas, in moist depressions, around waterholes etc[1].
Marsilea exarata	sway-back nardoo			Y		Grows in ephemeral moist sites[1]
Marsilea hirsuta	hairy nardoo			Y		Widespread, mostly in shallow swamps or flood plains[1].
Marsilea mutica	shiny nardoo			Y		Widespread, often in deeper water than other species[1].
Melaleuca alternifolia				Y	Y	REs 13.3.1 and 13.3.1a dominated by this species. Under threat in NET catchments. Probably better captured under M5.2.1[2].
Melaleuca bracteata				Y	Y	Widespread, along watercourses or on heavier inland soils in depressions[1].
Melaleuca densispicata				Y	Y	Grows around depressions or along stream channels[1].
Melaleuca flavovirens		NT		Y	Y	
Melaleuca fluviatilis					Y	
Melaleuca irbyana		E		Y		
Melaleuca linariifolia	snow-in summer			Y	Y	Widespread, along watercourses or on heavier inland soils in depressions[1].
Melaleuca thymifolia	thyme honey myrtle			Y		
Melaleuca trichostachya					Y	Grows along watercourses or on ground subject to flooding[1].
Melaleuca viminalis					Y	Woody shrub. Freshwater aquatic/fringing[1].
Melaleuca williamsii subsp. fletcheri		V	V	Y	Y	Grows in or near rocky watercourses, usually in sandy creek beds on granite[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Monochoria cyanea				Y		Grows in shallow water or drying mud of permanent or temporary water bodies[1].
Muehlenbeckia gracillima				Y	Y	Often on sandy riverbanks[1].
Muehlenbeckia rhyticarya				Y	Y	
Muehlenbeckia sp. (Stanthorpe A.R.Bean 12466)				Y	Y	It may be disjunct or at the edge of its range in QLD[2].
Myriophyllum artesium		E		Y		Forms macrophytic beds. Is a springs species[2].
Myriophyllum crispatum				Y	Y	Grows in still water or on mud[1]. Forms macrophyte beds. Good frog habitat and supplies food for invertebrates. Nursery for hatchling turtles[2].
Myriophyllum gracile				Y	Y	Grows in shallow water or on mud[1].
Myriophyllum gracile var. gracile				Y	Y	
Myriophyllum gracile var. laeve				Y		
Myriophyllum gracile var. lineare					Y	
Myriophyllum implicatum				Y		
Myriophyllum jacobsii				Y	Y	
Myriophyllum papillosum	common water-milfoil			Y	Y	Freshwater lake/streams[2].
Myriophyllum simulans				Y	Y	Grows in still water or, more frequently, fully emergent on mud[1].
Myriophyllum striatum				Y		Grows in damp situations on the banks of creeks and around waterholes[1].
Myriophyllum variifolium				Y	Y	Grows in still or slowly flowing water[1].
Myriophyllum verrucosum	water milfoil			Y	Y	
Najas tenuifolia	water nymph			Y	Y	Freshwater lake/streams[2].
Nelumbo nucifera	pink waterlily			Y	Y	
Nitella cristata				Y	Y	
Nitella hyalina				Y	Y	

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Nitella lhotzkyi				Y	Y	
Nitella pseudoflabellata				Y	Y	
Nitella sonderi				Y	Y	
Nitella tasmanica				Y	Y	
Nostoc commune				Y	Y	
Nostoc parmelioides				Y	Y	
Nymphaea gigantea				Y	Y	In permanent water with deep muddy substrate in tropics & subtropics[2].
Nymphoides crenata	wavy marshwort			Y	Y	Grows in slow-flowing water to about 1.5 m deep, usually on a mud substrate, can persist on drying mud[1].
Nymphoides exiliflora				Y	Y	
Nymphoides geminata				Y		Grows in perennial and ephemeral pools usually less than 1 m deep on a variety of substrates[1].
Nymphoides indica	water snowflake			Y	Y	Freshwater lake/streams[2].
Nymphoides spinulosperma				Y	Y	
Oedogonium ambiceps				Y	Y	
Oedogonium capilliforme				Y	Y	
Oedogonium cardiacum				Y	Y	
Oedogonium confertum				Y	Y	
Oedogonium oblongum				Y	Y	
Oedogonium plagiostomum				Y	Y	
Oedogonium platygynum				Y	Y	
Oedogonium sexangulare				Y	Y	
Oedogonium tapeinosporum				Y	Y	

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Oedogonium varians				Y	Y	
Ottelia ovalifolia	swamp lily			Y	Y	Freshwater aquatic[1] Occurrence indicates cool, good stream conditions[2].
Ottelia ovalifolia subsp. chrysobasis				Y	Y	
Panicum obseptum	white water panic			Y	Y	
Paspalum distichum	water couch			Y	Y	Freshwater lake/streams[2].
Peplidium foecundum				Y		
Peplidium maritimum				Y		
Persicaria attenuata				Y	Y	Grows on margins of open swamps[2].
Persicaria barbata				Y		
Persicaria decipiens	slender knotweed			Y	Y	Semi-aquatic woody/fringing[1].
Persicaria hydropiper	water pepper			Y	Y	
Persicaria lapathifolia	pale knotweed			Y	Y	
Persicaria orientalis	princes feathers			Y	Y	
Persicaria praetermissa				Y	Y	
Persicaria prostrata	creeping knotweed			Y	Y	
Persicaria subsessilis	hairy knotweed			Y		
Philydrum lanuginosum	frogsmouth			Y		Freshwater aquatic/fringing[3].
Phragmites australis	common reed			Y	Y	Freshwater aquatic[1]. Species may be more widespread than GAB springs[2].
Platyzoma microphyllum	braid fern			Y	Y	
Polygonum plebeium	small knotweed			Y	Y	
Potamogeton crispus	curly pondweed			Y	Y	Grows in slowly flowing freshwater, also tolerant of slightly saline water common in drains[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Potamogeton ochreatus	blunt pondweed			Y	Y	
Potamogeton perfoliatus	perfoliate pondweed			Y	Y	
Potamogeton sulcatus				Y	Y	
Potamogeton tricarinatus	floating pondweed			Y	Y	Grows in slowly flowing water of rivers and creeks to 3m deep[1].
Pseudendoclonium					Y	
Pseudoraphis paradoxa	slender mudgrass			Y	Y	
Pseudoraphis spinescens	spiny mudgrass			Y		
Ptilothrix deusta				Y	Y	Grows in seasonally wet heath and dry sclerophyll forest and woodland, on sandy soil[1].
Ranunculus inundatus	river buttercup			Y	Y	
Rhynchospora brownii	beak rush			Y	Y	Wetter areas beside creeks, water courses, swamps[2].
Riccia multifida					Y	
Rotala diandra					Y	
Rotala mexicana				Y		
Rotala occultiflora					Y	
Rumex stenoglottis				Y	Y	
Rumex tenax				Y	Y	
Ruppia maritima	sea tassel				Y	
Sacciolepis indica	Indian cupscale grass			Y		
Samolus valerandi	brookweed				Y	
Schoenoplectiella dissachantha				Y	Y	Grows in seasonally wet open situations[2].
Schoenoplectiella laevis				Y	Y	Seasonally wet open situations[2].
Schoenoplectiella lateriflora var. lateriflora				Y	Y	Seasonally wet open situations[2].
Schoenoplectiella mucronata				Y		Grows in streams and other damp situations[1].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Schoenoplectus subulatus				Y	Y	
Schoenoplectus tabernaemontani				Y	Y	Grows along creeks, lakes and open swamps (in fresh and brackish water)[1].
Schoenus apogon				Y	Y	
Schoenus centralis				Y	Y	Grows along drainage lines; apparently very sporadic[1].
Schoenus falcatus				Y	Y	
Schoenus latelaminatus	medusa bogrush			Y	Y	
Schoenus maschalinus				Y	Y	Wet to swampy areas alongside streams[2].
Schoenus melanostachys				Y		Wet seepage areas in forest openings, often in rocky outcrops[2].
Scirpus polystachyus				Y	Y	Grows in creeks and in swampy areas on higher tablelands, extending to higher coastal ranges[1].
Selaginella uliginosa	swamp selaginella			Y		
Sesbania cannabina				Y	Y	
Sparganium subglobosum	floating bur-reed				Y	
Spirodela oligorrhiza				Y	Y	
Spirodela punctata	thin duckweed			Y	Y	
Spirogyra juergensii				Y	Y	
Sporobolus pamelae		E		Y		
Sporobolus virginicus	sand couch			Y		
Stuckenia pectinata					Y	Freshwater lake/streams[2].
Stylidium debile	frail trigger plant			Y	Y	
Stylidium ecorne				Y	Y	
Stylidium eglandulosum				Y	Y	
Stylidium eriorhizum				Y		

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Stylidium graminifolium	grassy-leaved trigger-flower			Y		
Stylidium laricifolium	tree trigger plant			Y	Y	
Stylidium paniculatum				Y	Y	
Suaeda australis				Y	Y	
Tecticornia indica subsp. leiostachya				Y		
Tecticornia pergranulata				Y		
Tecticornia pergranulata subsp. divaricata				Y		
Tecticornia pergranulata subsp. pergranulata				Y		
Trentepohlia abietina					Y	
Trentepohlia arborum					Y	
Trentepohlia effusa					Y	
Trentepohlia lagenifera					Y	
Trentepohlia odorata					Y	
Trentepohlia peruana				Y	Y	
Trentepohlia rigidula				Y	Y	
Triglochin hexagona				Y	Y	
Triglochin isingiana				Y	Y	
Triglochin nana				Y		
Triglochin striata	streaked arrowgrass			Y	Y	
Trigonella suavissima				Y	Y	Grows along dry watercourses, floodplains and depressions[1].
Typha domingensis				Y	Y	Freshwater lake/streams, springs and other wetlands[2].

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Typha orientalis	broad-leaved cumbungi			Y	Y	Freshwater lake/streams, springs and other wetlands[2].
Utricularia aurea	golden bladderwort			Y	Y	
Utricularia caerulea	blue bladderwort			Y	Y	
Utricularia dichotoma	fairy aprons			Y	Y	
Utricularia gibba	floating bladderwort			Y	Y	
Utricularia stellaris				Y	Y	
Utricularia uliginosa	asian bladderwort			Y	Y	
Vallisneria annua				Y		
Vallisneria australis				Y	Y	
Vallisneria nana				Y	Y	Forms large beds, critical food resource, basis of complex food webs and instream diversity[3].
Walwhalleya subxerophila				Y	Y	
Xyris complanata	yellow-eye			Y		
Xyris juncea	dwarf yellow-eye			Y		
Zygogonium ericetorum				Y	Y	

[1] PlantNET website <http://plantnet.rbgsyd.nsw.gov.au/>
[2] Expert panel comments
[3] Clayton et al. (2006)

3.3 Near threatened and threatened flora

The panel identified 13 threatened or near-threatened flora taxa relevant to the riverine and non-riverine wetlands (Table 4). Only species judged to be aquatic, semi-aquatic or riparian dependent and scheduled as Near threatened (NT), Vulnerable (V), Endangered (E), or Critically Endangered (CE) under the Queensland *Nature Conservation Act 1992* (NCA) or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) were considered.

Point records for the listed species were used to identify spatial units containing near-threatened or threatened flora taxa to calculate scores for AquaBAMM Measure 4.1.2 (Presence of near threatened or threatened aquatic ecosystem dependent flora species — NCA, EPBC Act).

Table 4. Aquatic dependent threatened or near-threatened flora taxa

Scientific Name	Common Name	NCA Status	EPBC Status	NR	R	Expert Panel Comments
Arthraxon hispidus		V	V	Y	Y	Occurs on and off springs.
Eragrostis fenshamii		E		Y		GAB springs.
Eriocaulon carsonii		E		Y		GAB springs.
Eriocaulon carsonii subsp. orientale		E	E	Y		GAB and non-GAB springs.
Euphrasia orthocheila subsp. peraspera	Tenterfield eyebright	NT		Y		Grows in moist open sites such as swamps.
Fimbristylis vagans		E		Y	Y	Damp and shade-loving grass often near creeks or swamps.
Lepidium peregrinum	Wandering pepper grass	C	E		Y	Occurs on the banks of creeks.
Lobelia fenshamii		E		Y		
Melaleuca flavovirens		NT		Y	Y	
Melaleuca irbyana		E		Y		Some in Brigalow. Is a WISL in SEQ. Also occurs in drier areas. Does need overland flow to exist. Very rare in QMDBB catchments. One small patch. Probably more ground water dependent than overland flow.
Melaleuca williamsii subsp. fletcheri		V	V		Y	Grows in or near rocky watercourses, usually in sandy creek beds, on granite or basalt.
Myriophyllum artesium		E		Y		GAB springs.
Sporobolus pamelae		E		Y		Often a spring fringing species.

3.4 Priority flora

Priority taxa are defined as those not listed as NT, V, E, or CE in Queensland or Commonwealth legislation but are considered important by the expert panel for the integrity of local aquatic ecosystems as they exhibit one or more of the following priority attributes:

1. It forms significant macrophyte beds (in shallow or deep water)
2. It is an important/critical food source
3. It is important/critical habitat
4. It is implicated in spawning or reproduction for other fauna and/or flora species.
5. It is at its distributional limit or is a disjunct population
6. It provides stream bank or bed stabilisation or has soil-binding properties
7. It is a small population and subject to threatening processes
8. Taxa vulnerable to impacts of climate change - Species that are considered to be adversely affected by the predicted changes in climate, e.g. increasing temperatures, sea level rise and increasing frequency of extreme weather events (drought, flood & cyclones).

The panel identified 60 priority flora taxa relevant to the riverine and non-riverine wetlands of the study areas (Table 5). Only species judged to be aquatic, semi-aquatic or riparian dependent were considered. Point records for the listed species were used to identify spatial units containing priority flora taxa to calculate scores for AquaBAMM Measure 5.1.2 (Presence of aquatic ecosystem dependent 'priority' flora species).

Table 5. Aquatic dependent priority flora taxa

Scientific Name	Common Name	NR	R	Priority Attributes	Expert Panel Comments
Acacia stenophylla	belalie	Y	Y	3	Good bird nesting habitat in the Bulloo.
Aponogeton queenslandicus		Y	Y	1	
Bacopa monnieri		Y	Y	6	Usually grows on the edge of freshwater or brackish pools, GAB springs or streams, sometimes submerged. May form dense stands over larger areas which provide habitat for a range of wetland species.
Bolboschoenus fluviatilis		Y		1, 3	Forms significant macrophyte beds. Possibly important habitat.
Casuarina cunninghamiana			Y	6	Bank stabilisation in upper tributaries. Grows along permanent freshwater streams.
Ceratophyllum demersum	hornwort		Y	1	Widespread, in water to 10 m deep, tolerant of low light levels. Formation of large macrophyte beds.
Cycnogeton procerus		Y	Y	2,3	
Cyperus gymnocaulos	spiny flatsedge	Y	Y	6	Can form dense stands on stream banks thus providing stream bank stabilisation.
Damasonium minus	starfruit	Y	Y	2	Grows in shallow freshwater in a range of habitats; widespread. This is a fringing plant usually found in wetlands, but it can also occur along flowing streams. Provides food for waterbirds.

Scientific Name	Common Name	NR	R	Priority Attributes	Expert Panel Comments
Duma florulenta	lignum	Y	Y	1,2,3,4	Usually forms significant stands where it occurs. It provides multiple benefits for fauna during dry periods as well as during inundation providing waterbird habitat.
Eleocharis blakeana		Y	Y	1,3	Grows in dense swards and provides important food source and habitat.
Eleocharis pallens	pale spikerush	Y	Y	1,3	
Eleocharis plana	ribbed spikerush	Y		1,3	Grows in dense swards and provides important food source and habitat.
Eleocharis sphacelata	tall spikerush	Y		1,3	Grows in dense swards and provides important food source and habitat.
Eragrostis australasica		Y	Y	3	
Eucalyptus camaldulensis		Y	Y	2,3,6	Provides multiple ecological values including habitat, food resources for fauna and stream bank stabilisation.
Eucalyptus camphora subsp. camphora		Y	Y	5	Grows in swampy areas around Wallangarra which is at northern limit of its distribution.
Eucalyptus coolabah	coolabah	Y	Y	2,3,6	Provides multiple ecological values including habitat, food resources for fauna and stream bank stabilisation.
Eucalyptus largiflorens	black box	Y	Y	5	Grows in grassy woodland in seasonally flooded areas. At the northern limit of distribution of this species, this is widespread in NSW. Like *Eucalyptus camaldulensis*, it is a local species which serves as a useful indicator of wetland ecosystem health.
Eucalyptus ochrophloia	yapunyah	Y		2,3,6	Provides multiple fauna values including habitat, food resources and stream bank stabilisation.
Fimbristylis ferruginea		Y		5,7	
Glycyrrhiza acanthocarpa	native liquorice	Y	Y	5,7	
Goodenia cylindrocarpa		Y		5	
Isoetes drummondii		Y	Y	5	Grows in mud or temporary water and in damp soil depressions. Unique and very seldom recorded.
Juncus aridicola	tussock rush	Y	Y	1	Forms dense stands - although usually on edge of open water rather than in it.

Scientific Name	Common Name	NR	R	Priority Attributes	Expert Panel Comments
Ludwigia peploides subsp. montevidensis		Y	Y	1,2,6	Species is found on a variety of landforms, but mostly on freshwater swamp, soaks or lake/riverbanks. It provides the stabilisation of stream banks, formation of large macrophyte beds. Seeds are a food source for waterbirds.
Machaerina articulata		Y	Y	2,3	Provides important bird nesting material and food source for waterbirds. Grows in standing water of lagoons, deeper swamps, and streams.
Marsilea drummondii	common nardoo	Y		3,5	Widespread in inland areas, in moist depressions, around waterholes. Provides bank stability and retains surface moisture in wetlands during dry periods. Provides habitat for amphibians and macroinvertebrates.
Marsilea hirsuta	hairy nardoo	Y		3,5	Widespread, often in deeper water than other species. As per *M. drummondii*.
Marsilea mutica	shiny nardoo	Y		3,5	Widespread, often in deeper water than other species. As per *M. drummondii*.
Melaleuca bracteata		Y	Y	3,5	Widespread, along watercourses or on heavier inland soils in depressions. Bank stabilisation in upper tributaries. Habitat for birds.
Melaleuca densispicata		Y	Y	5	Grows around depressions or along stream channels. This species has a disjunct distribution in Queensland/northern New South Wales. It has a major Mulga Lands population in low dune fields from Dynevor Lakes to Currawinya National Park. It represents a very distinctive component of flora.
Melaleuca linariifolia	snow-in summer	Y	Y	3,5	Widespread, along watercourses or on heavier inland soils in depressions. Bank stabilisation in upper tributaries. Habitat for birds.
Melaleuca trichostachya			Y	2,3,6	
Melaleuca viminalis			Y	3,6	Mostly grows along watercourses, chiefly in sandstone or granite areas. Bank stabilisation in upper tributaries. Habitat for birds.
Muehlenbeckia sp. (Stanthorpe A.R.Bean 12466)		Y	Y	5, 7	Disjunct population at the edge of its range. Small population makes it vulnerable.
Myriophyllum crispatum		Y	Y	1, 3	Forms macrophyte beds. Good frog habitat and food for invertebrates. Nursery for hatchling turtles.
Najas browniana		Y	Y	2	Submerged aquatic species. Provides important habitat for in-stream fauna.

Scientific Name	Common Name	NR	R	Priority Attributes	Expert Panel Comments
Najas tenuifolia	water nymph	Y	Y	2	Grows in freshwater less than 3m deep; widespread. Submerged aquatic species. Provides important habitat for in-stream fauna.
Nelumbo nucifera	pink waterlily	Y	Y	5	Occurs in deep lagoons and deep slow-moving streams. Disjunct population, very southern limit of species distribution. Recorded west of Condamine from 1930, in one lagoon - may be introduced - still present.
Nymphaea gigantea		Y	Y	2	Important habitat for waterbirds, snails and other aquatic fauna. Of note, *Nymphaea gigantea* can often be replaced by an exotic species, *Nymphaea caerulea*, *zanzibarensis* (Cape waterlily).
Paspalum distichum	water couch	Y	Y	1, 6	Forms dense stands on edge of open water. Resistant to grazing so provides bank stabilisation in over grazed areas.
Persicaria attenuata		Y	Y	1,3,6	Common along most waterholes.
Persicaria decipiens	slender knotweed	Y	Y	1,3,6	Common along most waterholes.
Persicaria lapathifolia	pale knotweed	Y	Y	1,3,6	Common along most waterholes.
Persicaria orientalis	Princes' feathers	Y	Y	1,3,6	Common along most waterholes.
Phragmites australis	common reed	Y	Y	3,5,7	Only GAB springs in study area. Discharge (GAB). Provides important habitat for warblers, chats and insectivorous birds.
Pseudoraphis spinescens	spiny mudgrass	Y		6	Can form mats on stream banks and therefore provides stabilisation.
Schoenoplectiella mucronata		Y		1	Grows in dense stand in range of aquatic habitats.
Schoenus falcatus		Y	Y	5,7	
Spirodela punctata	thin duckweed	Y	Y	5,7	
Tecticornia indica subsp. leiostachya		Y		3	
Tecticornia pergranulata		Y		3	Habitat for small reptiles and mammals.
Tecticornia pergranulata subsp. divaricata		Y		3	Habitat for small reptiles and mammals.
Tecticornia pergranulata subsp. pergranulata		Y		3	Habitat for small reptiles and mammals.
Typha domingensis		Y	Y	3,6	Can be invasive, but definitely forms thick stands and provides stream bank stabilisation and possibly important habitat (e.g. orange chats).

Scientific Name	Common Name	NR	R	Priority Attributes	Expert Panel Comments
Typha orientalis	broad-leaved cumbungi	Y	Y	3,6	Can be invasive and displace native species, particularly in areas subject to nutrification. However, can provide stream bank stabilisation and habitat for a range of species.
Utricularia caerulea	blue bladderwort	Y	Y	5,7	Only springs in study area. Discharge (GAB).
Utricularia dichotoma	fairy aprons	Y	Y	5,7	Only springs in study area. Discharge (GAB).
Vallisneria nana		Y	Y	1,3	Grows in still or slow-moving waters up to 70cm deep. Forms large beds, critical food resource, basis of complex food webs and in-stream diversity.

4 Fauna

4.1 Exotic fauna

Exotic fauna species found in or likely to invade study area wetlands were evaluated by the panel. Only species known or suspected to cause significant detrimental impact to wetland habitat and/or native species were considered. The panel identified nine exotic vertebrate fauna taxa impacting riverine or non-riverine wetlands within the study areas (Table 6).

Point records for the listed species were used to identify spatial units containing exotic vertebrate fauna taxa. These taxa counts were used to calculate scores for the AquaBAMM Measure 1.1.1 (Presence of 'alien' fish species within the wetland), 1.1.3 (Presence of exotic invertebrate fauna within the wetland) and 1.1.4 (Presence of feral/exotic vertebrate fauna (other than fish)).

Table 6. Exotic fauna taxa impacting study area wetland values

Scientific Name	Common Name	R	NR	M1.1.1	M1.1.3	M1.1.4	Expert Panel Comments
Fish							
Carassius auratus	goldfish	Y		Y			Goldfish are widespread throughout the Murray-Darling Basin and have been reported in all catchments of the QMDBB. The species is known to impact on native fish and invertebrates and has been found hybridizing with European carp (*Cyprinus carpio*).
Cyprinus carpio	european carp	Y		Y			European carp are widespread throughout the Murray-Darling Basin, though not known from the Bulloo catchment at this stage. They are known to impact greatly on native fish, invertebrates, and water turbidity and are one of the most damaging aquatic invasive species in Australia.
Gambusia holbrooki	mosquitofish	Y	Y	Y			Mosquitofish are widespread throughout the Murray-Darling Basin, though not known from the Bulloo catchment at this stage. They are known to impact greatly on native fish, frogs, and invertebrates and are considered one of the most damaging aquatic invasive species in Australia.
Oncorhynchus mykiss	rainbow trout	Y		Y			Rainbow trout are only known from the upper reaches of the Condamine and Balonne catchments through stocking for recreational fishing. This species is known to be damaging to native fish and invertebrates.
Salmo trutta	brown trout	Y					Brown trout are almost unknown from the study area; however, they have been reported in the 1990s and may still be present from illegal stocking activities. The species will be retained for future panels however as there are currently no records for the study area.

Scientific Name	Common Name	R	NR	M1.1.1	M1.1.3	M1.1.4	Expert Panel Comments
Invertebrates							
Cherax quadricarinatus	redclaw crayfish	Y	Y		Y		The panel noted there are rumours of this species having been found near Roma, though there are currently no records for this species. Given the known invasiveness and damage to ecosystems caused by this species it will be kept on the list for future QMDBB panels to consider.
Amphibian							
Rhinella marina	cane toad	Y	Y			Y	Cane toads are widespread throughout the Murray-Darling Basin. They are known to impact on higher order predators when poisoned due to eating toads or their tadpoles or eggs, which are highly toxic.
Birds							
Anas platyrhynchos	northern mallard	Y	Y			Y	Mallards are rare in Queensland outside of urban areas; however, they are known to hybridize with native duck species such as Pacific black duck (*Anas superciliosa*) and could be threatening to wetland biodiversity as a result.
Mammals							
Sus scrofa	pig	Y	Y			Y	Pigs are widespread throughout the Murray-Darling Basin and Bulloo catchments. They are known to have large impacts on wetland biodiversity, vegetation condition, hydrology, and water quality. They are possibly the most damaging invasive species in Australia for the aquatic environment.

4.2 Fauna species richness

Fauna species richness (total number of species) was calculated using wetland dependent species. Wetland dependent fauna species were defined as:

> *Species that are adapted to and dependent on living in wet conditions for at least part of their life and are found either within or immediately adjoining a riverine, non-riverine or estuarine wetland.*

4.2.1 Amphibian richness

The panel identified 45 native amphibian wetland indicator species relevant to the riverine and non-riverine wetlands of the study areas (Table 7). Point records for the listed species were used to identify spatial units containing native amphibian taxa to calculate species richness scores for AquaBAMM Measures 3.1.1 (Richness of native amphibians (riverine wetland breeders)) and 3.1.6 (Richness of native amphibians (non-riverine wetland breeders).

Table 7. Aquatic dependent native amphibian taxa

Scientific Name	Common Name	M3.1.1: (Riverine)	M3.1.6 (Non-riverine)	Expert Panel Comments
Adelotus brevis	tusked frog	Y	Y	Tusked frog can breed in slow moving streams and in dams or larger wetlands. The species was probably widespread within the headwaters of the eastern QMDBB e.g., Carnarvons, Bunyas, Main Range, Girraween, but has experienced massive declines in this area. There are some small populations on the western side of the Main Range and along the Macintyre River.
Crinia deserticola	chirping froglet	Y	Y	
Crinia parinsignifera	beeping froglet	Y	Y	
Crinia signifera	clicking froglet	Y	Y	
Cyclorana alboguttata	greenstripe frog		Y	
Cyclorana brevipes	Superb-collared frog		Y	
Cyclorana cultripes	grassland collared frog		Y	There are several *Cyclorana* species, and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. cultripes* is a bit of a taxonomic mess and the population in the QMDBB could well be an undescribed species for the QMDBB which forms a significant part of its range. This population possibly meets criterion for being disjunct or range limit, but the population is also strongly associated with downs country which in areas has suffered extensive cultivation (e.g., around Roma, Moonie).
Cyclorana novaehollandiae	eastern snapping frog		Y	

Scientific Name	Common Name	M3.1.1: (Riverine)	M3.1.6 (Non-riverine)	Expert Panel Comments
Cyclorana platycephala	water holding frog		Y	There are several *Cyclorana* species, and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. platycephala* is the quite widespread in Qld but appears to be heavily reliant upon heavy clay soils that are extensively cultivated.
Cyclorana verrucosa	rough collared frog		Y	There are several *Cyclorana* species, and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. verrucosa* appears to be largely confined to heavy clay soils within the southern Brigalow Belt, areas that have been extensively cultivated. Records west of Wallam/Nebine catchments are probably not verrucosa but cultripes sensu lato.
Lechriodus fletcheri	black soled frog		Y	
Limnodynastes dumerilii	grey bellied pobblebonk	Y	Y	
Limnodynastes fletcheri	barking frog	Y	Y	
Limnodynastes peronii	striped marshfrog	Y	Y	
Limnodynastes salmini	salmon striped frog		Y	
Limnodynastes tasmaniensis	spotted grassfrog		Y	
Limnodynastes terraereginae	scarlet sided pobblebonk		Y	
Litoria caerulea	common green treefrog	Y	Y	
Litoria chloris	orange eyed treefrog	Y	Y	Orange-eyed treefrog breeds in unconnected rock pools within streams, and sometimes within small streams.
Litoria dentata	bleating treefrog		Y	A recent taxonomic revision for this species has been published that splits this species into three. Within the QMDBB the species remains as *Litoria dentata*, apart from a single record of the new *L. quiritatus*. At this stage we will proceed as if all records for the study area are *L. dentata* however this taxon will require further investigation prior to future ACA updates.
Litoria fallax	eastern sedgefrog	Y	Y	

Scientific Name	Common Name	M3.1.1: (Riverine)	M3.1.6 (Non-riverine)	Expert Panel Comments
Litoria gracilenta	graceful treefrog	Y	Y	
Litoria latopalmata	broad palmed rocketfrog	Y	Y	
Litoria nasuta	striped rocketfrog		Y	
Litoria pearsoniana	cascade treefrog	Y		There is evidence of population recovery for cascade treefrogs along Main Range, however the Girraween NP appears to be locally extinct.
Litoria peronii	emerald spotted treefrog	Y	Y	
Litoria revelata	whirring treefrog	Y	Y	
Litoria rubella	ruddy treefrog	Y	Y	
Litoria subglandulosa	New England treefrog	Y		Girraween National Park is the northern limit of distribution for this species. It is also restricted to higher altitudes or subalpine swamps.
Litoria tyleri	southern laughing treefrog		Y	
Litoria verreauxii	whistling treefrog	Y	Y	
Litoria wilcoxii	eastern stony creek frog	Y		
Mixophyes fasciolatus	great barred frog	Y	Y	
Mixophyes fleayi	Fleay's barred frog	Y		Fleay's barred frog females and subadults and rarely males move well away from streams, males typically remain close to streams. Main Range population likely to have suffered from 2019 fires and the drought that led to them. There is an historical record from the Bunya Mountains.
Mixophyes iteratus	giant barred frog	Y		There have been no records of giant barred frog from the QMDBB area for many years, and it may be locally extinct this side of the Great Dividing Range.
Neobatrachus sudellae	meeowing frog		Y	
Notaden bennettii	holy cross frog		Y	

Scientific Name	Common Name	M3.1.1: (Riverine)	M3.1.6 (Non-riverine)	Expert Panel Comments
Philoria kundagungan	red-and-yellow mountainfrog	Y	Y	Red-and-yellow mountainfrog has a narrow altitudinal and latitudinal distribution, with majority of range in Qld and mostly within Main Range NP (and within QMDBB). The Main Range population is likely to have suffered from 2019 fires and the drought that led to them. Utilises soaks and seepages mostly in headwater streams but will utilise such features anywhere in the upland rainforest landscape. Restricted to rainforest and adjacent eucalypt forests. Tadpoles develop within a nest cavity possibly relying solely on yolk.
Platyplectrum ornatum	ornate burrowing frog	Y	Y	
Platyplectrum spenceri	desert burrowing frog	Y	Y	
Pseudophryne coriacea	red backed broodfrog		Y	
Pseudophryne major	great brown broodfrog		Y	
Uperoleia fusca	dusky gungan		Y	
Uperoleia laevigata	eastern gungan		Y	
Uperoleia rugosa	chubby gungan		Y	

4.2.2 Fish richness

The panel identified 23 native fish taxa relevant to the riverine and non-riverine wetlands of the study areas (Table 8). Point records for the listed species were used to identify spatial units containing native fish taxa to calculate species richness scores for AquaBAMM Measure 3.1.2 (Richness of native fish).

Table 8. Aquatic dependent native fish taxa

Scientific Name	Common Name	R	NR	Panel Comments
Ambassis agassizii	Agassiz's glassfish	Y	Y	Agassiz's glassfish is known from several Murray-Darling Basin catchments. They prefer macrophytes. In rivers and floodplain lagoons. Has declined in lowland areas. Now rare or absent over much of its former range in the QMDBB but are still common in east coastal catchments.
Bidyanus bidyanus	silver perch	Y		Silver perch have seriously declined in the Murray-Darling Basin and may be functionally extinct in the QMDBB. With artificial stocking in some areas, it is difficult to tease apart the status of this species in the wild. The panel has noted potential wild populations in the Paroo, Warrego, and Moonie Rivers. They are flow-dependent spawners. Juveniles may require access to off-river wetlands, hence reduced connectivity to these wetlands is a likely threat.

Scientific Name	Common Name	R	NR	Panel Comments
Bidyanus welchi	Welch's grunter	Y		Welch's grunter is known only from the Bulloo catchment within the ACA study area.
Craterocephalus amniculus	Darling Hardyhead	Y		Darling hardyhead has a limited distribution in the QMDBB, with only a few records in the Macintyre River near to and upstream of Texas. They are possibly an occasionally downstream vagrant from NSW tributaries into Qld. They are included as a priority species due to limited available habitat, threats to habitat, and climate change impacts.
Craterocephalus stercusmuscarum	flyspecked hardyhead	Y	Y	This species is in our records as flyspecked hardyhead (*Craterocephalus stercusmuscarum*) however the panel noted all records of this species in the QMDBB are likely to be unspecked hardyhead (*C. fulvus*). Their distribution in the QMDBB is the Condamine, Balonne and occasionally the Dumaresq Rivers.
Gadopsis marmoratus	river blackfish	Y		River blackfish is found in the upper Condamine and upper Border Rivers catchments. It has been impacted by recent drought and bushfire and translocated populations have been established. Climate change is likely to be a threat to this species.
Galaxias olidus	mountain galaxias	Y		Mountain galaxias is found in the upper Condamine and upper Border Rivers catchments. It has been impacted by recent drought and bushfire and translocated populations have been established. Climate change is likely to be a threat to this species.
Hypseleotris sp.	carp gudgeon sp.	Y	Y	The *Hypseleotris* complex of species in the QMDBB includes *H. klungzingeri* as well as 3 undescribed species which form a complex network of fertile and infertile hybrids. As it is difficult to separate these species in the field the panel has recommended, we treat all four species as *Hypseleotris sp*.
Leiopotherapon unicolor	spangled perch	Y	Y	Widespread in the QMDBB.
Maccullochella peelii	Murray cod	Y		Murray cod are patchily distributed throughout the northern Murray-Darling Basin. They are stocked in some areas and may be regionally extinct in the Paroo where it was formerly common. There are still high densities in Oakey Creek near Jondaryan and in the Border Rivers, but not present in the Bulloo at all. Has increased in abundance in some areas due to re-snagging of rivers.
Macquaria ambigua	golden perch	Y		Widespread in the QMDBB.
Melanotaenia fluviatilis	Murray River rainbowfish	Y		Murray River rainbowfish are present in Condamine-Balonne, Moonie and Border Rivers and possibly lower Warrego, though they could be confused with the closely related desert rainbowfish (*Melanotaenia splendida tatei*) present in the Warrego.
Melanotaenia splendida tatei	desert rainbowfish	Y		Desert rainbowfish are present in the Paroo, Warrego, and Bulloo catchments within the QMDBB.
Mogurnda adspersa	southern purplespotted gudgeon	Y	Y	Purple-spotted gudgeon are restricted in the QMDBB to tributaries of the Condamine and Border Rivers in the mid to upper catchments. Outside of the QMDBB they are common in east coastal catchments.

Scientific Name	Common Name	R	NR	Panel Comments
Nematalosa erebi	bony bream	Y	Y	Widespread in the QMDBB. This species was considered to be important as an abundant and key food source; however, it was decided it could not be meaningfully applied as a priority species.
Neosiluroides cooperensis	Cooper Creek catfish	Y		The Cooper Creek catfish occurs only within the Bulloo catchment within our study area.
Neosilurus hyrtlii	Hyrtl's catfish	Y	Y	Hyrtl's catfish is known from the Condamine-Balonne, Warrego, Maranoa, Paroo and Bulloo catchments in our study area. They can be locally common but may have declined in recent years in the lower Balonne River.
Philypnodon grandiceps	flathead gudgeon	Y	Y	Flathead gudgeon is known to our panel from only one specimen in the Macintyre River. On this basis we have removed 39 records from our analysis pending review of their identification by experts but have left the species in the official list for future panels to review.
Philypnodon macrostomus	dwarf flathead gudgeon	Y	Y	Dwarf flathead gudgeon is known in the QMDBB from Leyburn to Cotswold Weir of the Condamine catchment, and a single record from St George.
Porochilus argenteus	silver catfish	Y		Silver catfish are known from the Bulloo catchment and are not found elsewhere in our study area.
Porochilus rendahli	Rendahl's catfish	Y	Y	Rendahl's catfish are known from the QMDBB only in the Condamine-Balonne catchment and tributaries. They are uncommon, associated with macrophytes and present in the river and floodplain oxbow lakes. They are likely to be threatened by a reduction in suitable habitat as well as climate change.
Retropinna semoni	Australian smelt	Y	Y	Australian smelt are present and widespread in all catchments within the QMDBB.
Tandanus tandanus	freshwater catfish	Y		Freshwater catfish are known from all QMDBB catchments except the Bulloo. They have declined in the Balonne and are now absent from the Paroo which was formerly a stronghold for the species. They are still common in the mid to upper Condamine and Border Rivers catchments. They are found mainly in less turbid, sandy bottomed areas in the upper catchment of rivers, and may be negatively impacted by European carp.

4.2.3 Reptile richness

The panel identified 13 native reptile wetland dependent species relevant to the riverine and non-riverine wetlands of the study areas (Table 9). Point records for the listed species were used to identify spatial units containing native reptile taxa to calculate scores for AquaBAMM Measure 3.1.3 (Richness of native aquatic dependent reptiles).

Table 9. Aquatic dependent native reptile taxa

Scientific Name	Common Name	R	NR	Panel Comments
Chelodina expansa	broad-shelled river turtle	Y	Y	This species was identified as a priority species for the Warrego and Paroo catchments because of the scarcity of records for these river catchments.
Chelodina longicollis	eastern snake-necked turtle	Y	Y	

Scientific Name	Common Name	R	NR	Panel Comments
Emydura macquarii emmotti	Emmott's short-neck turtle	Y	Y	"Cooper Creek" subspecies of *Emydura macquarii.*
Emydura macquarii macquarii	Murray turtle	Y	Y	"Murray River" subspecies of *Emydura macquarii.*
Eulamprus kosciuskoi	alpine water skink	Y	Y	Restricted to New England Tableland in the QMDBB.
Eulamprus quoyii	eastern water skink	Y	Y	Recorded as far west as the Balonne River.
Hemiaspis signata	black-bellied swamp snake			Records further west than New England Tableland likely incorrect.
Hemiaspis damelii	grey snake	Y	Y	Favours woodlands, usually on heavier, cracking clay soils, particularly in association with water bodies.
Intellagama lesueurii	eastern water dragon	Y	Y	
Pseudechis porphyriacus	red-bellied black snake	Y	Y	
Tropidechis carinatus	Rough-scaled Snake	Y	Y	Limited to areas with annual rainfall exceeding 800 mm (Pearn, 1987). Common in riparian areas and heath (Covacevich & McDonald, 1993; Covacevich & Wilson, 1995; Shine & Charles, 1982). Western extent of range in New England Tableland.
Tropidonophis mairii	freshwater snake	Y	Y	Subsequent to the previous ACA, there appears to be many more sightings in the QMDBB e.g., St George, East Creek and Waterbird Habitat and two records from Bailie-Henderson (wet gully into Gowrie Ck).
Wollumbinia belli	Bell's turtle	Y		In shallow to deep pools of upper reaches of freshwater creeks flowing through granitic bedrock, >700 metres above sea level.

4.2.4 Waterbird richness

The panel identified 87 native bird wetland indicator species relevant to the riverine and non-riverine wetlands of the study areas (Table 10). Only bird species inhabiting freshwater wetland environments for all, or part of their life history were considered.

Point records for the listed species were used to identify spatial units containing native bird taxa to calculate species richness scores for AquaBAMM Measure 3.1.4 (Richness of native waterbirds).

Table 10. Aquatic dependent native bird taxa

Scientific Name	Common Name	R	NR	Panel Comments
Acrocephalus australis	Australian reed-warbler	Y	Y	
Actitis hypoleucos	common sandpiper	Y	Y	
Amaurornis moluccana	pale-vented bush-hen	Y	Y	

Scientific Name	Common Name	R	NR	Panel Comments
Amytornis barbatus barbatus	grey grasswren (Bulloo)		Y	This species is tied closely to lignum swamps and other ephemeral wetland types for breeding.
Anas castanea	chestnut teal	Y	Y	
Anas gracilis	grey teal	Y	Y	
Anas superciliosa	Pacific black duck	Y	Y	
Anhinga novaehollandiae	Australasian darter	Y	Y	
Anseranas semipalmata	magpie goose		Y	
Antigone rubicunda	brolga		Y	
Ardea alba modesta	eastern great egret	Y	Y	
Ardea intermedia	intermediate egret	Y	Y	
Ardea pacifica	white-necked heron	Y	Y	
Aythya australis	hardhead	Y	Y	
Biziura lobata	musk duck	Y	Y	In decline throughout the basin. Loss of breeding habitat a concern; requires lignum, good quality habitat. Regularly seen on Cooby Dam. Needs deep open water and these are scarce in the Condamine catchment.
Botaurus poiciloptilus	Australasian bittern	Y	Y	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp.*) and spikerushes (*Eleocharis spp.*).
Bubulcus ibis	cattle egret	Y	Y	
Calidris acuminata	sharp-tailed sandpiper	Y	Y	
Calidris ferruginea	curlew sandpiper	Y	Y	
Calidris melanotos	pectoral sandpiper	Y	Y	
Calidris ruficollis	red-necked stint	Y	Y	
Ceyx azureus	azure kingfisher	Y	Y	
Charadrius ruficapillus	red-capped plover	Y	Y	
Chenonetta jubata	Australian wood duck	Y	Y	
Chlidonias hybrida	whiskered tern	Y	Y	
Chlidonias leucopterus	white-winged black tern	Y	Y	

Scientific Name	Common Name	R	NR	Panel Comments
Chroicocephalus novaehollandiae	silver gull	Y	Y	
Circus approximans	swamp harrier	Y	Y	
Cladorhynchus leucocephalus	banded stilt	Y	Y	
Cygnus atratus	black swan	Y	Y	
Dendrocygna arcuata	wandering whistling-duck	Y	Y	
Dendrocygna eytoni	plumed whistling-duck	Y	Y	
Egretta garzetta	little egret	Y	Y	
Egretta novaehollandiae	white-faced heron	Y	Y	
Elanus scriptus	letter-winged kite		Y	
Elseyornis melanops	black-fronted dotterel	Y	Y	This species roosts and breeds predominantly around water in its normal core range.
Ephippiorhynchus asiaticus	black-necked stork	Y	Y	
Epthianura albifrons	white-fronted chat		Y	This species appears to be tied to water in QMDBB.
Epthianura crocea	yellow chat		Y	This species requires wetland fringing vegetation for breeding.
Erythrogonys cinctus	red-kneed dotterel	Y	Y	
Fulica atra	Eurasian coot	Y	Y	
Gallinago hardwickii	Latham's snipe	Y	Y	
Gallinula tenebrosa	dusky moorhen	Y	Y	
Gallirallus philippensis	buff-banded rail	Y	Y	
Gelochelidon nilotica	gull-billed tern	Y	Y	
Haliaeetus leucogaster	white-bellied sea-eagle	Y	Y	
Haliastur sphenurus	whistling kite	Y	Y	
Himantopus himantopus	black-winged stilt	Y	Y	

Scientific Name	Common Name	R	NR	Panel Comments
Hydroprogne caspia	Caspian tern	Y	Y	
Irediparra gallinacea	comb-crested jacana	Y	Y	
Ixobrychus dubius	Australian little bittern	Y	Y	
Ixobrychus flavicollis	black bittern	Y	Y	
Limosa limosa	black-tailed godwit	Y	Y	
Malacorhynchus membranaceus	pink-eared duck	Y	Y	
Megalurus gramineus	little grassbird	Y	Y	
Microcarbo melanoleucos	little pied cormorant	Y	Y	
Nettapus coromandelianus	cotton pygmy-goose		Y	
Numenius minutus	little curlew	Y	Y	Retain on the list as panel decided to keep all EPBC listed migratory species even if not strictly wetland dependent.
Nycticorax caledonicus	nankeen night-heron	Y	Y	
Oxyura australis	blue-billed duck		Y	
Pandion cristatus	eastern osprey	Y	Y	
Pelecanus conspicillatus	Australian pelican	Y	Y	
Phalacrocorax carbo	great cormorant	Y	Y	
Phalacrocorax sulcirostris	little black cormorant	Y	Y	
Phalacrocorax varius	pied cormorant	Y	Y	
Platalea flavipes	yellow-billed spoonbill	Y	Y	
Platalea regia	royal spoonbill	Y	Y	
Plegadis falcinellus	glossy ibis	Y	Y	
Podiceps cristatus	great crested grebe	Y	Y	
Poliocephalus poliocephalus	hoary-headed grebe		Y	

Scientific Name	Common Name	R	NR	Panel Comments
Porphyrio melanotus	purple swamphen	Y	Y	
Porzana fluminea	Australian spotted crake	Y	Y	
Porzana pusilla	Baillon's crake	Y	Y	
Porzana tabuensis	spotless crake	Y	Y	
Recurvirostra novaehollandiae	red-necked avocet	Y	Y	
Rostratula australis	Australian painted snipe	Y	Y	Australian painted snipe has declined over the past five decades. This species has suffered primarily from either drainage of wetlands, or water extraction from rivers resulting in fewer shallow wetlands. Overgrazing has contributed to its decline in at least part of its range.
Spatula rhynchotis	Australasian shoveler	Y	Y	
Stictonetta naevosa	freckled duck		Y	
Tachybaptus novaehollandiae	Australasian grebe	Y	Y	
Tadorna tadornoides	Australian shelduck	Y	Y	
Threskiornis molucca	Australian white ibis	Y	Y	
Threskiornis spinicollis	straw-necked ibis	Y	Y	
Tribonyx ventralis	black-tailed native-hen	Y	Y	
Tringa glareola	wood sandpiper	Y	Y	
Tringa nebularia	common greenshank	Y	Y	
Tringa stagnatilis	marsh sandpiper	Y	Y	
Vanellus miles	masked lapwing	Y	Y	

4.2.5 Mammal richness

Five mammal taxa were considered by the panel to be aquatic dependent and relevant to the riverine and non-riverine wetlands of the study areas (Table 11). Point records for the listed species were used to identify spatial units containing mammal taxa to calculate species richness scores for AquaBAMM Measure 3.1.7 (Richness of native aquatic dependent mammals).

Table 11. Aquatic dependent native mammal taxa

Scientific Name	Common Name	R	NR	Panel Comments
Hydromys chrysogaster	water rat	Y	Y	
Myotis macropus	large-footed myotis	Y	Y	Large-footed myotis is probably the only strictly wetland-dependent microchiropteran in Queensland, though other species regularly forage and roost near water.
Ornithorhynchus anatinus	platypus	Y	Y	Only found high in the catchment around Killarney and Warwick.
Rattus lutreolus	swamp rat	Y	Y	Literature supports riverine and non-riverine habitats being critical for this species.
Pteropus poliocephalus	grey-headed flying-fox	Y	Y	Grey-headed flying-foxes are known to make camps predominantly near water.

4.2.6 Macroinvertebrate richness

The panel advised against using wetland-dependent macroinvertebrate taxa lists to calculate macroinvertebrate diversity for the study areas. They based this recommendation on the lack of detailed macroinvertebrate surveys across the region. Past ACAs have used maximum richness scores derived from higher-level macroinvertebrates studies undertaken using recognised survey and analysis methods (such as those used by Conrick & Cockayne 2000, Chessman 2003, and Healthy Waterways 2014). Such methods estimate macroinvertebrate diversity at the broad taxonomic group level (e.g. sub-family, family, order or class). The panel however, felt such an approach would not provide the best available representation of macroinvertebrate richness for the study areas.

While specific taxa were not listed for AquaBAMM Measure 3.2.1, experts were still invited to nominate individual priority macroinvertebrate species for Measure 5.1.1 (See section 3.4.1).

The AquaBAMM Measure 3.2.1 (Richness of macroinvertebrate taxa) was not calculated for the Queensland Murray-Darling and Bulloo Basins ACA.

4.3 Near threatened and threatened fauna

The panel identified 17 near threatened or threatened fauna taxa relevant to the riverine and non-riverine wetlands of the study areas (Table 12). Only species judged to be aquatic, semi-aquatic or riparian dependent and scheduled as NT, V, E, or CE under the NCA or the EPBC Act were considered.

Point records for the listed species were used to identify spatial units containing near threatened or threatened fauna taxa to calculate scores for AquaBAMM Measure 4.1.1 (Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA, EPBC Act).

Table 12. Aquatic dependent near threatened and threatened fauna taxa

Scientific Name	Common Name	NCA Status	EPBC Status	R	NR	Expert panel Comments
Adelotus brevis	tusked frog	V		Y	Y	Tusked frog can breed in slow moving streams and in dams or larger wetlands. The species was probably widespread within the headwaters of the eastern QMDBB e.g., Carnarvons, Bunyas, Main Range, Girraween, but has experienced massive declines in this area. There are some small populations on the western side of the Main Range and along the Macintyre River.
Amytornis barbatus barbatus	grey grasswren (Bulloo)	E	E		Y	This species is tied closely to lignum swamps and other ephemeral wetland types for breeding.
Bidyanus bidyanus	silver perch		CE	Y		Silver perch have seriously declined in the Murray-Darling Basin and may be functionally extinct in the QMDBB. With artificial stocking in some areas, it is difficult to tease apart the status of this species in the wild. The panel has noted potential wild populations in the Paroo, Warrego, and Moonie Rivers. They are flow-dependent spawners. Juveniles may require access to off-river wetlands, hence reduced connectivity to these wetlands is a likely threat.
Botaurus poiciloptilus	Australasian bittern	E	E	Y	Y	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp*.) and spikerushes (*Eleocharis spp*.).
Calidris ferruginea	curlew sandpiper	CE	CE	Y	Y	
Epthianura crocea	yellow chat	V			Y	This species requires wetland fringing vegetation for breeding.
Euastacus jagara	Jagara hairy crayfish	CE		Y		
Hemiaspis damelii	grey snake	E		Y	Y	Favours woodlands, usually on heavier, cracking clay soils, particularly in association with water bodies.
Litoria pearsoniana	cascade treefrog	V		Y		There is evidence of population recovery for cascade treefrogs along Main Range, however the Girraween NP population appears to be locally extinct.

Scientific Name	Common Name	NCA Status	EPBC Status	R	NR	Expert panel Comments
Litoria subglandulosa	New England treefrog	V		Y	Y	Girraween National Park the northern limit of distribution for this species. It is also restricted to higher altitudes or subalpine swamps.
Maccullochella peelii	Murray cod		V	Y		Murray cod are patchily distributed throughout the northern Murray-Darling Basin. They are stocked in some areas and may be regionally extinct in the Paroo where it was formerly common. There are still high densities in Oakey Creek near Jondaryan and in the Border Rivers, but not present in the Bulloo at all. Has increased in abundance in some areas due to re-snagging of rivers.
Mixophyes fleayi	Fleay's barred frog	E	E	Y		Fleay's barred frog females and subadults and rarely males move well away from streams, males typically remain close to streams. Main Range population likely to have suffered from 2019 fires and the drought that led to them. There is an historical record from the Bunyas.
Mixophyes iteratus	giant barred frog	V	E	Y		There have been no records of giant barred frog from the QMDBB area for many years, and it may be locally extinct this side of the Great Dividing Range.
Philoria kundagungan	red-and-yellow mountainfrog	E		Y		Red-and-yellow mountainfrog has a narrow altitudinal and latitudinal distribution, with majority of range in Qld and mostly within Main Range NP (and within QMDBB). Main Range population likely to have suffered from 2019 fires and the drought that led to them. Utilises soaks and seepages mostly in headwater streams but will utilise such features anywhere in the upland rainforest landscape. Restricted to rainforest and adjacent eucalypt forests. Tadpoles develop within a nest cavity possibly relying solely on yolk.
Pteropus poliocephalus	grey-headed flying-fox	C	V	Y	Y	Grey-headed flying-foxes are known to make camps predominantly near water.
Rostratula australis	Australian painted snipe	E	E	Y	Y	Australian painted snipe has declined over the past five decades. This species has suffered primarily from either drainage of wetlands, or water extraction from rivers resulting in fewer shallow wetlands. Overgrazing has been attributed to its decline in at least part of its range.
Wollumbinia belli	Bell's turtle	V	V	Y		In shallow to deep pools of upper reaches of freshwater creeks flowing through granitic bedrock, >700 metres above sea level.

4.4 Priority fauna

The panel deliberated on all aquatic-dependent fauna species within the study areas to identify priority fauna. Priority taxa are defined as those not listed as NT, V, E, or CE in Queensland or Commonwealth legislation but are considered significant within the study region as they exhibit one or more of the following attributes:

1. It is endemic to the study area (>75% of its distribution is in the study area/catchment)
2. It has experienced, or is suspected of experiencing, a serious population decline
3. It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment
4. It is currently a small population and threatened by loss of habitat
5. It is a significant disjunct population
6. It is a migratory species (other than birds)
7. A significant proportion of the breeding population (>1% for waterbirds, >75% other species) occurs in the waterbody (see Ramsar Criterion 6 for waterbirds)
8. Taxa vulnerable to impacts of climate change - Species that are considered to be adversely affected by the predicted changes in climate e.g. increasing temperatures, sea level rise and increasing frequency of extreme weather events (drought, flood & cyclones). Species can only be listed under this reason if there is sufficient knowledge of species' biology and its interaction with climate that would support an assessed impact under climate change scenarios

4.4.1 Priority species

The panel identified 28 priority fauna taxa relevant to the riverine and non-riverine wetlands of study areas (Table 13). Point records for the listed species were used to identify spatial units containing priority fauna taxa to calculate scores for AquaBAMM Measure 5.1.1 (Presence of aquatic ecosystem dependent 'priority' fauna species).

This list includes all appropriate species listed as "No Take" under the *Fisheries Act* (1994) based on fauna expert panel recommendations.

Table 13. Aquatic dependent priority fauna taxa

Scientific Name	Common Name	R	NR	Priority Attributes	Panel Comments
Ambassis agassizii	Agassiz's glassfish/olive perchlet	Y	Y	2	Agassiz's glassfish is known from a number of Murray-Darling Basin catchments. They have a preference for macrophytes. In rivers and floodplain lagoons. Has declined in lowland areas. Now rare or absent over much of its former range in the QMDBB, but are still common in east coastal catchments.
Biziura lobata	musk duck	Y	Y	2	In decline throughout the basin. Loss of breeding habitat a concern; require lignum, good quality habitat. Regularly seen on Cooby Dam. Needs deep open water and these are scarce in the Condamine catchment.
Chelodina expansa	broad-shelled river turtle	Y	Y	4	This species was identified as a priority species for the Warrego and Paroo catchments because of the scarcity of records for these river catchments.
Craterocephalus amniculus	Darling hardyhead	Y		3, 5	Darling hardyhead has a limited distribution in the QMDBB, with only a few records in the Macintyre River near to and upstream of Texas. They are possibly an occasionally downstream vagrant from NSW tributaries into Qld. They are included as a priority species due to limited available habitat, threats to habitat, and climate change impacts.

Scientific Name	Common Name	R	NR	Priority Attributes	Panel Comments
Cyclorana cultripes	grassland collared frog		Y	2, 5	There are several *Cyclorana* species and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. cultripes* is a bit of a taxonomic mess and the population in the QMDBB could well be an undescribed species for QMDBB which forms a significant part of its range. This population possibly meets criterion for being disjunct or range limit, but the population is also strongly associated with downs country which in areas has suffered extensive cultivation (e.g. around Roma, Moonie).
Cyclorana platycephala	water-holding frog		Y	2	There are several *Cyclorana* species and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. platycephala* is the quite widespread in Qld but appears to be heavily reliant upon heavy clay soils that are extensively cultivated.
Cyclorana verrucosa	rough frog		Y	2	There are several *Cyclorana* species and *Notaden bennetti* that have suffered very large areas of habitat loss through cultivation, particularly through the Darling Downs. These are obligate burrowing species and do not tolerate being cultivated. *C. verrucosa* appears to be largely confined to heavy clay soils within the southern Brigalow Belt, areas that have been extensively cultivated. Records west of Wallam/Nebine catchments are probably not *C. verrucosa* but *'cultripes sensu lato*'.
Euastacus sulcatus	Lamington spiny crayfish	Y		1, 8	Lamington spiny crayfish *Euastacus sulcatus*— restricted to altitudes >300 m in subtropical rainforests of south-east Queensland and far northern NSW, including the Lamington Plateau, McPherson Range, Cunningham's Gap, Mistake Mountains and Mt Tamborine, and Acacia Plateau near Killarney (headwaters of the Condamine River).
Euastacus suttoni	New England crayfish	Y		1, 8	Extends from the Stanthorpe area, southern Queensland, 120 km south to Dundee near Glen Innes, New South Wales, and east along the Gibraltar Range only and Acacia Plateau near Killarney (headwaters of the Condamine River). This species only occurs in streams >700m.
Gadopsis marmoratus	river blackfish	Y		3, 4, 8	River blackfish is found in the upper Condamine and upper Border Rivers catchments. It has been impacted by recent drought and bushfire and translocated populations have been established. Climate change is likely to be a threat to this species.
Galaxias olidus	mountain galaxias	Y		3, 4, 5, 8	Mountain galaxias is found in the upper Condamine and upper Border Rivers catchments. It has been impacted by recent drought and bushfire and translocated populations have been established. Climate change is likely to be a threat to this species.

Scientific Name	Common Name	R	NR	Priority Attributes	Panel Comments
Jardinella eulo			Y	1, 4	A snail endemic to the Eulo springs aggregation. Endemic to the QMDBB and highly range restricted.
Limnodynastes dumerilii	grey bellied pobblebonk	Y	Y	5	This species is at the northern limit of its range in the Border Rivers and Condamine areas and is restricted to upland streams.
Limnodynastes salmini	salmon striped frog		Y	2	The Brigalow Belt is a stronghold for this species; however, its distribution is limited. There appears to be a north–south line west of Chinchilla/Kogan where *L. salmini* is doing well. East of this line the species may have always been uncommon or patchy. There are historical records from Drayton and Brisbane however the species may now be locally extinct east of the Great Divide. The study area makes up a significant portion of its Qld range, and the panel identified *L. salmini* as a priority species because of a loss of heavy soil habitat through cultivation.
Litoria chloris	orange eyed treefrog	Y	Y	5	This species has disjunct populations restricted to the headwaters in wet forest of the Bunya Mountains and Main Range National Parks and is also restricted by an altitudinal limit.
Litoria dentata complex			Y	5	The species is at its western range limit within the eastern edge of the QMDBB. It has a patchy distribution within study area and is mostly associated with landscapes with some tree cover. This species has been split into three taxa, two of which may occur in the study area, but unfortunately genetic work has not produced a clear picture on where the boundaries of the occurrence of the two local species are. At this stage all *L. dentata* records for the study area will be included in the analysis however this will need to be revised next time the ACA is updated.
Litoria verreauxii	whistling treefrog	Y	Y	8	Mostly a stream breeder in QMDBB, which differs from the pond-breeding behaviour of this species in the south of the country. In QMDBB restricted to the Bunyas, south along Great Divide to Girraween NP. The species is at the northern limits of its range in the QMDBB and is of concern due to its altitudinal distribution limits and the impacts of climate change.
Mogurnda adspersa	southern purple-spotted gudgeon	Y	Y	2	*Mogurnda adspersa* has a restricted range to upper regions in the QMDBB and is experiencing further contractions. The southern-purple-spotted gudgeon is declining across the Murray Darling Basin. It is generally found in the upstream area of creeks. Specimens were caught some three years ago in Dry Creek. Genetic work shows that they are poorly dispersed, so there is little resilience in the system. Also occurs in Bunya Mountain streams.
Myotis macropus	Large-footed Myotis	Y	Y	5	Large-footed myotis is probably the only strictly wetland-dependent microchiropteran in Queensland, though other species regularly forage and roost near water.

Scientific Name	Common Name	R	NR	Priority Attributes	Panel Comments
Neosilurus hyrtlii	Hyrtl's catfish	Y		2, 6	This species is almost migratory. The species is suspected to be declining, particularly in places where previously it was common, with known declines south of St George.
Notaden bennettii	holy cross frog	Y		2	This species is threatened by loss of habitat. It is a heavy soil species. At the north-easterly edge of its distributional range. Its habitat and populations have been impacted by cultivation. This burrowing frog is found in 'black soil' areas of slopes and plains as well as woodland, mallee and savannah habitats. It is usually only found above ground after heavy rain. Eggs are laid on the surface of temporary pools. This species seems to prefer ephemeral wetlands such as gilgais and claypans.
Notopala sublineata	river snail	Y		2, 3	Near extinct and limited to inside irrigation pipes and similar wherever carp are present. Thriving in Bulloo and Ambathala Creek in the absence of carp. The species is listed under NSW and Victorian legislation but not EPBC as there is a subspecies (*N. alisoni*) which is still common and abundant across the Lake Eyre Basin.
Ornithorhynchus anatinus	Platypus	Y	Y	2	Platypus was regarded as an iconic species by the fauna panel. Records are known from Tenterfield Creek (in the large pool at Richfield, approximately 20 km downstream from Tenterfield); at the junction of the Dumaresq, Mole and Severn River; 5 km below Cunningham Weir; directly below Bonshaw Weir; and at Macintyre Falls. They are also known from the Condamine River and small streams upstream from Killarney. They are usually present at low densities and are generally suffering degradation of habitat, and death from opera traps.
Oxyura australis	blue-billed duck	Y	Y	5	Blue-billed ducks are at the northern extent of their range in the QMDBB. They are a deeper water species, and drainage or degradation of deep permanent wetlands is a threatening process. This duck is likely not very common in the Condamine catchment, however there is an overall lack of data on their abundance and distribution for the region.
Philypnodon macrostomus	dwarf flathead gudgeon	Y		4, 5	Dwarf flathead gudgeon is known in the QMDBB from a small disjunct population from Leyburn to Cotswold Weir of the Condamine catchment, and a single record from St George.
Porochilus rendahli	Rendahl's catfish	Y	Y	3,8	Rendahl's catfish are known from the QMDBB only in the Condamine-Balonne catchment and tributaries. They are uncommon, associated with macrophytes and present in the river and floodplain oxbow lakes. They are likely to be threatened by a reduction in suitable habitat as well as climate change.
Pseudophryne coriacea	red backed broodfrog	Y	Y	5	This species in QMDBB is restricted to Main Range and New England Tableland. Confined to upland forests and is at the northern limit of its range. It is also altitudinally restricted. Girraween NP is a stronghold for this species.

Scientific Name	Common Name	R	NR	Priority Attributes	Panel Comments
Tandanus tandanus	freshwater catfish	Y	Y	2	Freshwater catfish are known from all of the QMDBB catchments except the Bulloo. They have declined in the Balonne and are now absent from the Paroo which was formerly a stronghold for the species. They are still common in the mid to upper Condamine and Border Rivers catchments. They are found mainly in less turbid, sandy bottomed areas in the upper catchment of rivers, and may be negatively impacted by European carp.

4.4.2 Migratory species

In addition to the priority species identified above, the panel nominated migratory species for inclusion in AquaBAMM Measure 5.1.3. Only species listed under the Convention on Migratory Species (Bonn), Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), or Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) as significant fauna taxa were considered.

The panel identified 18 migratory species relevant to the riverine and non-riverine wetlands of the study areas (Table 14). Point records for the listed species were used to identify spatial units containing migratory taxa to calculate the scores for AquaBAMM Measure 5.1.3 (Habitat for, or presence of, migratory species).

Table 14. Migratory taxa listed on international agreements

Scientific Name	Common Name	NCA Status	NR	R	Agreements/Conventions	v2.1 Expert panel Comments (M5.1.3)
Actitis hypoleucos	common sandpiper	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Calidris acuminata	sharp-tailed sandpiper	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Calidris ferruginea	curlew sandpiper	CE	Y	Y	CAMBA JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Calidris melanotos	pectoral sandpiper	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Calidris ruficollis	red-necked stint	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Chlidonias leucopterus	white-winged black tern	SL	Y	Y	CAMBA JAMBA ROKAMBA	10+ records in the QMDBB so not a vagrant.
Gallinago hardwickii	Latham's snipe	SL	Y	Y	JAMBA ROKAMBA Bonn	10+ records in the QMDBB so not a vagrant.
Gelochelidon nilotica	gull-billed tern	SL	Y	Y	CAMBA	Known from inland waterways so not a vagrant.
Hydroprogne caspia	Caspian tern	SL	Y	Y	JAMBA	Known from inland waterways so not a vagrant.
Limosa limosa	black-tailed godwit	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn	Known from inland waterways so not a vagrant.

Scientific Name	Common Name	NCA Status	NR	R	Agreements/Conventions	v2.1 Expert panel Comments (M5.1.3)
Pandion cristatus	eastern osprey	SL	Y	Y	Bonn.	10+ records in the QMDBB so not a vagrant.
Plegadis falcinellus	glossy ibis	SL	Y	Y	Bonn.	Known from inland waterways so not a vagrant.
Tringa glareola	wood sandpiper	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn.	10+ records in the QMDBB so not a vagrant.
Tringa nebularia	common greenshank	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn.	10+ records in the QMDBB so not a vagrant.
Tringa stagnatilis	marsh sandpiper	SL	Y	Y	CAMBA JAMBA ROKAMBA Bonn.	10+ records in the QMDBB so not a vagrant.
Ixobrychus dubius	Australian little bittern	C	Y	Y	Not listed, panel decision.	Known from inland waterways so not a vagrant.
Porzana pusilla	Baillon's crake	C	Y	Y	Not listed, panel decision.	Known from inland waterways so not a vagrant.
Acrocephalus australis	Australian reed-warbler	C	Y	Y	Not listed, panel decision.	10+ records in the QMDBB so not a vagrant.

5 Springs

A distinct hydrological component of the study areas are the deep artesian groundwater systems operating almost entirely independent of shallower surface water alluvial aquifers. Artesian water emanating from deep artesian aquifers result in numerous spring systems displaying unique geomorphic appearances and specialised habitats of high intrinsic conservation value (Fensham 2006).

Spring wetlands were not explicitly assessed as part of the Queensland Murray-Darling and Bulloo Basins assessment. In the absence of an Aquatic Conservation Assessment for spring wetlands, the reader is referred to the Queensland spring database published by the Queensland Herbarium (Queensland Herbarium 2020). This database provides comprehensive data on the condition, threats and biodiversity values associated with springs within the database. The database also includes a conservation priority rating for springs within the Great Artesian Basin. These ratings were developed by Fensham and Fairfax (2005) and are based on the following criteria:

- Category 1a: These spring wetlands provide habitat for biota endemic to one spring complex.
- Category 1b: These spring wetlands provide habitat for biota endemic to more than one spring complex.
- Category 1c: These spring wetlands provide habitat for species listed under State or Commonwealth legislation (except *Callistemon* sp. Boulia (L. Pedley 5297) which is listed as vulnerable under the EPBC and has since been identified as the common species *C. viminalis*).
- Category 2: These spring wetlands provide habitat for some isolated populations of plant species or, are outstanding examples of their type.
- Category 3: Any spring of lower value than above that is relatively intact.
- Category 4: Severely degraded by any threatening processes.

The Queensland Murray-Darling and Bulloo Basins assessment assigned value under Criterion 6 (Special and Unique Values) to any non-riverine spatial units containing active springs. The Queensland Herbarium Groundwater Dependent Ecosystems Surface Points dataset was used as a basis for selecting springs locations. Springs were selected and grouped based on their hydrological modification (hydromod) attribute as either unmodified (H1) or slightly modified (H2M4). Highly modified and dormant springs were not included in the assessment.

Conservation value ratings were assigned to Measures 6.1.1 (Presence of distinct, unique or special geomorphic features) and 6.3.1 (Presence of distinct, unique or special habitat including habitat that functions as refugia or other critical purpose), based on the springs hydromod attribute as follows:

- Non-riverine spatial units that contained an unmodified spring (H1) were assigned a value of 4 for Measures 6.1.1, 6.3.1, 6.4.1
- Non-riverine spatial units that contained a slightly modified spring (H2M4) were assigned a value of 3 for Measures 6.1.1, 6.3.1, 6.4.1

6 Special Features

6.1 Special Features

The flora, fauna and ecology expert panels were asked to identify special and unique features relevant to the riverine and non-riverine wetlands within each study area. The expert panels reviewed decisions from the previous ACA as well as nominating new decisions. Expert panel derived special features are used to calculate scores for the following AquaBAMM measures:

- 5.1.4 (Habitat for significant numbers of waterbirds)
- 5.2.1 (Presence of 'priority' aquatic ecosystem)
    - (Presence of distinct, unique or special geomorphic features)
- 6.2.1 (Presence of or requirement for distinct, unique or special ecological processes)
- 6.3.1 (Presence of distinct, unique or special habitat, including habitat that functions as refugia or other critical purpose)
- 6.3.3 (Ecologically significant wetlands identified through expert opinion and/or documented study)
- 6.3.4 (Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)
- 6.4.1 (Presence of distinct, unique or special hydrological regimes, e.g. spring fed stream, ephemeral stream or boggomoss)
- 8.2.5 (Wetland type representative of the study area).

Where a single special feature decision crossed more than one study area, the special feature was implemented separately in each study area. Special features were assigned a conservation rating of 2 (Medium), 3 (High) or 4 (Very High). Areas having multiple values (e.g. flora and fauna values) were consolidated and implemented as ecology special feature decisions. Decisions that were not able to be implemented due to uncertainty or a lack of available data are indicated as ‘Not Implemented’ in the special feature tables.

An overall decision was made by the expert panel to not assign a special feature value to any artificial wetlands. However while reviewing the special features, some artificial wetlands have been identified as special features by the expert panel. The values that have been assigned to the wetlands are meant to serve primarily as an ecological inventory and are valued as playing a role in a special feature. Their inclusion is not meant to imply any policy, protective or legislative requirements.

For example, the Thallon Waterholes in the Moonie River catchment are filled during floods and provide habitat for a range of aquatic organisms and waterbirds. These waterholes are given a conservation value of 3.

Another example is the Balonne River Floodplain which covers an area that is part of the Directory of Important Wetlands Australia and is listed as QLD084 (DAWE, 2021). The special feature is an aggregation of permanent and ephemeral freshwater billabongs and swamps on an inland floodplain and given a conservation value of 3. Some of the swamps have been classified as ‘artificial’ and have either been fully or partly cultivated. A decision was made to remove the fully cultivated wetlands from the special feature decision but retain the partly cultivated areas and downgrade their conservation value to 2. These partly cultivated wetlands maintained some ecological value as they are still partly covered in vegetation and are still flooded during high rainfall events due to their lack of constructed high dam walls.

The riverine and non-riverine special features identified by the Queensland Murray-Darling and Bulloo Basins expert panels are listed in following 16 tables which are sorted by study area and either riverine or non-riverine spatial units. Each feature may have fauna, flora and/or ecology values, either singularly or in combination.

The 16 tables include:

- Table 15. Border Rivers Riverine flora and ecology special features
- Table 16. Border Rivers Non-Riverine fauna, flora and ecology special features
- Table 17. Condamine-Balonne Riverine flora and ecology special features
- Table 18. Condamine-Balonne Non-Riverine fauna, flora and ecology special features
- Table 19. Maranoa Riverine flora and ecology special features
- Table 20. Maranoa Non-Riverine flora and ecology special features
- Table 21. Moonie Riverine flora and ecology special features
- Table 22. Moonie Non-Riverine flora and ecology special features
- Table 23. Paroo Riverine flora and ecology special features
- Table 24. Paroo Non-Riverine fauna, flora and ecology special features
- Table 25. Warrego Riverine fauna, flora and ecology special features
- Table 26. Warrego Non-Riverine flora and ecology special features
- Table 27. Wallam Riverine flora and ecology special features
- Table 28. Wallam Non-Riverine flora and ecology special features
- Table 29. Bulloo Riverine flora and ecology special features
- Table 30. Bulloo Non-Riverine fauna, flora and ecology special features

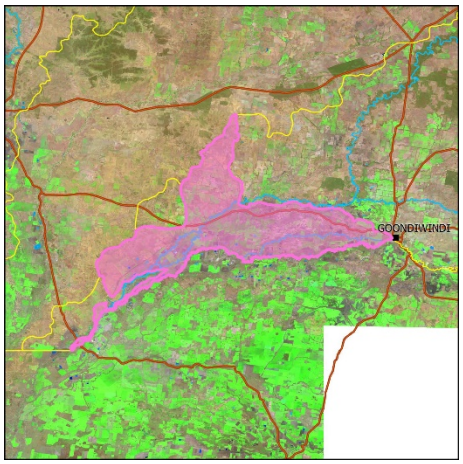
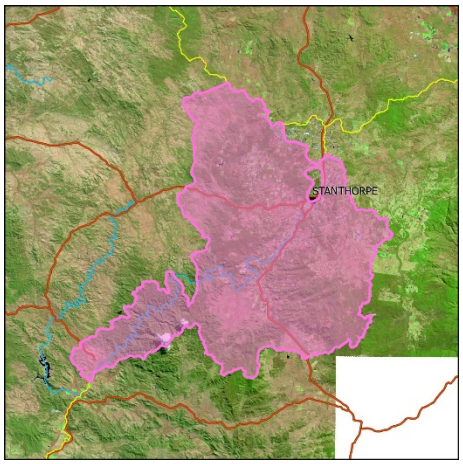
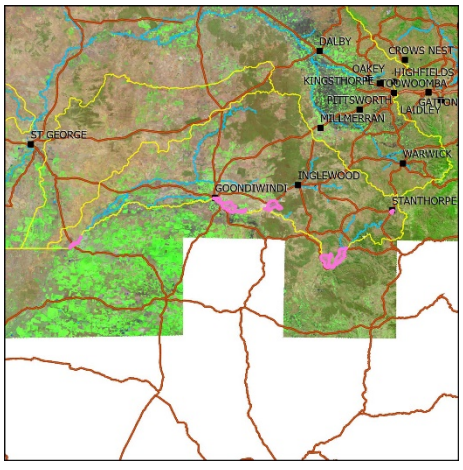
Table glossary:

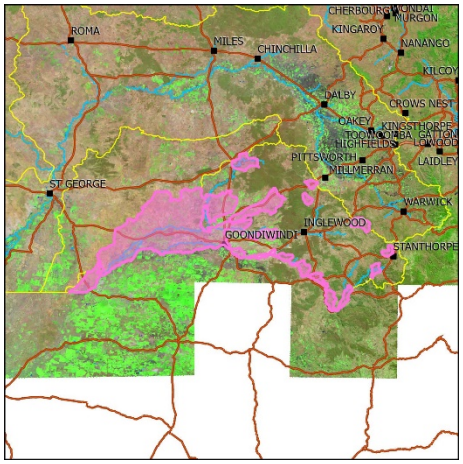
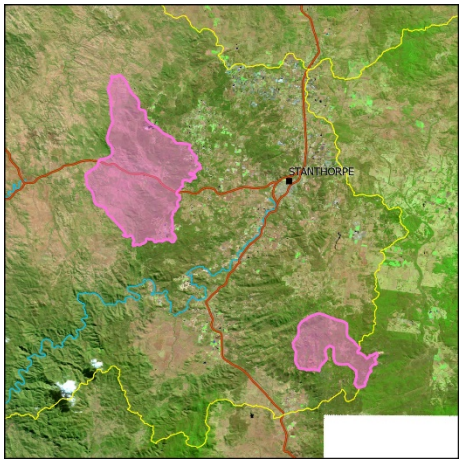
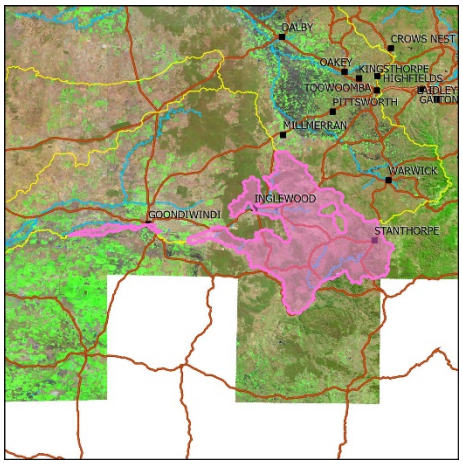
bd	Border Rivers study area	cb	Condamine-Balonne study area
mz	Maranoa study area	mn	Moonie Basin study area
pa	Paroo study area	ul	Bulloo study area
wg	Warrego study area	wm	Wallam study area
ec	Ecology	fa	Fauna
fl	Flora	nr	Non-riverine
r	Riverine		

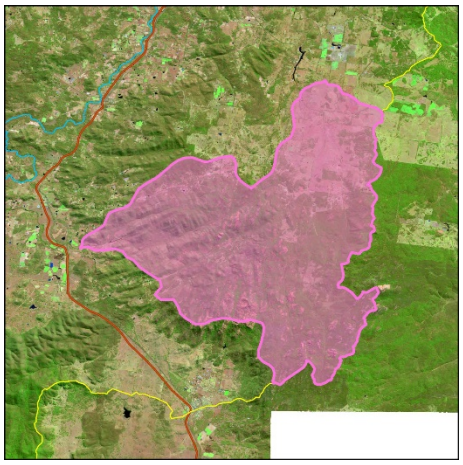
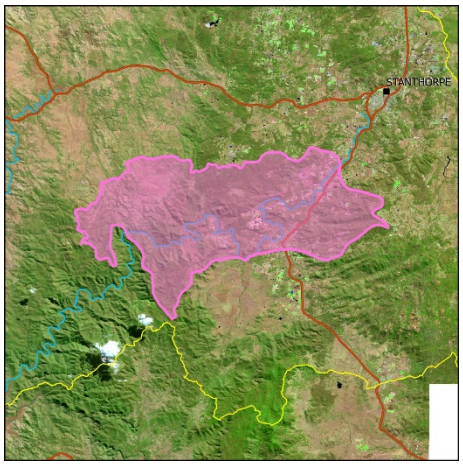
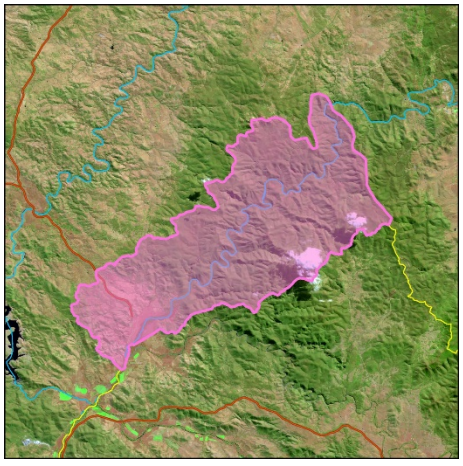
Map location legend:

■	Towns	▬	Major roads
▬	Watercourses	▬	QMDBB study area boundary
▬	Special features	Background image: Sentinel 2; captured in 2020	

Table 15. Border Rivers Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
bd_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which if generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
bd_r_fl_03 *Fringing riparian shrublands of the New England Tablelands bioregion* 	RE 13.3.1 (Riverine wetland or fringing riverine wetland) and 13.3.1x1 (which is the denser, shrubby part of RE 13.3.1). Very limited extent. Is also an unusual ecosystem due to riparian flora species diversity. The shrublands are under threat from hydrological modification (eg proposed Emu Swamp Dam). They exhibit high riparian species diversity (*Melaleucas* and *Leucopogon, Leptospermums*). They fringe along the Severn River. The riparian zone is habitat for rare and threatened flora species including *Melaleuca williamsii subsp. fletcheri* (NCA - V).	5.2.1	4
bd_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. bd_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4

Special Feature	Values	CIM	Rating
bd_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
bd_r_ec_25 *Rockholes (Gnammas)* 	This decision applies to gnammas (rockholes) on the Stanthorpe Plateau. The exposed granites of the Stanthorpe Plateau are pitted with shallow rock holes known as "pan gnammas" of which most are <7 cm deep which is much shallower than gnammas studied elsewhere in Australia (Timms et. al., 2020). These rain fed and isolated aquatic ecosystems support unique biota assemblages. For example, surveys of 26 gnammas across the Stanthorpe Plateau revealed 35 aquatic invertebrate taxa and an invertebrate metacommunity consisting mainly of dipterans and crustaceans of which 14% were gnamma obligates (Timms et. al., 2020). Insects (22 taxa) made up almost two-thirds of the total, and crustaceans (8 taxa) about a quarter. However, few taxa are gnamma specialists, and just two of these are endemic or possibly endemic to the northern New England Tableland (Timms, et. al., 2020). Climatic change could restrict reduce clam shrimps to deeper gnammas which are scarce on the Stanthorpe Plateau (Timms, et. al., 2020). Gnammas are also important for terrestrial wildlife and have cultural significance to Australian First Nations people.	5.2.1	3
bd_r_ec_31 *Upland riverine reaches with flows sustained by groundwater seeps* 	Groundwater connectivity with riverine ecosystems were viewed as important by the expert panel as inflow of groundwater (especially where granite geology exists), sustains rivers and creeks during drier periods. Water exchange can happen through fractured rock aquafers, but more typically coincides with sandy bottomed riverbeds. Flows are not necessarily perennial during drought.	7.2.1	4

Special Feature	Values	CIM	Rating
bd_r_ec_32 *Headwaters Accommodation Ck, tributaries, Baldock Creek, Beehiveully* 	The headwater sections of Bald Rock Creek and Accommodation Creek (upstream from Beehive Dam, near Wallangarra) are in good condition with a diversity of fish and aquatic plants and habitats. These are perennial, cold flowing streams which are uncommon in the Queensland Murray-Darling catchments. Important species known to occur include *Gadopsis marmoratus* (River blackfish), *Euastacus suttoni* (Suttons Crayfish), *Myuchelys bellii* (Bell's turtle), *Galaxis olidus* (Mountain Galaxias), *Litoria subglandulosa* (New England treefrog) and a freshwater jellyfish.	6.3.1	4
bd_r_ec_33 *Severn River between Glen Aplin and Sundown National Park* 	The riparian zone and instream condition is good on the Severn River between Glen Aplin and Sundown National Park. It also is habitat for several flora threatened species including *Melaleuca williamsii subsp. fletcheri* (NCA - V). The zone is also floristically diverse. The river system provides good habitat for Murray Cod. Good submerged macrophytes communities support small-bodied fish. Platypus have also been known to occur in selected pools.	6.3.1	4
bd_r_ec_34 *Severn River through Sundown National Park* 	Sundown National Park is a rugged wilderness area with steep-sided gorges, sharp ridges and peaks of over 1,000m rising above the Severn River which is habitat for black ducks, wood ducks, herons, cormorants and tiny azure kingfishers, yellow-belly, Murray cod or eel-tailed catfish. This section of the Severn River contains a series of permanent or near-permanent waterholes in excellent condition and sustain high fish diversity. The Broadwater waterhole in particular offers significant drought refugia due to its permanency. Threatened flora species include *Lepidium peregrinum* (EPBC - E).	6.1.1 6.3.1	4 4

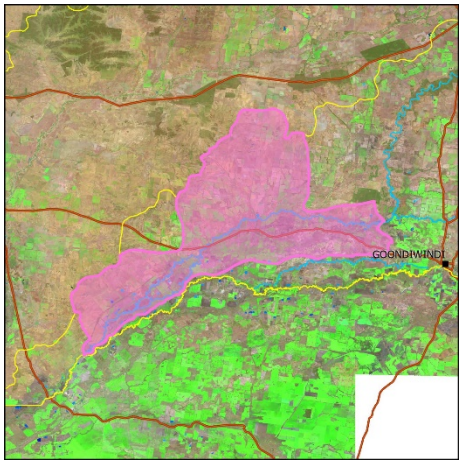
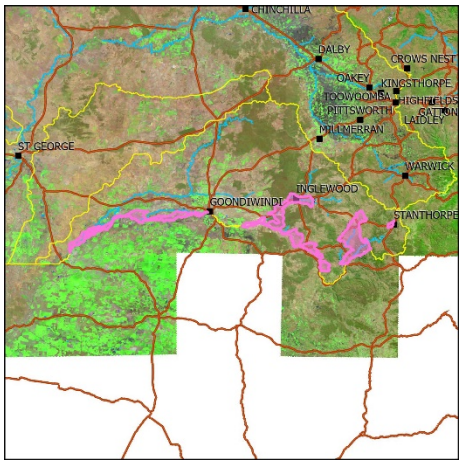
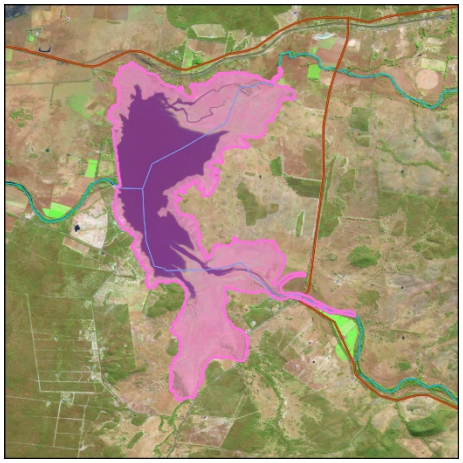
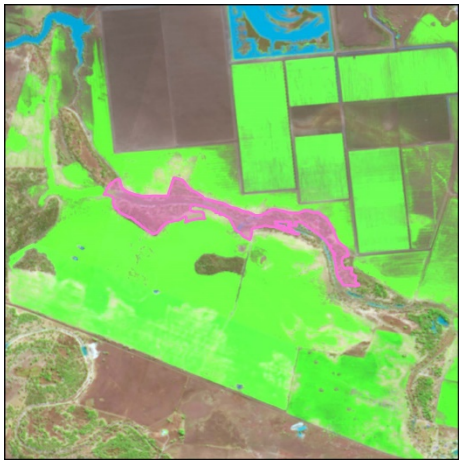
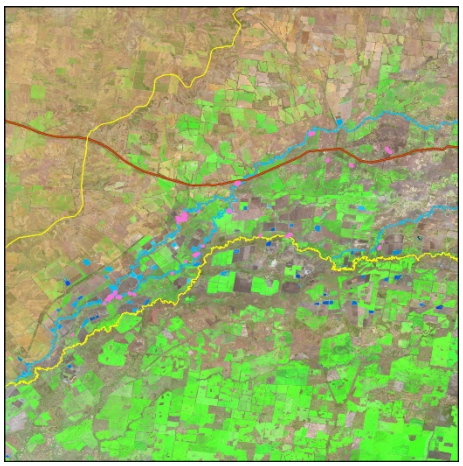
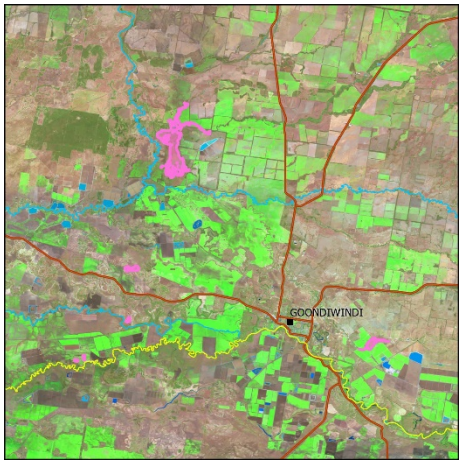
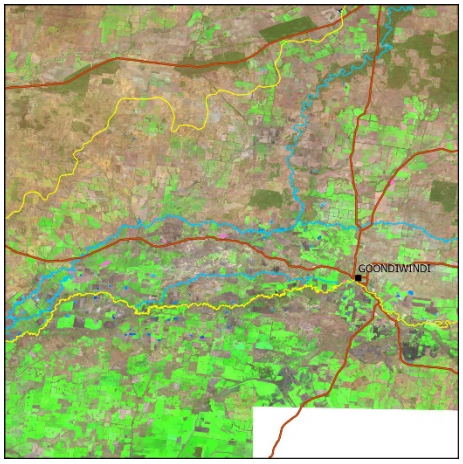
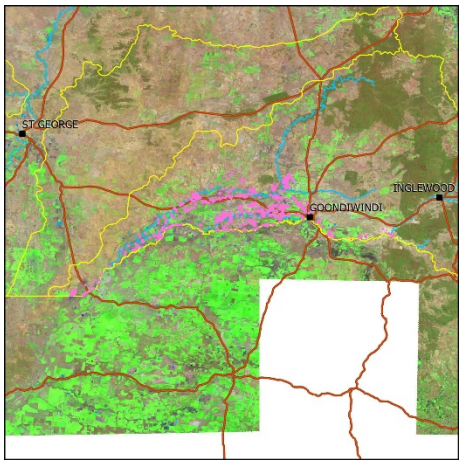
Special Feature	Values	CIM	Rating
bd_r_ec_35 *Talwood waterholes* 	Several waterholes on the Weir River near Talwood known to provide good fish habitat, act as important drought refugia and contain high fish diversity.	6.3.1	4
bd_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. bd_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

Table 16. Border Rivers Non-Riverine fauna, flora and ecology special features

Special Feature	Values	CIM	Rating
bd_nr_fa_07 *Lake Coolmunda - significant waterbird habitat* 	Lake Coolmunda includes extensive shallow habitat for waterbirds. This wetland consistently has up to 10,000 waterbirds at various times. Additionally, there is a good diversity of waterbirds.	5.1.4	4
bd_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt Bioregion, 6.3.1a in the Mulga Lands Bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystems 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4
bd_nr_fl_03 *Lignum Wetlands* 	Wetlands that contain lignum (*Muehlenbeckia florulenta*) provide significant habitat values (including water bird breeding habitat when in expansive stands) and habitat for threatened fauna species including the freckled duck (*Stictonetta naevosa*). Lignum may also be a strong driver/indicator of healthy wetlands. Experts noted that lignum is often a sub-component of *Eucalyptus coolabah* and there is likely a lot more lignum, including dense lignum, present in the study areas and that is not mapped. Artificial wetlands within the area were assigned a rating of 2.	5.2.1	4

Special Feature	Values	CIM	Rating
bd_nr_fl_11 *Redgum swamps across the southern Brigalow* 	*Eucalyptus camaldulensis* or *E. tereticornis* woodland to open woodland with sedgeland ground layer. This vegetation community is common in the southern parts of the Murray-Darlin Basin, but not very common in Queensland. Habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds.	6.2.1 6.3.1 6.4.1	4 4 4
bd_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4
bd_nr_ec_25 *Non-riverine wetlands of the Macintyre - Weir Fan subregion (Natural Hydrology)* 	The MacIntyre-Weir Fan subregion comprises alluvial plains and associated riverine landforms with numerous permanent wetlands in the area. The system of waterbodies within the floodplain of the Macintyre River, downstream of Goondiwindi, is known as the Macintyre Billabongs. These include billabongs or ox-bow lakes, anabranches, and other wetland types. Much of the floodplain has been developed for irrigated agriculture and up to 90 per cent of local water resources used for this purpose. Riparian vegetation along the lagoons and anabranches of the Macintyre and Weir Rivers has overstorey species that include river red gum, river cooba, coolabah, whitewood and black tea-tree, tangled lignum, Darling pea, black roly-poly and prickly Acacia. Emu bush and native bluebell may be found in a shrub layer (Capon et al. 2012). The endangered terrestrial herb, *Microcarpaea agonis*, is also found in the plan area, on the margins of ephemeral swamps between Goondiwindi and Millmerran (Bean 1997). The wetlands also provide habitat for Olive perchlet (*Ambassis agassizii*) which has undergone significant declines elsewhere in the Murray-Darlin Basin and is naturally extinct in South Australia.	6.3.1 6.4.1	3 3

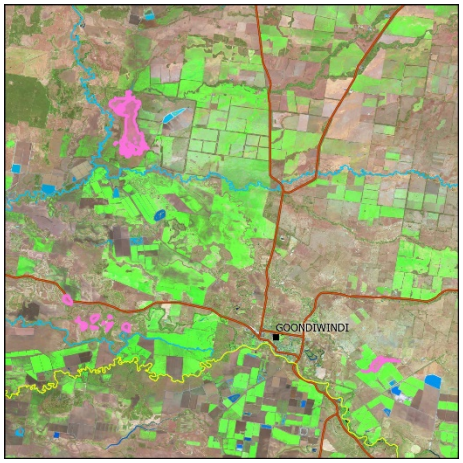
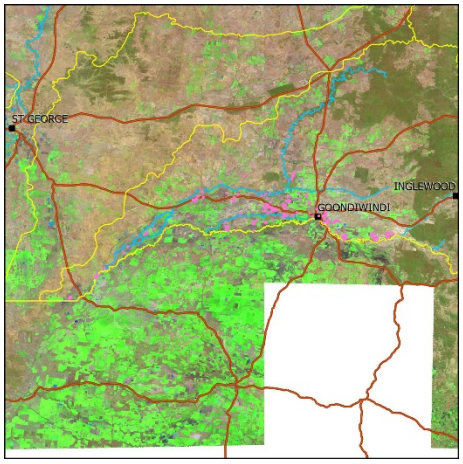
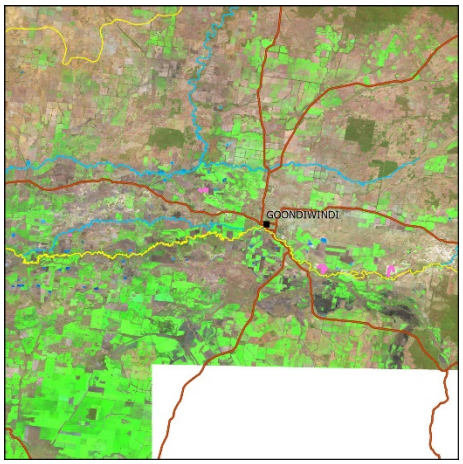
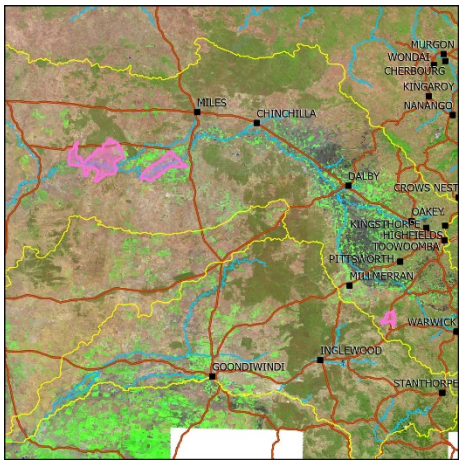
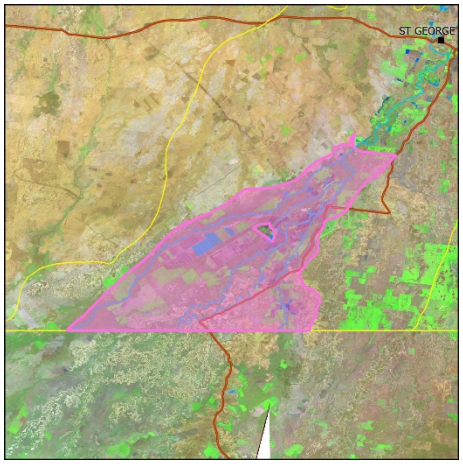
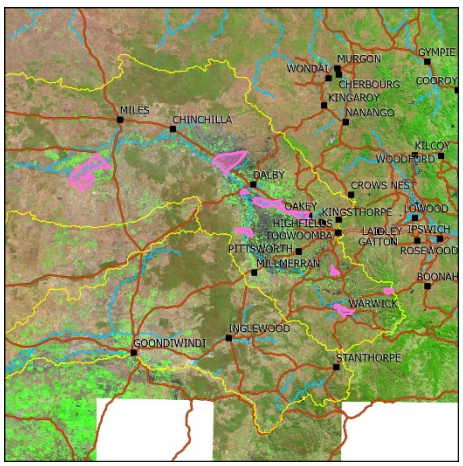
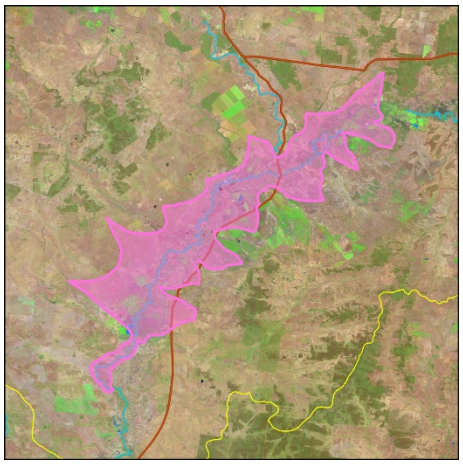
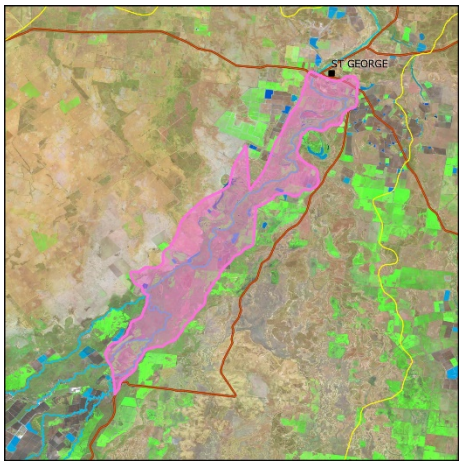
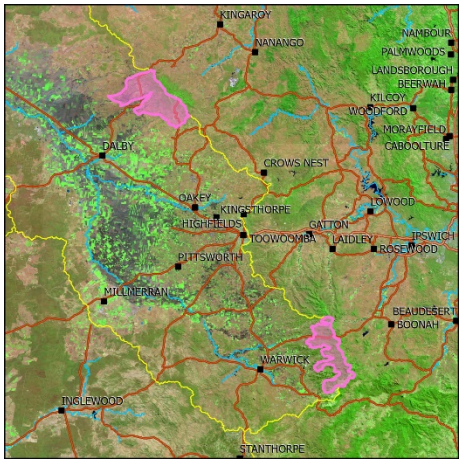
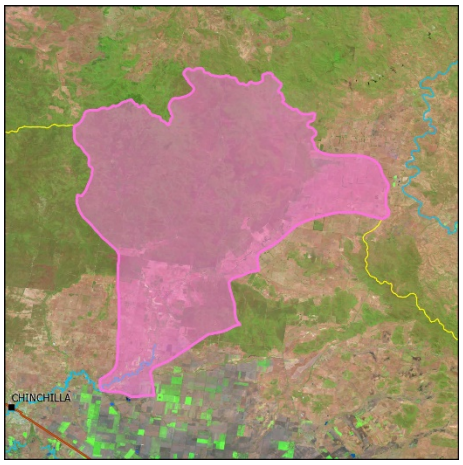
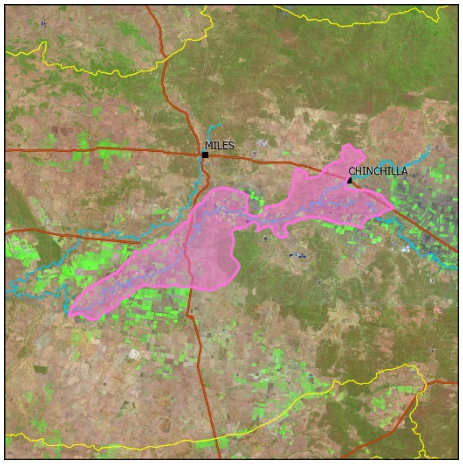
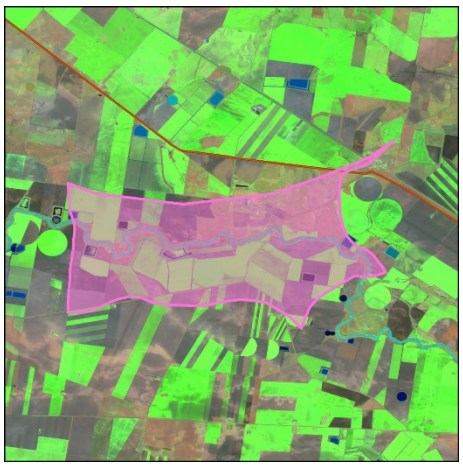
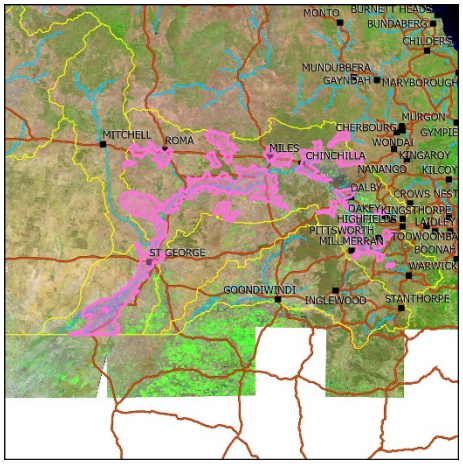
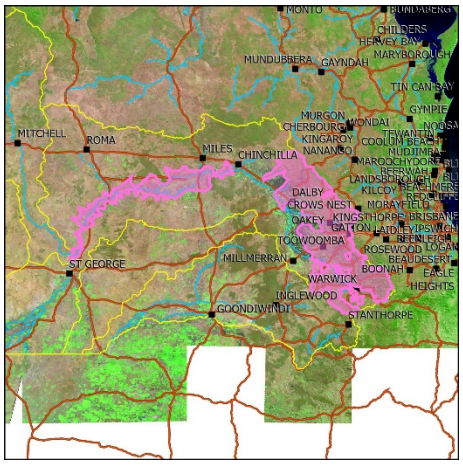
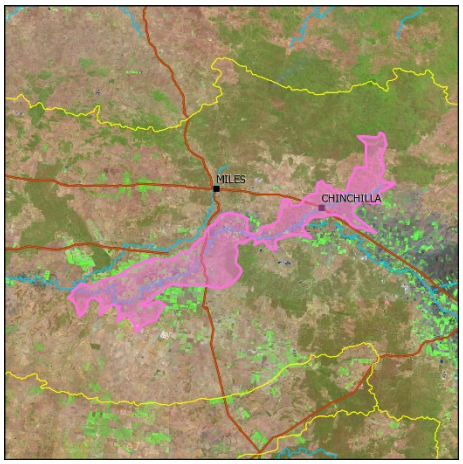
Special Feature	Values	CIM	Rating
bd_nr_ec_26 *Good condition wetlands near Goondiwindi* 	These wetlands were identified by experts as being in good condition with intact riparian vegetation. Aquatic ecological significance includes wetlands consisting of a series of large pools containing interesting fish communities.	6.3.1	3
bd_nr_ec_27 *Non-riverine wetlands of the Macintyre - Weir Fan subregion (Slightly modified Hydrology)* 	The MacIntyre-Weir Fan subregion comprises alluvial plains and associated riverine landforms with numerous permanent wetlands in the area. The system of waterbodies within the floodplain of the Macintyre River, downstream of Goondiwindi, is known as the Macintyre Billabongs. These include billabongs or ox-bow lakes, anabranches, and other wetland types. Much of the floodplain has been developed for irrigated agriculture and up to 90 per cent of local water resources used for this purpose. Riparian vegetation along the lagoons and anabranches of the Macintyre and Weir Rivers have overstorey species that include river red gum, river cooba, coolabah, whitewood and black tea-tree, tangled lignum, Darling pea, black roly-poly and prickly Acacia. Emu bush and native bluebell may be found in a shrub layer (Capon et al. 2012). The endangered terrestrial herb, *Microcarpaea agonis*, is also found in the plan area, on the margins of ephemeral swamps between Goondiwindi and Millmerran (Bean 1997). The wetlands also provide habitat for Olive perchlet (*Ambassis agassizii*) which has undergone significant declines elsewhere in the Murray-Darlin Basin and is naturally extinct in South Australia.	6.3.1 6.4.1	2 2
bd_nr_ec_44 *Non-riverine refugia wetlands - slightly modified hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	3 3

Table 17. Condamine-Balonne Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
cb_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country Bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which are generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
cb_r_ec_03 *Distributory fans: Lower Balonne* 	This special feature was defined in 2011 (v1.4) as having multiple special features, including being a unique geological feature. The macroscale nature of this area is significant from a geomorphic point-of-view. The feature is hydrologically important as a distributary system - however, irrigated agriculture in this area has intensified since 2011 resulting in increased hydrological modification due to bunding and sedimentation, reducing overall habitat condition. In some places riparian vegetation remains connected and relatively intact. Recent surveys suggest instream species diversity is still good.	6.1.1	2
cb_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. cb_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4

Special Feature	Values	CIM	Rating
cb_r_ec_07 *Riparian vegetation on the Balonne River between Surat to St George* 	The Balonne River between Surat and St George has an extensive riparian zone with many mature river red gums and large waterholes. This is the most intact riparian zone for floristic values in this area. Upstream of Beardmore Dam is in particularly good condition. Riparian vegetation becomes less intact above Surat, but many riparian values are still present. Surrounding groundwater fed sandy levees (regional ecosystem 11.3.19) provide ecological processes supporting these wetland systems.	6.3.1	4
cb_r_ec_08 *Riparian zone downstream of Jack Taylor Weir* 	The Balonne River has good riparian condition and structural integrity immediately downstream of Jack Taylor Weir to Horseshoe Lagoon.	6.3.1	3
cb_r_ec_10 *Perennial mountain streams of Main Range and the Bunya Mountains* 	The Main Range/Gambubal section contains important macroinvertebrate communities and other species that occur only in headwater streams. These include *Euastacus spp.*, stoneflies, frogs, River blackfish, kingfishers, and microbat colony *Miniopterus schreibersii* on Steamer Creek. Vine forest in the area provide habitat for rare and threatened species including the Hastings River mouse (Mt Colliery) (Measure 6.3.1). These headwater streams also have many small groundwater springs which flow into them, and have good water quality (e.g., Dalrymple Creek in Main Range National Park) (Measure 6.4.1). The Bunya Mountains section to the north includes other important headwater streams in the Condamine catchment and are habitat for numerous macroinvertebrates, frogs and other species of importance. The area is also a significant Aboriginal site because of the Bunya pine trees. The panel recommended only riverine spatial units above the 600 ASL contour be identified as containing special and unique features.	6.3.1 6.4.1	4 4

Special Feature	Values	CIM	Rating
cb_r_ec_12 *Riverine wetlands of the Charleys Creek catchment* 	Charleys Creek retains many wetlands (both riverine and non-riverine) in good condition maintaining near-natural ecological processes. Recent East Australian bird surveys conducted by UNSW confirmed the selected reaches have good riparian condition. Wetlands in this catchment are hotspots for Rendahl's Catfish (*Porochilus rendahli*) which has a disjunct distribution and only occurs in the mid to lower Condamine catchment. Pelican and Caliguel Lagoon are hotspots for this species (see cb_nr_ec_09).	6.2.1 6.3.1	4 4
cb_r_ec_14 *The lower Condamine River and surrounding wetlands: south of the Condamine township to the end of the system* 	This decision includes the lower reaches of the Condamine River south of the Condamine township where the Condamine River exhibits relatively intact riparian zones and a range of representative riverine habitats in relatively good condition compared to other parts of the Condamine system.	6.3.1 6.3.3	3 3
cb_r_ec_16 *Oakey Creek waterhole* 	Permanent waterholes including one near Bowenville are critical drought refuge for Oakey Creek. There is a weir along this section of Oakey creek however fish ladders and netting of carp (*Cyprinus carpio*) have improved habitat condition over the past ten years resulting in the presence of more Murray cod (*Maccullochella peelii*) and other species now that were not there before. Platypus (*Ornithorhynchus anatinus*) have been spotted in selected waterholes and along the banks downstream of the weir. This is also one the few places in the Condamine-Balonne where silver perch (*Bidyanus bidyanus*) have been caught in recent times, but it remains unclear if restocking has led to natural recruitment. Eel-tailed catfish (*Tandanus tandanus*), Murray cod (*Maccullochella peelii*) and many species of freshwater turtle are all naturally occurring here.	6.3.1	4

Special Feature	Values	CIM	Rating
cb_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
cb_r_ec_31 *Upland riverine reaches with flows sustained by groundwater seeps* 	Groundwater connectivity with riverine ecosystems were viewed as important by the expert panel as inflow of groundwater, especially where granite geology exists, sustains rivers and creeks during drier periods. Water exchange can happen through fractured rock aquafers, but more typically coincides with sandy bottomed riverbeds. Flows are not necessarily perennial during drought.	7.2.1	4
cb_r_ec_38 *Streams providing habitat for Rendahl's Catfish* 	Charley's Creek retains many wetlands (both riverine & non-riverine) in good condition, and which maintain natural ecological processes. This catchment is also surveyed as part of East Australian bird survey and has been observed to exhibit good condition riparian vegetation. Wetlands in this catchment are a hotspot for Rendahl's Catfish (*Porochilus rendahli*) which has a disjunct distribution and only occurs in the mid to lower Condamine catchment. Rendahl's catfish occurs in other QLD catchments (i.e. in the Gulf of Carpentaria), but this the only location that it occurs in the QMDBB. Rendahl's Catfish occurs in billabongs and streams in slow to fast-flowing water that is clear to turbid with rock, gravel or sand bottoms, and is more common in wetlands and smaller tributaries where there are abundant macrophytes.	6.3.1 6.3.3	3 3

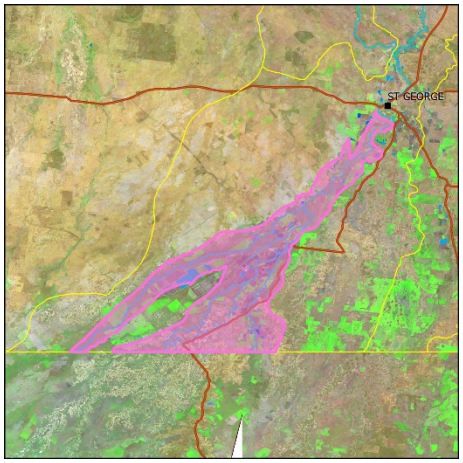
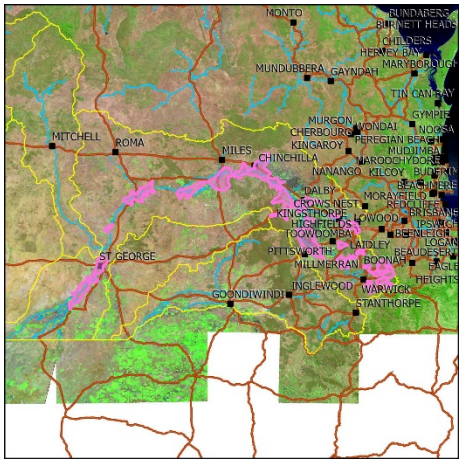
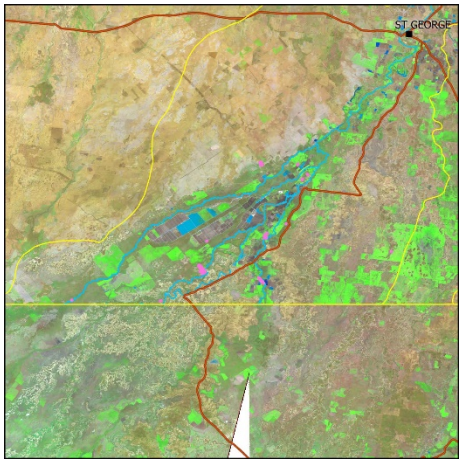
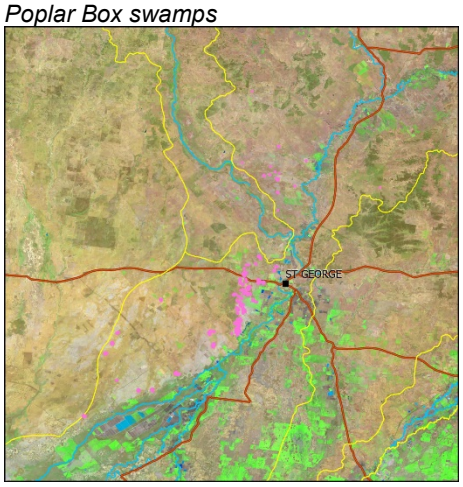
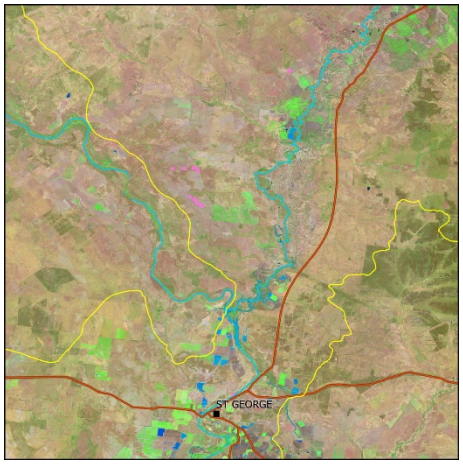
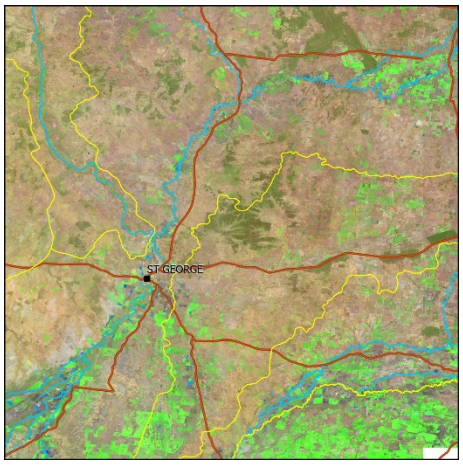
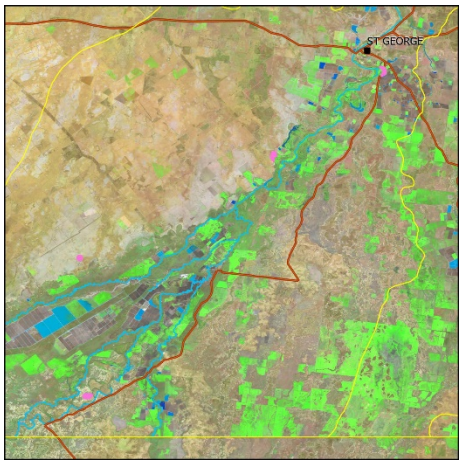
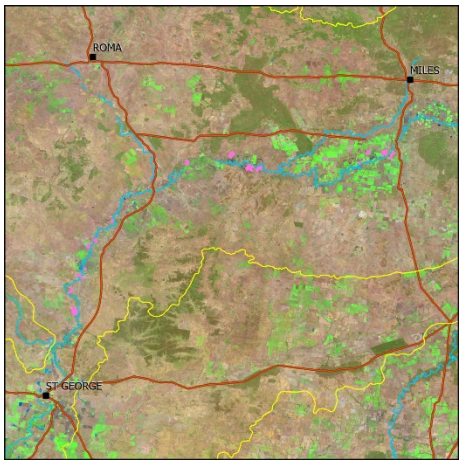
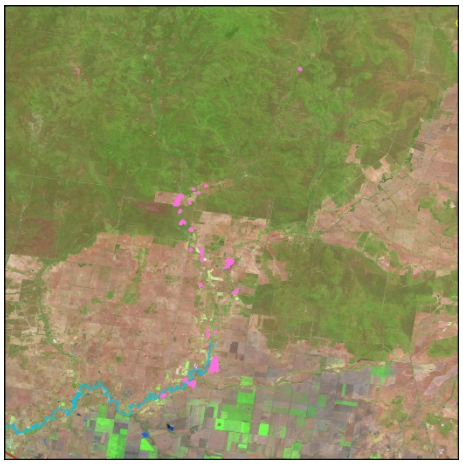
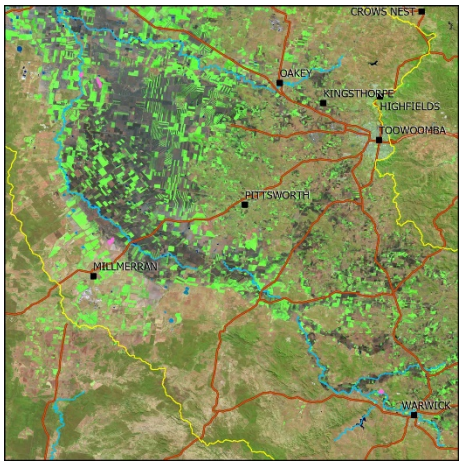
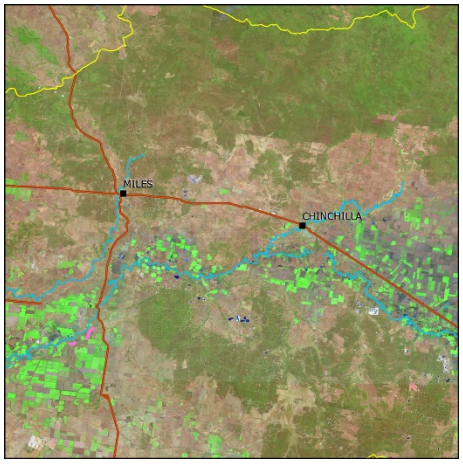
Special Feature	Values	CIM	Rating
cb_r_ec_40 *Waterways feeding wetlands of key ecological significance across the state border* 	The decision captures selected reaches of Culgoa River which are known to feed wetlands with high biodiversity value across the QLD state border. The Culgoa River contains Coolabah forests which require intermittent flooding, and the western section of Culgoa floodplain is a critical feeder to wetlands and National Parks on both sides of the state border. The system is poorly understood hydrologically but is recognised to be important.	6.1.1 6.2.1 6.3.3	3 3 3
cb_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. cb_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

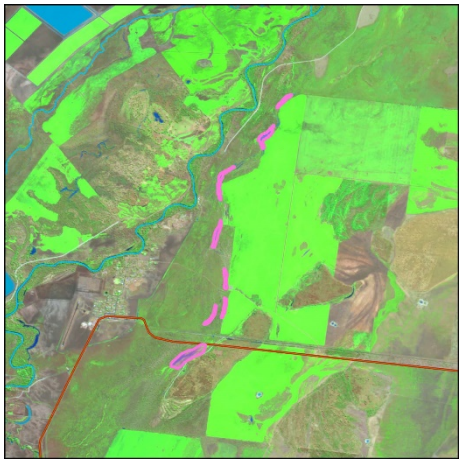
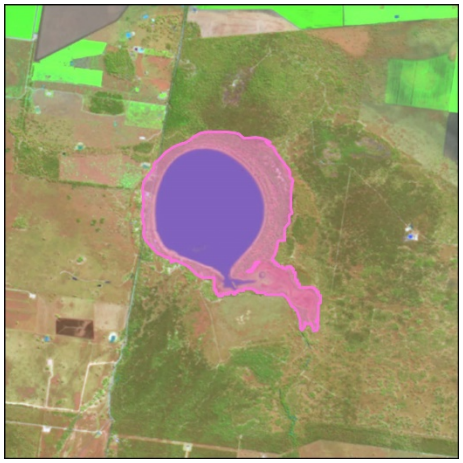
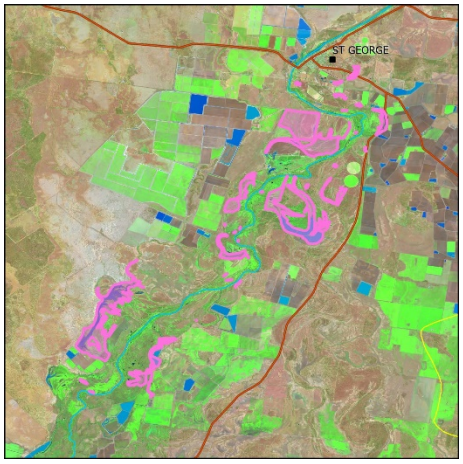
Table 18. Condamine-Balonne Non-Riverine fauna, flora and ecology special features

Special Feature	Values	CIM	Rating
cb_nr_fa_01 *North Toolburra Swamp* 	These wetlands were identified by Roger Jaensch as providing habitat for a large number of waterbirds despite being heavily grazed and ploughed.	5.1.4	2
cb_nr_fl_03 *Lignum Wetlands* 	Wetlands that contain lignum (*Muehlenbeckia florulenta*) provide significant habitat values (including water bird breeding habitat when in expansive stands) and habitat for threatened fauna species including the freckled duck (*Stictonetta naevosa*). Lignum may also be a strong driver/indicator of healthy wetlands. Experts noted that lignum is often a sub-component of *Eucalyptus coolabah* and there is likely a lot more lignum, including dense lignum, present in the study areas and that is not mapped. Artificial wetlands within the area were assigned a rating of 2.	5.2.1	4
cb_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with Gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4

Special Feature	Values	CIM	Rating
cb_nr_fl_11 *Redgum swamps across the southern Brigalow* 	*Eucalyptus camaldulensis* or *E. tereticornis* woodland to open woodland with sedgeland ground layer. This vegetation community is common in the southern parts of the Murray-Darlin Basin, but not very common in Queensland. Habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds.	6.2.1 6.3.1 6.4.1	4 4 4
cb_nr_fl_13 *Herbland closed depressions, not on alluvium - open herblands on clays, associated with ephemeral lakes, billabongs and permanent waterholes.* 	Regional ecosystem 6.3.11 (*Eleocharis pallens* + short grasses + *Eragrostis australasica* open forbland clay associated with ephemeral lakes: billabongs and permanent waterholes) sits on broad sand sheets. This ecosystem traps water for longer times and are associated with a diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Artificial wetlands within the area were assigned a value of 2.	5.2.1	2
cb_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4

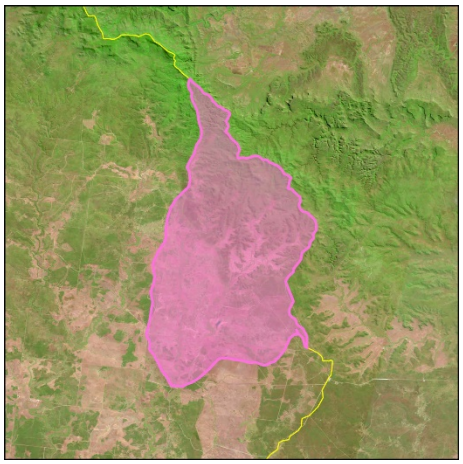
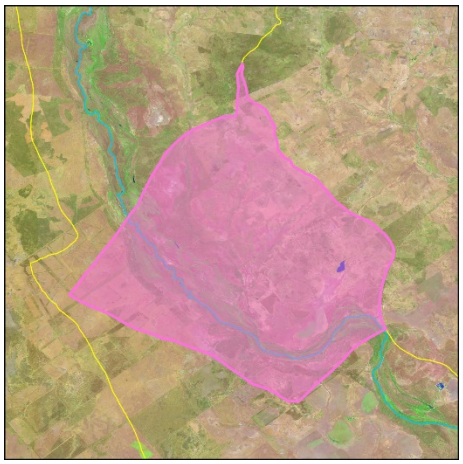
Special Feature	Values	CIM	Rating
cb_nr_ec_03 *Bellevue Swamp* 	Bellevue Swamp is an infrequently inundated woodland swamp situated 22 km west of Chinchilla (150.42, -26.72). The wetland covers approximately 50ha when full, and a dozen or so waterbirds have been observed to breed there making it important waterbird habitat. A detailed description of the values is contained on page 55 of “Going Bush with the Chinchilla Nats” 2nd Edition. Eds R and V. Hando. 1997. Chinchilla Field Naturalists' Club Inc. The swamp is currently surrounded by coal seam gas wells.	6.3.1 6.3.3	4 4
cb_nr_ec_04 *High conservation value wetlands of the Lower Balonne* 	These wetlands meet one or all of the following criteria: significant waterbird breeding; threatened or rare species present; high waterbird diversity; uniqueness; high habitat diversity. The selected wetlands include: Beardie Lagoon (148.36, -28.30): one of the few remaining natural wetlands in the lower Balonne. Horseshoe Lagoon (148.64, -28.09): one of the few remaining natural wetlands in the lower Balonne exhibiting high habitat diversity. Inland Sea (147.88, -28.55): this wetland is located in the Mulga Lands bioregion and is unique in the catchment. Redgum Swamp (147.59, -28.77): exhibits uniqueness and valuable habitat for water bird breeding. Wyralla Swamp (147.90, -28.90): one of the few remaining natural swamps in the Lower Balonne.	6.3.3	3
cb_nr_ec_05 *High conservation value wetlands - Chinchilla to St George* 	These wetlands meet some or all of the following criteria: Significant waterbird breeding; threatened or rare species present; high waterbird diversity; uniqueness; high habitat diversity. The wetlands include: Beardie (148.72, -27.67), Donga (148.77, -27.48), Rolston (148.78, -27.38), Weribone (148.82, -27.36), Wycombe1 (148.70, -27.59), Wycombe2 (148.71, -27.58), Barrackdale1 (148.74, -27.51), Barrackdale2 (148.76, -27.52), Rockton (149.22, -27.02), Unnamed wetland (149.41, -26.99), Warkon (149.50, -27.04), Murilla 1 (149.52, -27.05), Murilla 2 (149.53, -27.04), Cobbareena (150.11, -26.98), Red Marley (150.08, -26.97), Arubial (150.01, -26.97), Dundee (149.97, -27.02).	6.3.3	4

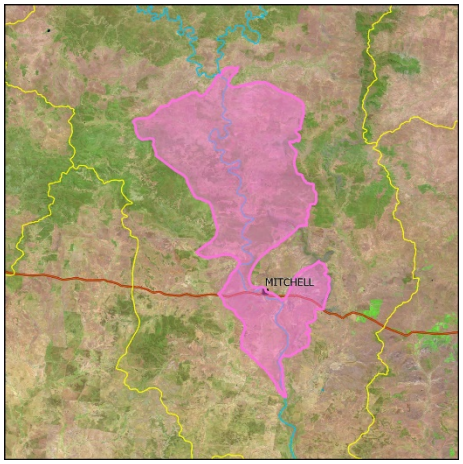
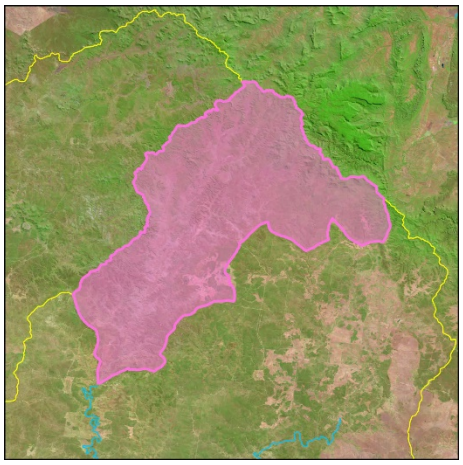
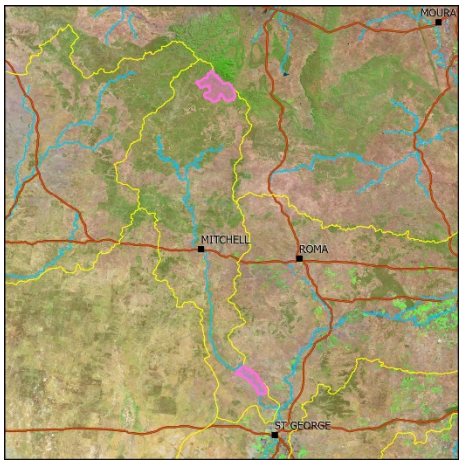
Special Feature	Values	CIM	Rating
cb_nr_ec_06 *Non-riverine wetlands of Charley's Creek catchment* 	Charley's Creek retains many wetlands (both riverine & non-riverine) in good condition, and which maintain natural ecological processes. Recent East Australian Waterbird Surveys confirmed good condition riparian vegetation still exists in this area. Wetlands in this catchment are a hotspot for Rendahl's Catfish (*Porochilus rendahli*) which has a disjunct distribution and only occurs in the mid to lower Condamine catchment. Rendahl's catfish occurs in other QLD catchments (i.e. in the Gulf of Carpentaria), but this is the only location that it occurs in the QMDBB. Pelican and Caliguel Lagoon are hotspots for the species (cb_nr_ec_09). Rendahl's Catfish occurs in billabongs and streams in slow to fast-flowing water that is clear to turbid with rock, gravel or sand bottoms. It is more common in wetlands and smaller tributaries where there are abundant macrophytes.	6.2.1 6.3.1	4 4
cb_nr_ec_07 *Ashall Swamp, Tipton Lagoon, Laguna Lagoons, North Toolburra Swamp* 	Ashall Swamp (151.29, -27.43) has native grassland on northern shoreline but is currently in poor condition and highly threatened. Tipton lagoon (151.246°E 27.411°S) is one of the few remaining natural wetlands in the Upper Condamine. Laguna lagoons (151.324°E 27.806°S) is known to have high water bird diversity. It was previously heavily grazed but due to bad erosion is now being re-grassed. North Toolburra swamp (151.95, -28.16) was identified by Roger Jaensch in 2011 as providing habitat for large numbers of waterbirds despite being heavily grazed and ploughed.	6.2.1 6.3.1	3 3
cb_nr_ec_09 *Pelican and Caliguel Lagoons - key habitat for Rendahl's Catfish* 	Pelican and Caliguel Lagoon are hotspots for Rendahl's Catfish (*Porochilus rendahli*). Rendahl's Catfish has a disjunct distribution and only occurs in the mid to lower Condamine catchment. The species occurs in billabongs and streams with slow to fast-flowing water that is clear to turbid and with rock, gravel or sand bottoms. Is more common in wetlands and smaller tributaries where there are abundant macrophytes. The species occurs in other QLD catchments (i.e. in the Gulf of Carpentaria), but this is the only location that it occurs in the QMDBB.	6.2.1 6.3.1	3 3

Special Feature	Values	CIM	Rating
cb_nr_ec_28 *Comale Lagoons (Police Lagoons)* 	Comale Lagoons (Police Lagoons) are a series of connected semi-arid floodplain tree swamps on the Lower Balonne River floodplain surrounding the town of Dirranbandi. These wetlands are associated with important cultural heritage sites for the local Aboriginal Traditional Owners and have a range of cultural and ecosystem values, including habitat and potential breeding ground for native fish such as the yellowbelly (golden perch).	5.2.1	2
cb_nr_ec_31 *Lake Broadwater* 	Lake Broadwater, listed under Directory of Important Wetlands Australia - QLD015 (DAWE, 2021) is situated at the edge of the broad valley of the Condamine River and lies to the west of the associated Long Swamp. The associated hydrological catchment includes the highlands to the southwest of the site and includes Wilkie Creek, Broadwater Gully and the Condamine River, further to the southeast, when in flood. Landforms include black plain, flood out, drainage depression, stream channel, stream bed, lake and swamp; surrounding uplands are gently sloping flats and low ridges. Lake Broadwater is a good example of a semi-permanent freshwater lake in an area where these are rare. A varied and well represented fauna assemblages are associated with the lake including frogs, reptiles and mammals including appreciable populations of a wide range of waterbirds. The latter includes representatives of a diversity of families together with holarctic breeding species protected under CAMBA and JAMBA. The lake has been enhanced by minor levee construction to a height of approximately 0.75m.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
cb_nr_ec_35 *Balonne River Floodplain* 	Balonne River Floodplain, listed in Directory of Important Wetlands Australia as QLD084 (DAWE, 2021) is a significant aggregation of permanent and ephemeral freshwater billabongs and swamps on an inland floodplain. The main wetland sites in the aggregation are: Lake Munya 28 degrees 06' 30" S, 148 degrees 32' 48" E; Parachute Lagoons 28 degrees 03' 42" S, 148 degrees 31' 12" E; Birch Lagoon 28 degrees 10' 42" S, 148 degrees 33' 42" E; Mooramanna Lake 28 degrees 18' 30" S, 148 degrees 26' 18" E; and the swamp at Brookdale 28 degrees 15' 00" S, 148 degrees 24' 00" E. No threatened flora species are known from the area, but the *Eleocharis spp.* sedgelands are a significant community in the area, being limited in distribution and often disturbed by grazing. Furthermore, black box (*Eucalyptus largiflorens*) is near the limit of its range in this area of Queensland. No threatened fauna are known from the area, however large numbers of waterbirds are known to use the wetlands in some seasons. Despite major agricultural disturbance in recent years, the fringing and aquatic vegetation of the wetlands appears to be reasonably intact. Some artificial wetlands were assigned a rating of 2 due to being partially cultivated. Full cultivated, artificial wetlands within the area were removed.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

Special Feature	Values	CIM	Rating
cb_nr_ec_40 *The Gums Lagoon* 	The Gums Lagoon, listed in Directory of Important Wetlands Australia as QLD020 (DAWE,2021) is a relatively undisturbed wooded swamp, in a small (240 ha) reserve of similarly undisturbed woodlands and open forest. The lagoon is a relatively shallow depression in an otherwise flat plain. Filling about once every seven to ten years, the lagoon may stay full for more than one year depending on subsequent seasonal top up. The lagoon supports a low open forest of river red gum (*Eucalyptus camaldulensis*) over perennial tussock grasses (probably species such as *Chloris spp.* and *Leptochloa digitata*). Ephemeral semi aquatic plants (e.g. *Marsilea spp.* and *Cyperaceae spp.*) occur during periods of inundation. Large numbers of waterbirds and fish are known to use the lagoon when it is full. The significance of this site lies largely in its existence as a relatively undisturbed wetland in a region of extensive habitat modification (i.e. heavily disturbed (cleared), grazed and cultivated rural land) for agriculture. No declared endangered or vulnerable flora or fauna are known from the wetland.	6.3.1 6.3.2 8.2.5	3 3 3
cb_nr_ec_44 *Non-riverine refugia wetlands - slightly modified hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	3 3

Table 19. Maranoa Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
mz_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country Bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which is generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
mz_r_fl_04 *Freshwater wetlands (billabongs) - riverine systems* 	This expert panel decision is implemented using regional ecosystems 6.3.3a in the Mulga Lands Bioregion, and 5.3.20a and 5.3.20b in the Channel Country bioregion. Regional ecosystem 6.3.3a (waterholes in drainage lines) special values include high fauna diversity, particularly bird and mammal (including Koala - Gordon et al. 1988) species. This regional ecosystem captures the larger more-permanent waterholes which provide important wetland and fauna refuge habitat. It is also floristically rich with more than 100 species/500m2. Regional ecosystems 5.3.20a (open woodland fringing waterholes connected to braided channel systems) and 5.3.20b (open woodland fringing waterholes in major river systems) special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4

Special Feature	Values	CIM	Rating
mz_r_ec_01 *Maranoa River, upstream of Mitchell* 	This is a distinctive wide and sandy bed ephemeral stream. The flat and continuous sandy bed is without pool features and remains uninterrupted longitudinally except for a small (2m) weir at Mitchell. Sandy areas may have more storage capacity hence more groundwater permeability. It is one of the best examples remaining in the Queensland's Murray-Darling Basin catchments.	6.1.1	2
mz_r_ec_02 *Headwater streams above 600m for Warrego and Maranoa catchments* 	The headwater streams of the Warrego and Maranoa catchments were identified by the panel as having unique and high aquatic habitat diversity. Set in a relatively arid landscape, these headwater watercourses are fed by surface run-off and are relatively clear and intact. Distinct or unique genetics are likely to occur.	6.3.1 6.4.1	4 4
mz_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. mz_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4

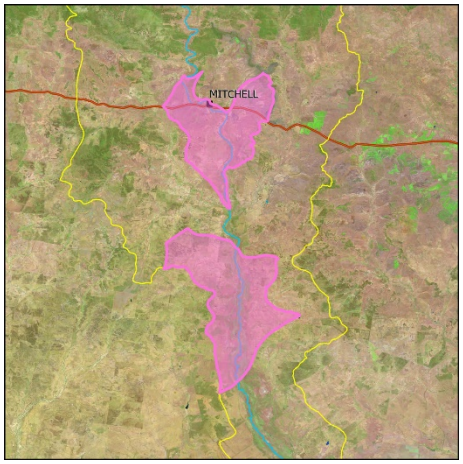
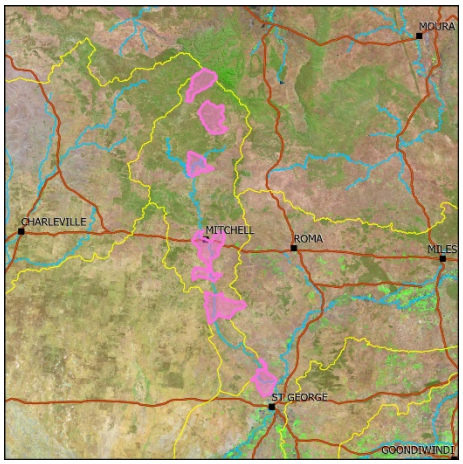
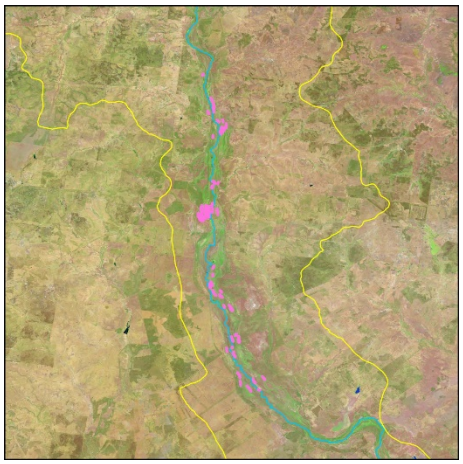
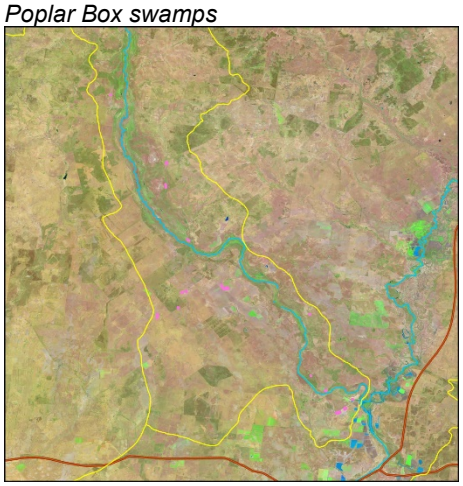
Special Feature	Values	CIM	Rating
mz_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
mz_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. mz_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

Table 20. Maranoa Non-Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
mz_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt Bioregion, 6.3.1a in the Mulga Lands Bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystems 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. An equivalent riverine expert panel decision (mz_r_fl_04) uses regional ecosystems 6.3.3x1 (v12.1 regional ecosystem mapping), 6.3.3a, 5.3.20a and 5.3.20b.	5.2.1	4
mz_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with Gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4
mz_nr_fl_11 *Redgum swamps across the southern Brigalow* 	*Eucalyptus camaldulensis* or *E. tereticornis* woodland to open woodland with sedgeland ground layer. This vegetation community is common in the southern parts of the Murray-Darlin Basin, but not very common in Queensland. Habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds.	6.2.1 6.3.1 6.4.1	4 4 4

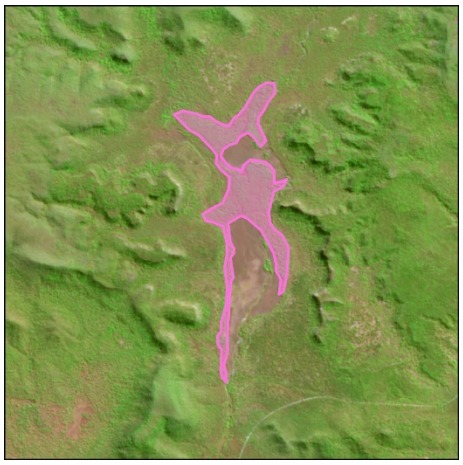
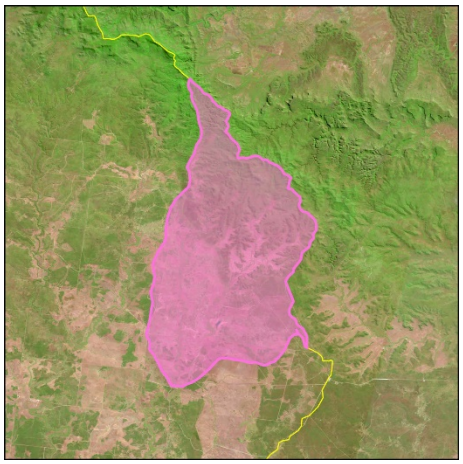
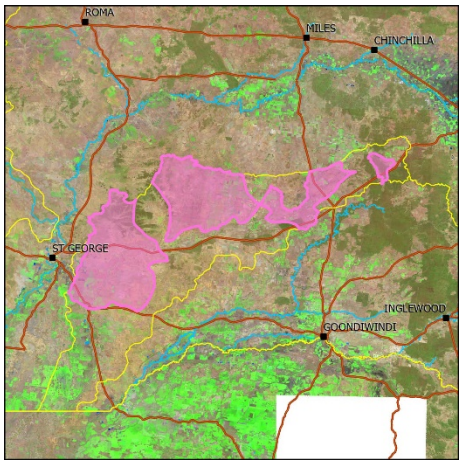
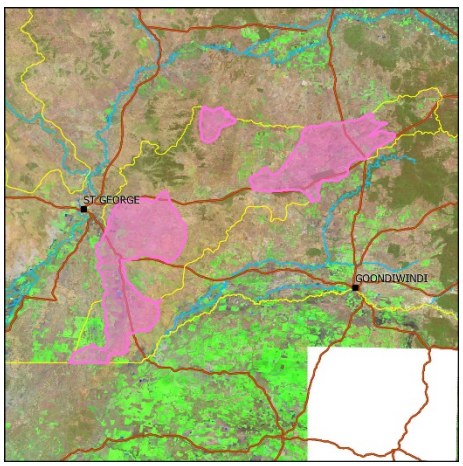
Special Feature	Values	CIM	Rating
mz_nr_ec_02 *Natural artesian springs within existing wetlands* 	The Expert Panel identified artesian springs as significant wetlands having multiple values including endemic species, unique habitat values, connectivity to groundwater. The refugia nature of artesian springs has resulted in distinct flora and fauna assemblages including highly specialised and endemic species. Great Artesian basin springs are known to be evolutionary hotspots providing habitat for endemic plants, fish, snails and other invertebrates (Boyd 1990; Ponder 2002; Fensham and Fairfax 2003; Fensham and Price 2004; Fensham et al. 2004; Fairfax et al 2007) as well as refugia for non-endemic native plants isolated by over 500km from other populations (Fensham et al. 2004). Freshwater wetland areas containing unmodified modified springs were considered to have very high intrinsic conservation value.	6.1.1 6.3.1 6.4.1	4 4 4

Table 21. Moonie Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
mn_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country Bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which if generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
mn_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. mn_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
mn_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

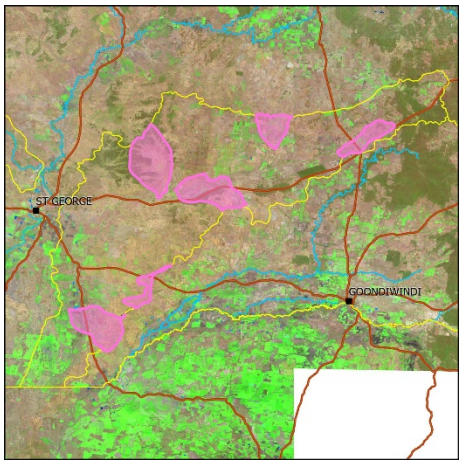
Special Feature	Values	CIM	Rating
mn_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. mn_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

Table 22. Moonie Non-Riverine flora and ecology special features

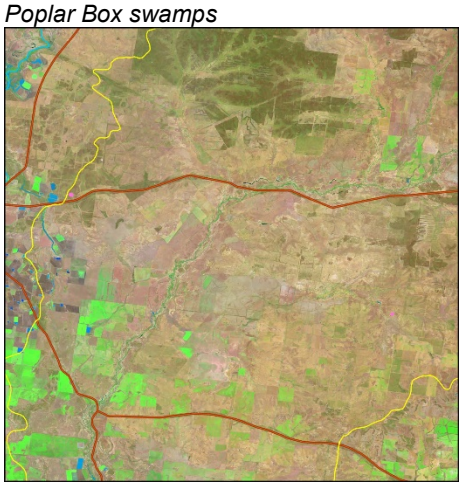
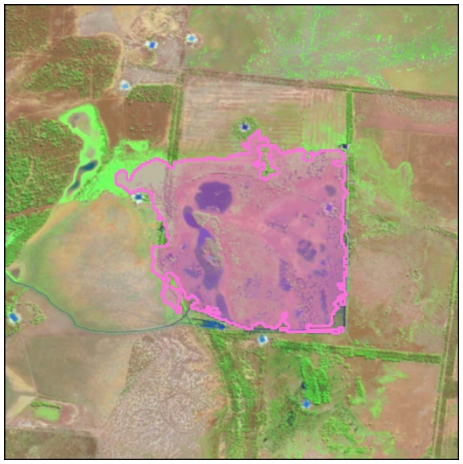
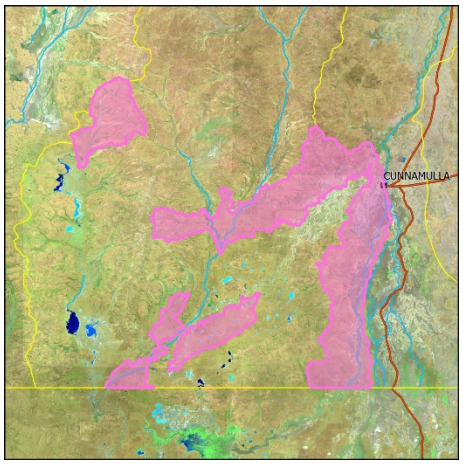
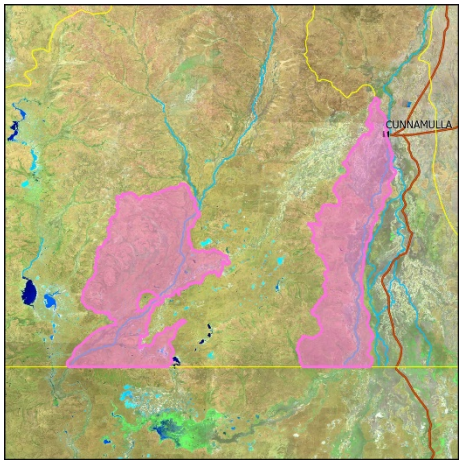
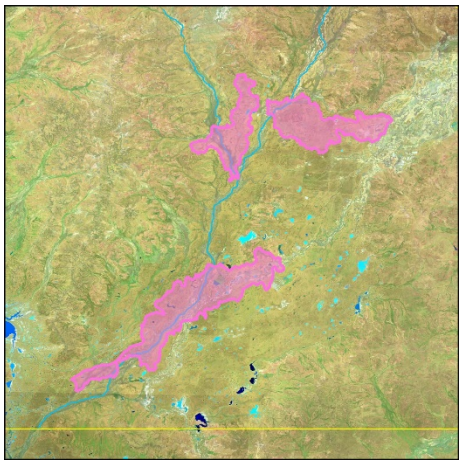
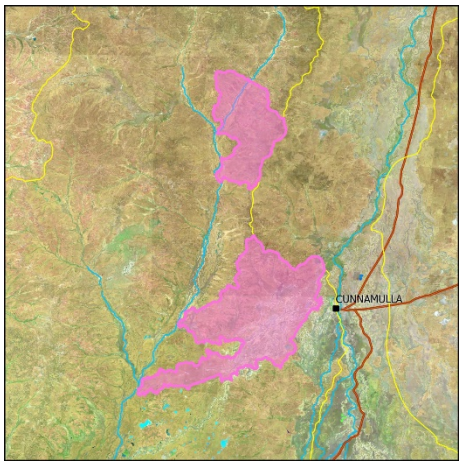
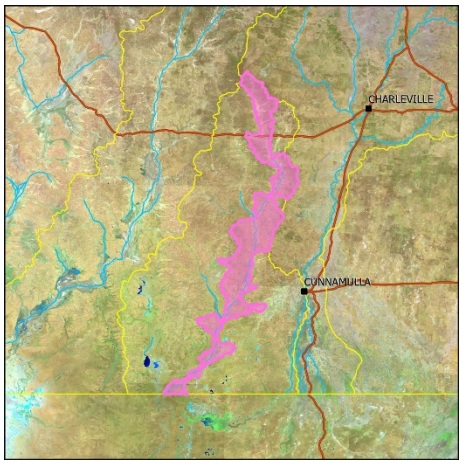
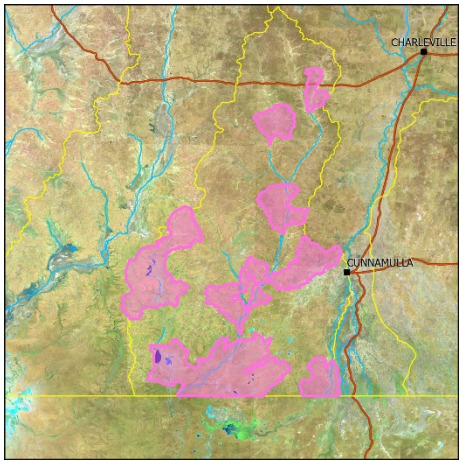
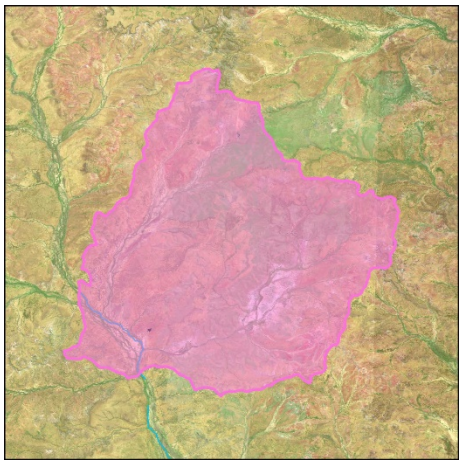
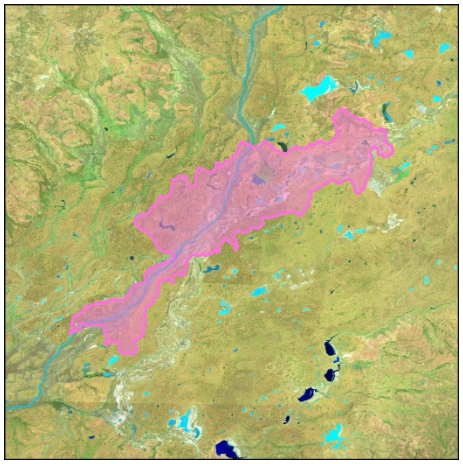
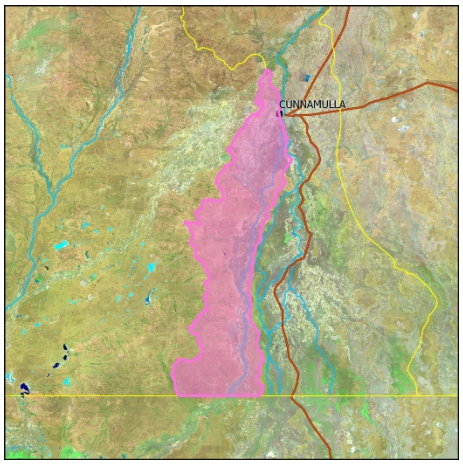
Special Feature	Values	CIM	Rating
mn_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with Gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4
mn_nr_ec_11 *Thallon Waterholes in the Moonie River catchment* 	The Thallon Waterholes (148.90, -28.59) include modified waterholes in the Moonie River catchment. While not given recognition as nationally or internationally important, these waterholes are filled during floods and provide habitat for a range of aquatic organisms and up to 20,000 waterbirds. They include two semi-permanent lakes of approximately twelve and twenty-one hectares in area.	5.1.4	3

Table 23. Paroo Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
pa_r_fl_04 *Freshwater wetlands (billabongs) - riverine systems* 	This expert panel decision is implemented using regional ecosystems 6.3.3a in the Mulga Lands Bioregion, and 5.3.20a and 5.3.20b in the Channel Country bioregion. Regional ecosystem 6.3.3a (waterholes in drainage lines) special values include high fauna diversity, particularly bird and mammal (including Koala - Gordon et al. 1988) species. This regional ecosystem captures the larger more-permanent waterholes which provide important wetland and fauna refuge habitat. It is also floristically rich with more than 100 species/500m2. Regional ecosystems 5.3.20a (open woodland fringing waterholes connected to braided channel systems) and 5.3.20b (open woodland fringing waterholes in major river systems) special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4
pa_r_ec_04 *Waterways feeding wetlands of key ecological significance across the state border* 	The decision captures selected reaches of a number of creeks and rivers known to feed wetlands with high biodiversity value across the QLD state border. Collectively these riverine systems have good longitudinal connectivity, diverse fish communities, support important waterbird habit, and provide ecosystem services further down the Darling system. This decision includes selected reaches of the Paroo River (below the confluence of the Paroo River and Yowah Creek), Cuttaburra creek (below Cunnamulla), selected reaches of the Warrego River (below Cunnamulla), and the riverine spatial units traversed by the Bulloo River. Cuttaburra creek is an important channel connecting the Warrego River to the lower Paroo. River red gum, coolabah and river cooba grow along channels and wetland areas. In wet years, waters of the Warrego River system may flow through Cuttaburra creek to the lower reaches of the Paroo River across the border. This process is important for gene flow and supporting large, nationally important terminal swamps and storages across the border (Yantabulla Swamp). The Paroo and Narran rivers feed RAMSAR wetlands across the border in NSW.	6.1.1 6.2.1 6.3.3	4 4 4

Special Feature	Values	CIM	Rating
pa_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. pa_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
pa_r_ec_21 *Upper breakouts of the Warrego River, Noorama creek and Widgeegoara creek* 	In its middle reach (below Wyandra), the Warrego River has a series of flood breakouts which drain west into the Paroo River and east into the Nebine River. Baruna breakouts to Gum Holes and Moonjari Waterholes provide an important route for recruitment in the event of long droughts. Uniquely, the Paroo and Warrego Rivers are hydrologically connected through overland flow emanating from north-west of Cunnamulla to Eulo. These connections provide for species connectivity and are drivers of processes and functioning in these catchments.	6.3.4 6.4.1	3 3
pa_r_ec_23 *Freeflowing rivers* 	The Paroo and Bulloo rivers are undoubtedly some of the last free flowing rivers, particularly in the Murray-Darling Basin. Hence, they have many special and unique special features including relatively natural hydrological process, ecological functioning and instream habitat. The Bulloo system river is also significant due to the lack of exotic fish including carp.	6.1.1 6.3.1 6.3.3 6.4.1	4 4 4 4

Special Feature	Values	CIM	Rating
pa_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
pa_r_ec_31 *Upland riverine reaches with flows sustained by groundwater seeps* 	Groundwater connectivity with riverine ecosystems were viewed as important by the expert panel as inflow of groundwater (especially where granite geology exists), sustains rivers and creeks during drier periods. Water exchange can happen through fractured rock aquafers, but more typically coincides with sandy bottomed riverbeds. Flows are not necessarily perennial during drought.	7.2.1	4

Special Feature	Values	CIM	Rating
pa_r_ec_43 *Paroo River Waterholes (Caiwarro Area)* 	The Paroo River Waterholes (Caiwarro Area) A, listed in Directory of Important Wetlands Australia as QLD176 (DAWE, 2021) includes a series of large waterholes in the main Paroo River channel and adjacent tributaries/distributaries in the vicinity of the "Caiwarro" ruins (the old Caiwarro Homestead site at or about 144.781°E, 28.689°S) on Currawinya National Park 62km south-south-west of Eulo. These instream waterholes are a good example of semi-permanent waterholes in an intermittent watercourse within an arid treed area. The areas of flowering yapunyah (*Eucalyptus ochrophloia*) along the Paroo River provide valuable food sources for honeyeater species. Communities of yapunyah and alluvial gidgee *Acacia cambagei* communities are supported along the flood channels and floodplains in this area. Water-rats (*Hydromys chrysogaster*) inhabit the waterholes along the Paroo River, while dunnarts and narrow-nosed planigales (*Planigale tenuirostris*) are found at various locations in the Paroo flood plains (EPA 2001). Various waterbird species attracted to the area by the nearby Currawinya Lakes also pass along the Paroo River and hence visit these waterholes. The white-bellied sea eagle (*Haliaeetus leucogaster*) has been sighted travelling along the Paroo riparian zone. These special values only apply to the larger, more permanent waterholes on the Paroo River adjacent to the old Caiwarro Homestead site at or about 144.781°E, 28.689°S.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
pa_r_ec_44 *Distributory fans: Cuttaburra Channel connecting to the Paroo system* 	Multiple special features. Unique geological feature within Australia. Around Wyandra are fish refugia in form of large pools throughout. They are hydrologically important as a distributary system. There is more water diversion down Cuttaburra Creek than known main channel of Warrego River. In large floods, flow breaks out and connects to Paroo system. The feature extends from Wyandra, through Cunnamulla, south to main distributary fan.	6.1.1 6.4.1	3 3

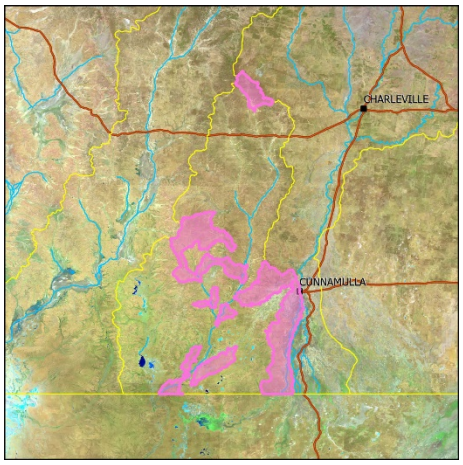
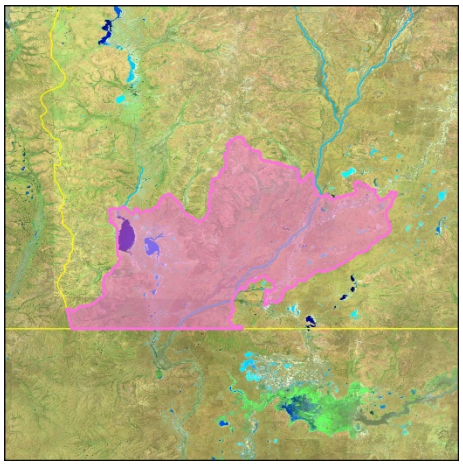
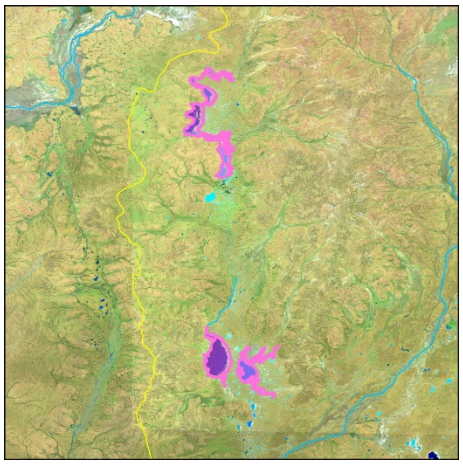
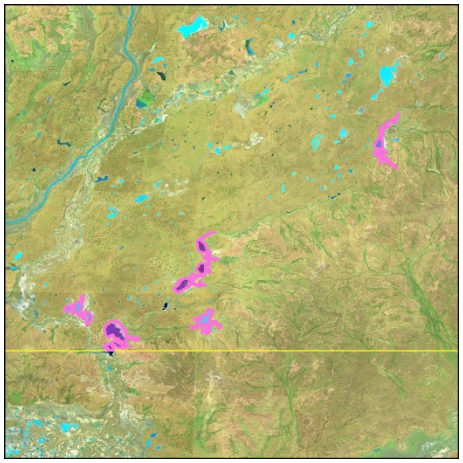
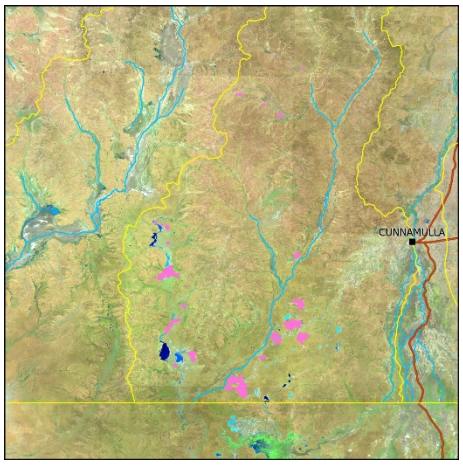
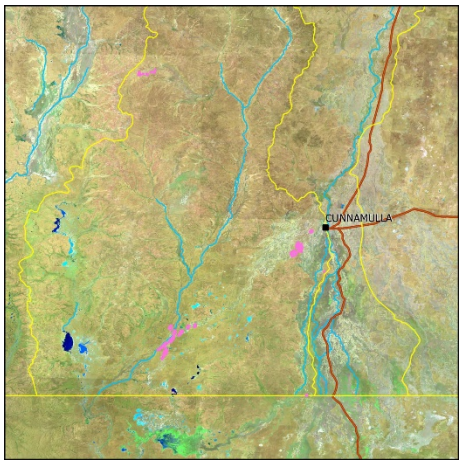
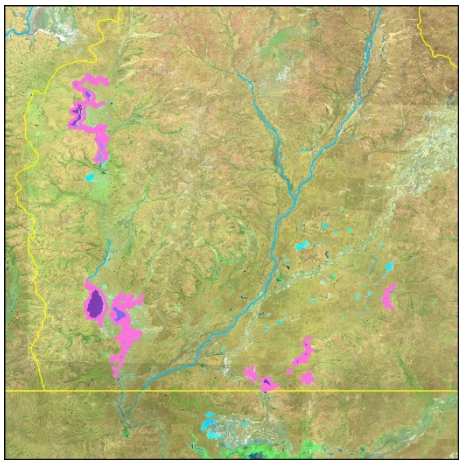
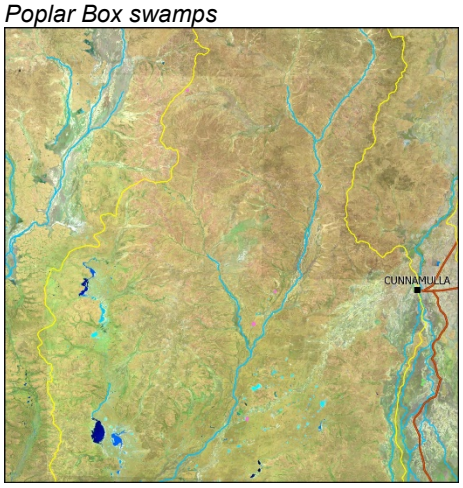
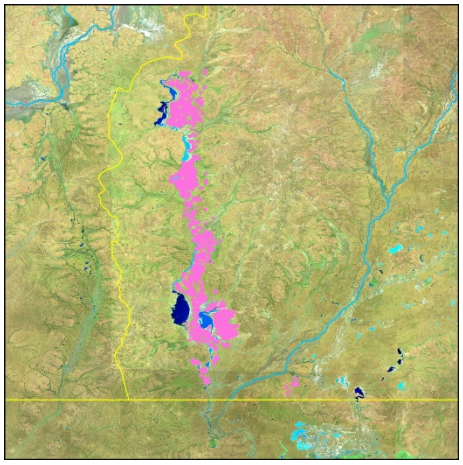
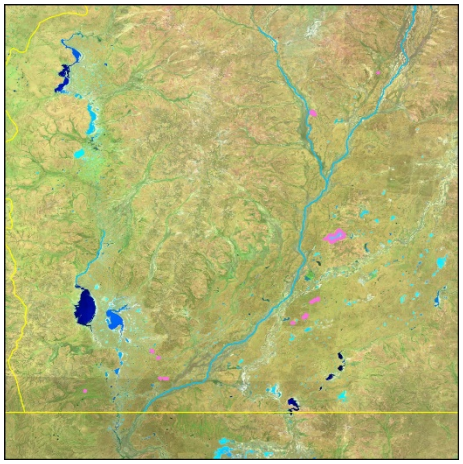
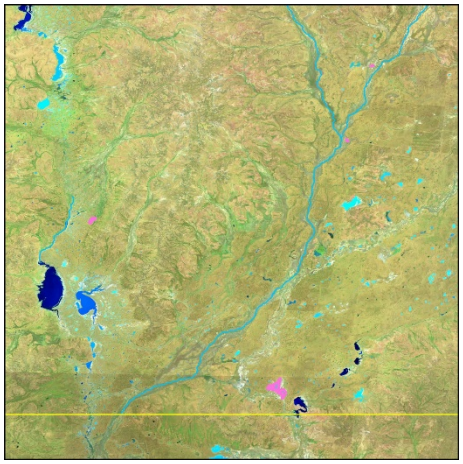
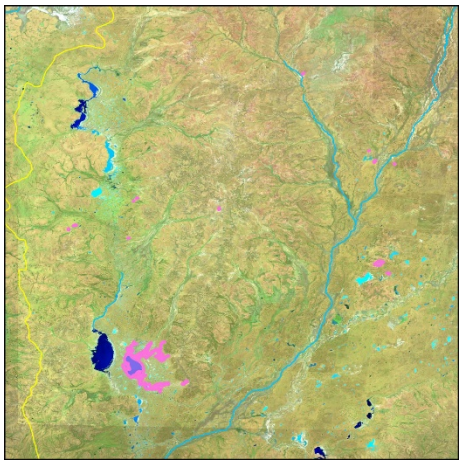
Special Feature	Values	CIM	Rating
pa_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. pa_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
pa_r_ec_46 *Currawinya Lakes (Currawinya National Park) - riverine systems* 	Currawinya Lakes Ramsar site is one of Queenslands most important inland wetland areas. It supports an amazing diversity of wetland types including the large Lake Numalla (freshwater) and Lake Wyara (saltwater), clay pans, swamps, smaller lakes, springs, and the waterholes of the Paroo River. The semi-arid climate and flooding from the Paroo River are key drivers of the health of the Currawinya wetlands. Currawinya Lakes is a Ramsar site because it contains a rich and diverse area of wetlands, including a range of saline and freshwater ecosystems that have remained largely unchanged by human impact. Currawinya's wetlands support a remarkable variety of native animals and plants, often at critical stages of their lifecycle, e.g. for breeding, feeding and drought refuge. Over 200 bird species have been observed at the Currawinya Lakes Ramsar site. Sometimes more than 250,000 individual birds are present at any one time. (DES 2014).	5.1.4 6.1.1 6.2.1 6.3.1 6.3.2 6.3.3 6.3.4 6.4.1	4 4 4 4 4 4 4 4

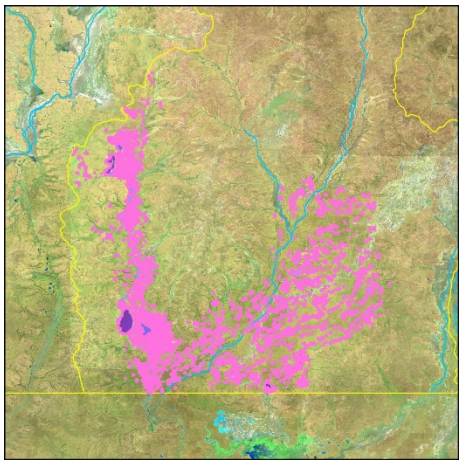
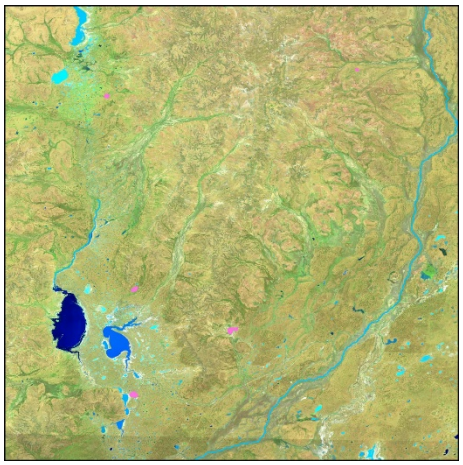
Table 24. Paroo Non-Riverine fauna, flora and ecology special features

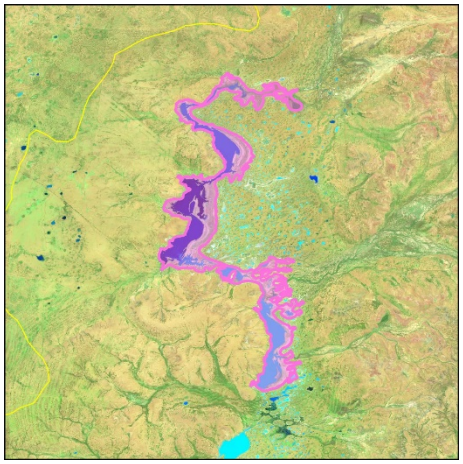
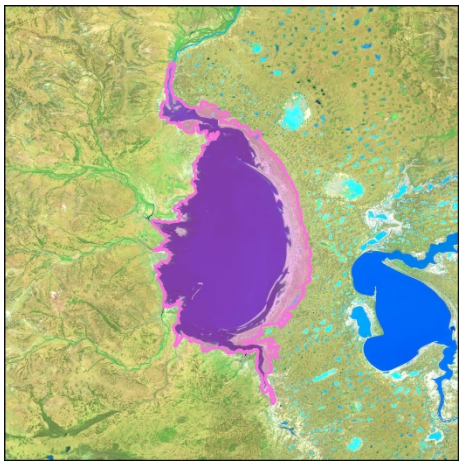
Special Feature	Values	CIM	Rating
pa_nr_fa_02 *Lake Wyara, Lake Numalla, and Lake Bindegolly -significant waterbird habitat* 	The Currawinya Lakes Ramsar site supports significant numbers of individual waterbird species. At least 10 species of waterbirds have exceeded the 1% breeding population threshold required to meet this criteria. These species include Pink-eared duck (>10 000), Eurasian coot, Black swan (100 00), Freckled duck (>10 000), Grey teal (>20 000), Sharp-tailed sandpipe, Hardhead (>10 000), Australasian shoveler, Banded stilt, and Red-necked avocet. (Ref: Ramsar Listing, Commonwealth Department of the Environment, Water, Heritage and the Arts; R. Jaensch, pers com). Lake Bindegolly is a saline lake with high diversity of bird species, in the 10Ks to 20Ks. >1% of the breeding population of Blue-billed and Freckled ducks are known to have bred at Lake Bindegolly (R. Jaensch, pers com).	5.1.4	4
pa_nr_fa_04 *Lake Wombah, Lake Bulla, Lake Thorlindah, Kungi Lake - significant waterbird habitat* 	This decision includes the larger, more permanent lacustrine wetlands within an area defined by the experts. These wetlands are important for waterbird breeding events supplementing overall waterbird breeding populations in the area. In wet times waterbirds spread out, retreating in drier times back to waterholes with more permanent water. Wetlands picked up by this decision include Lake Wombah, Lake Bulla, Lake Thorlindah, Kungi Lake and some other smaller un-named lake systems.	5.1.4	3

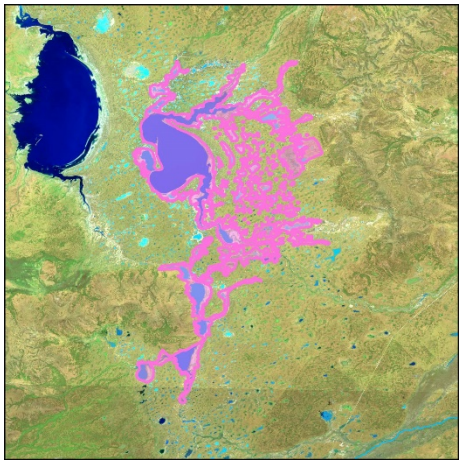
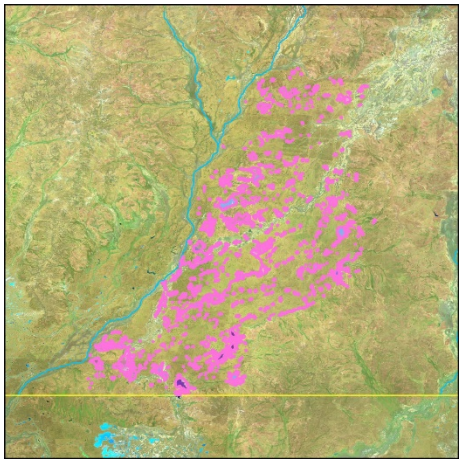
Special Feature	Values	CIM	Rating
pa_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt Bioregion, 6.3.1a in the Mulga Lands Bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystems 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. An equivalent riverine expert panel decision (pa_r_fl_04) uses regional ecosystems 6.3.3x1 (v12.1 regional ecosystem mapping), 6.3.3a, 5.3.20a and 5.3.20b.	5.2.1	4
pa_nr_fl_03 *Lignum Wetlands* 	Wetlands that contain lignum (*Muehlenbeckia florulenta*) provide significant habitat values (including water bird breeding habitat when in expansive stands) and habitat for threatened fauna species including the freckled duck (*Stictonetta naevosa*). Lignum may also be a strong driver/indicator of healthy wetlands. Experts noted that lignum is often a sub-component of *Eucalyptus* coolabah communities and there is likely a lot more lignum, including dense lignum, present in the study areas and that is not mapped. Artificial wetlands within the area were assigned a rating of 2.	5.2.1	4
pa_nr_fl_05 *Bluebush swamp, with or without Lignum on alluvium* 	These sparse to open low shrub land occur in depressions on flood plains, braided channels, interdune flats, clay pans and clay plains and were identified by the experts as having significant flora and fauna values including important seasonal water bird habitat. Regional ecosystem 6.3.11x1 (v12.1 regional ecosystem) sits on alluvium, the more fertile and wet parts of the landscape. Centres of diversity including diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Regional ecosystem 4.3.24 (Seasonal swamps. *Chenopodium auricomum* +/- *Duma florulenta* dwarf shrubland in closed depressions on floodplains) is habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. Regional ecosystem 5.3.12b provides wetland water bird habitat including potential habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. It is also habitat for Grey Grasswrens, *Amytornis barbatus*. Regional ecosystem 5.3.18a is potential habitat for threatened fauna species including plains-wanderer *Pedionomus torquatus* and fierce snake (western taipan) *Oxyuranus microlepidotus*. It also provides wetland habitat for a wide range of water birds and other flora and fauna.	5.2.1	4

Special Feature	Values	CIM	Rating
pa_nr_fl_08 *Key lakes and associated communities of the Mulga Lands Bioregion* 	The lakes of the Mulga Lands bioregion have a series of vegetation communities of limited extent related specifically to the lakes themselves. They are fringed by *Tecticornia* succulent shrublands, one of only two vegetation communities dominated by *Tecticornia* in the bioregion. A sporadic sedgeland, dominated by *Cyperus gymnocaulos*, is restricted to the lake fringes. A variable wooded community often occurs on the lake fringing lunettes from Lake Bindegolly, south to the Currawinya lakes. The lunette vegetation includes *Eucalyptus largiflorens* and *Acacia ligulata*, both species with limited extent in the bioregion.	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
pa_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4
pa_nr_fl_12 *Tecticornia closed depressions in reticulate dunes* 	*Tecticornia* is a genus of succulent, salt tolerant plants, commonly referred to as samphires and which are largely endemic to Australia. Vegetation communities associated with this decision are a very specific form of vegetated palustrine wetland in closed depressions with a restricted distribution, related to reticulate dune fields in the Paroo and Bulloo catchments. In addition, these are one of only two vegetation communities supporting *Tecticornia* and associated species in the Mulga Lands bioregion. Situated on alluvium, the most fertile part of this semi-arid landscape, these ecosystems trap water for extended periods, leading to high species diversity.	5.2.1	4

Special Feature	Values	CIM	Rating
pa_nr_fl_13 *Herbland closed depressions, not on alluvium - open herblands on clays, associated with ephemeral lakes, billabongs and permanent waterholes* 	Regional ecosystem 6.3.11 (*Eleocharis pallens* + short grasses + *Eragrostis australasica* open forbland clay associated with ephemeral lakes: billabongs and permanent waterholes) sits on broad sand sheets. These ecosystems trap water for longer times and are associated with a diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Artificial wetlands within the area were assigned a value of 2.	5.2.1	2
pa_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4
pa_nr_ec_02 *Natural artesian springs within existing wetlands* 	The expert panel identified artesian springs as significant wetlands having multiple values including endemic species, unique habitat values, connectivity to groundwater. The refugia nature of artesian springs has resulted in distinct flora and fauna assemblages including highly specialised and endemic species. Great Artesian basin springs are known to be evolutionary hotspots providing habitat for endemic plants, fish, snails and other invertebrates (Boyd 1990; Ponder 2002; Fensham and Fairfax 2003; Fensham and Price 2004; Fensham et al. 2004; Fairfax et al 2007) as well as refugia for non-endemic native plants isolated by over 500km from other populations (Fensham et al. 2004). Freshwater wetland areas containing unmodified modified springs were considered to have very high intrinsic conservation value.	6.1.1 6.3.1 6.4.1	4 4 4

Special Feature	Values	CIM	Rating
pa_nr_ec_15 *Non-riverine wetlands associated with the Paroo Sandsheet* 	The Paroo Sandsheets contains a numerous clusters of small non-riverine wetlands resulting from unique geomorphic and drainage processes. These clusters contain saline and fresh waterbodies both large and small. The diversity of geology and hydrology provides for various vegetation communities including a mixture of canegrass, wooded and bare swamps. Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.3.3	4 4
pa_nr_ec_29 *Modified artesian springs within existing wetlands* 	The expert panel identified artesian springs as significant wetlands having multiple values including endemic species, unique habitat values, connectivity to groundwater. The refugia nature of artesian springs has resulted in distinct flora and fauna assemblages including highly specialised and endemic species. Great Artesian basin springs are known to be evolutionary hotspots providing habitat for endemic plants, fish, snails and other invertebrates (Boyd 1990; Ponder 2002; Fensham and Fairfax 2003; Fensham and Price 2004; Fensham et al. 2004; Fairfax et al 2007) as well as refugia for non-endemic native plants (Fensham et al. 2004). Freshwater wetlands containing slightly modified springs were considered to have high intrinsic conservation value.	6.1.1 6.3.1 6.4.1	3 3 3

Special Feature	Values	CIM	Rating
pa_nr_ec_33 *Lakes Bindegolly and Toomaroo* 	The Lakes Bindegolly and Toomaroo wetlands listed in Directory of Important Wetlands Australia as QLD125 (DAWE, 2021) is comprised of two hydrologically connected lakes together with an aggregation of small ephemeral lakes to the east of Lake Bindegolly. Water is fresh to brackish in Lake Bindegolly, with salinity levels increasing as water levels decline. Water in the clay depressions is thought to be saline. Three wetland habitats occur including shallow open water habitat, emergent wetland on seasonally flooded unconsolidated shores, and emergent wetland in ephemerally flooded depressions. This site is a good example of a wetland type with fresh, brackish and saline components within the Mulga Lands bioregion. It is an important body of water in an arid region, an important drought refuge for waterbirds, and habitat for rare and endangered species (e.g. freckled duck (*Stictonetta naevosa*) (Sr) and musk duck (*Biziura lobata*)). The dunes surrounding Lake Bindegolly support the vulnerable species *Acacia ammophila*. The area is an important drought refuge for thousands of birds, particularly waterbirds with 60 species present at various times. Lake Bindegolly is also one of four large terminal lakes in the Queensland Murray-Darlin Basin catchments. Large terminal lakes are a unique geomorphic feature and important due to their isolation/lack of connectivity for most of the time creating unique ecological (biotic/abiotic) settings.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
pa_nr_ec_36 *Lake Wyara* 	Lake Wyara listed in Directory of Important Wetlands Australia as QLD124 (DAWE, 2021) is a large terminal saline lake dammed up against deep aeolian sands on it's eastern side, and an predominantly internally draining catchment system. Landforms include drainage depression, stream bed, stream channel and lake; uplands are gently sloping flats and slightly elevated surfaces with low relief. Three wetland habitats occur including deep water and open water, emergent wetland in shallow waters and shore margins, and vegetated claypans. The site is a particularly good example of a biologically rich, saline wetland type within the Mulga Lands bioregion. It is a significant persistent wetland habitat within an arid region, is a major drought refuge for waterbirds (e.g. freckled duck (*Stictonetta naevosa*) and pink-eared duck (*Malacorhynchus membranaceus*)) and habitat for rare and endangered species. Together with Lake Numalla, no other wetland complex in arid, or southern, Australia is thought to support such large populations of waterbirds. For example, Lake Wyara supports up to ten times the number of waterbirds as Lake Numalla. Currawinya National Park, which includes both lakes Wyara and Numulla, is listed as a Ramsar site. Estimates of c.100 000 individuals of 31 species of waterbirds have been made (Kingsford and Porter 1994), including up to 5000 freckled duck (*Stictonetta naevosa*) or 16% of the national population. The catchment for Lake Wyara is quite separate from that of adjacent Lake Numalla, and Lake Wyara is also one of four large terminal lakes in the Queensland Murray-Darlin Basin catchments. Large terminal lakes are a unique geomorphic feature and important due to their isolation/lack of connectivity for most of the time creating unique ecological (biotic/abiotic) settings.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

Special Feature	Values	CIM	Rating
pa_nr_ec_37 *Lake Numalla Aggregation* 	The Lake Numalla Aggregation listed in Directory of Important Wetlands Australia as QLD123 (DAWE, 2021) comprises Lake Numalla together with an aggregation of small ephemeral lakes, drainage depressions and associated streamlines. Landforms include drainage depression, stream channel, stream bed and lake; uplands are gently sloping flats and slightly elevated surfaces with low relief. Three wetland habitats occur including deep water and open water habitat, emergent wetland in shallow waters and shore margins, and vegetated claypans. The site is a particularly good example of a freshwater wetland type within the Mulga Lands bioregion. It is an important body of freshwater in an arid region, a major drought refuge for waterbirds (e.g. freckled duck (*Stictonetta naevosa*)) and a habitat for rare and endangered species. Together with Lake Wyara, no other wetland complex in arid or southern Australia is thought to constantly support such large populations of waterbirds. Estimates of c.10 000 waterbirds comprising 39 species have been made (Kingsford and Porter 1994).	6.1.1 6.2.1 6.3.1 6.3.2 5.1.4 8.2.5	3 3 3 3 3 3
pa_nr_ec_43 *Lake Wombah-Kungie Lake Group* 	The Lake Wombah-Kungie Lake Group listed in Directory of Important Wetlands Australia as QLD175 (DAWE, 2021) includes a vast complex of claypans and ephemeral to semi-permanent lakes occurring in sandplain country. The complex extends from about 30km south of Eulo to the New South Wales border, just east of Hungerford immediately to the east of the Currawinya Lakes system and Paroo River. Most of the pans are only intermittently inundated, although the larger lakes (Lake Wombah, Blue Lake and Kungie Lake) appear to be at least semi-permanent. Water quality is apparently very good in most and is reported to be fresh (although satellite interpretation suggests that there may be a degree of salinity in the larger lakes). Substantial areas of open, deep water occur on the large lakes throughout most years. All may dry out in protracted droughts. Fringing vegetation communities include samphire (Halosarcia) low shrublands, black box (*Eucalyptus largiflorens*) woodlands, sedgelands (Cyperus, Eleocharis) and ephemeral grasslands/forblands. Many of the smaller claypans appear to have swamp canegrass (*Eragrostis australasica*) sparse to open, low to tall grasslands +/- lignum (*Muehlenbeckia florulenta*) and chenopodiaceous sparse shrublands. Large beds of aquatic plants (e.g. Myriophyllum) grow in the shallower parts of the lakes. The fringing samphire shrublands and woodlands typify the larger claypan systems of the Mulga Lands. The highly productive aquatic beds provide substantial habitat and feed for aquatic fauna. Large colonies of waterbirds utilise the permanent lakes throughout most years, many probably travelling between this system and the nearby Currawinya Lakes. Pelicans, grebes and duck species are all known to breed at Lake Wombah, and also probably at the other semi-permanent lake in the complex. Numerous migratory wading birds are known to visit Currawinya, and it is very likely that these JAMBA/CAMBA listed species also inhabit the Lake Wombah aggregation. Freckled duck (*Stictonetta naevosa*) have been seen at Lake Wombah. Artificial wetlands within the area were assigned a value of 2.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

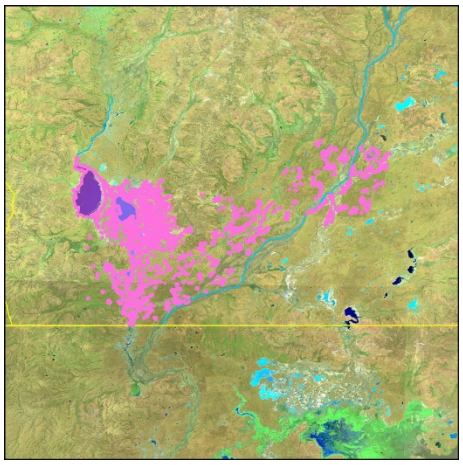
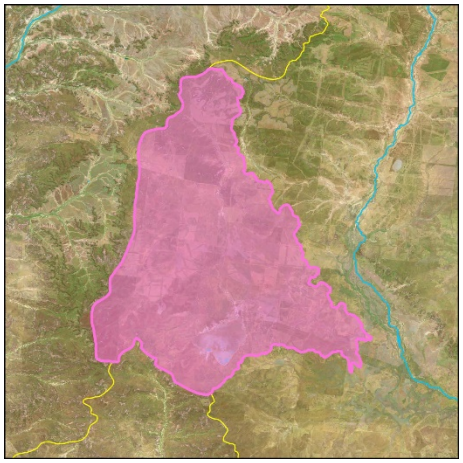
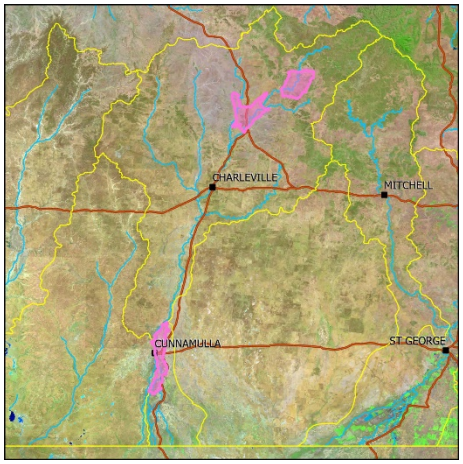
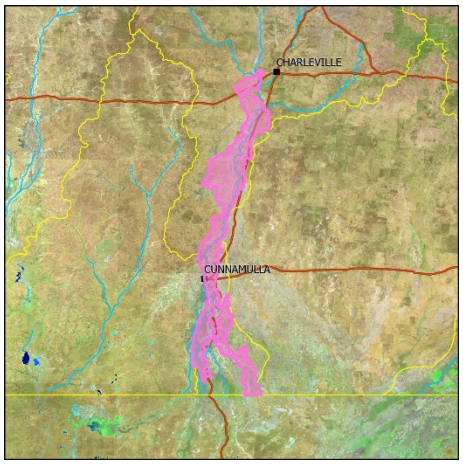
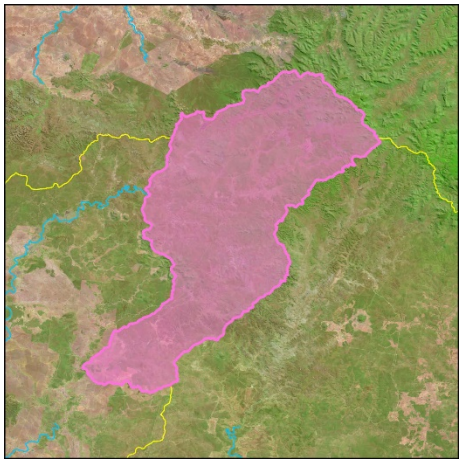
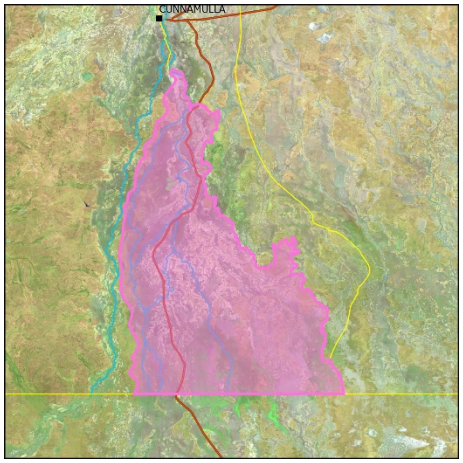
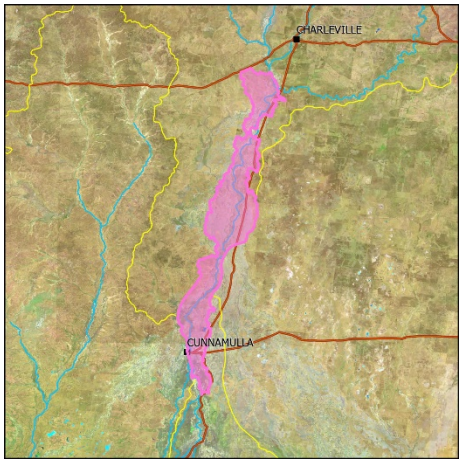
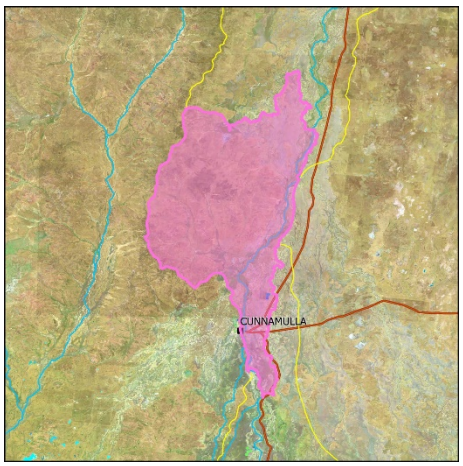
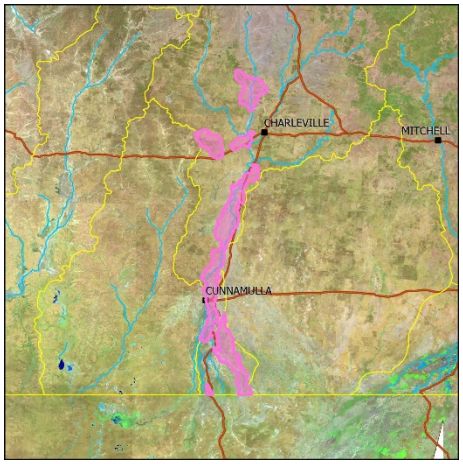
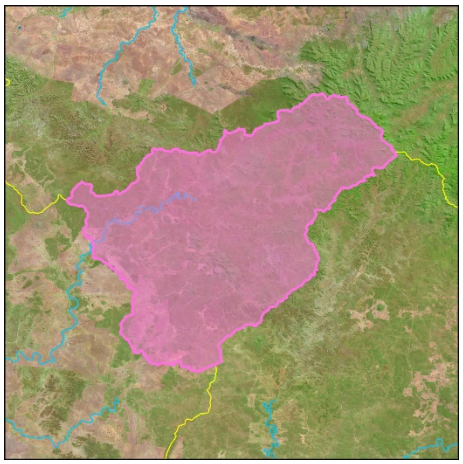
Special Feature	Values	CIM	Rating
pa_nr_ec_45 *Currawinya Lakes (Currawinya National Park) - non-riverine systems* 	Currawinya Lakes Ramsar site is one of Queenslands most important inland wetland areas. It supports an amazing diversity of wetland types including the large Lake Numalla (freshwater) and Lake Wyara (saltwater), clay pans, swamps, smaller lakes, springs, and the waterholes of the Paroo River. The semi-arid climate and flooding from the Paroo River are key drivers of the health of Currawinya's wetlands. Currawinya Lakes is a Ramsar site because it contains a rich and diverse area of wetlands, including a range of saline and freshwater ecosystems that have remained largely unchanged by human impact. Currawinya's wetlands support a remarkable variety of native animals and plants, often at critical stages of their lifecycle, e.g. for breeding, feeding and drought refuge. Over 200 bird species have been observed at the Currawinya Lakes Ramsar site. Sometimes more than 250,000 individual birds are present at any one time. (DES 2014).	5.1.4 6.1.1 6.2.1 6.3.1 6.3.2 6.3.3 6.3.4 6.4.1	4 4 4 4 4 4 4 4

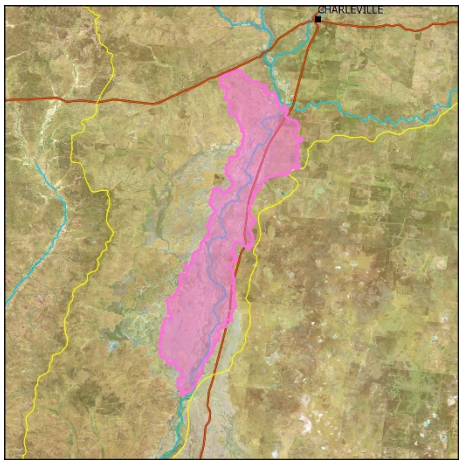
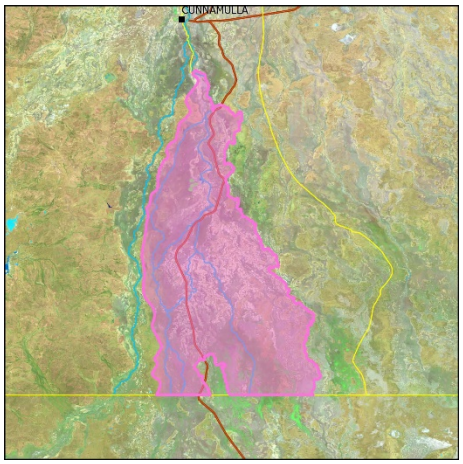
Table 25. Warrego Riverine fauna, flora and ecology special features

Special Feature	Values	CIM	Rating
wg_r_fa_03 *Ambathala Creek* 	Ambathala Creek drains a small endorheic sub-catchment at the top west of the Warrego and terminating in Lake Dartmouth, a large brackish to saline ephemeral lake known to provide important habitat for waterbirds (Kingsford and Porter 1999) and listed on the Directory or Important Wetlands Australia. Ambathala Creek is unique in that it is hydrologically isolated from the Warrego River and its tributaries (Power et al. 2007). Water in Ambathala Creek is fresh but turbid (DEH 2005). Being functionally separate from the rest of the Murray-Darling Basin, carp have not become established resulting to higher native fauna biomass and the presence of the IUCN listed River Snail (*Notopala sublineata*) which, with the exception of the Bulloo catchment, is considered extinct elsewhere across its natural range (Marshall et al. 2019).	6.1.1 6.3.1 6.4.1	3 3 3
wg_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which are generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4

Special Feature	Values	CIM	Rating
wg_r_fl_04 *Freshwater wetlands (billabongs) - riverine systems* 	This expert panel decision is implemented using regional ecosystems 6.3.3a in the Mulga Lands Bioregion, and 5.3.20a and 5.3.20b in the Channel Country bioregion. Regional ecosystem 6.3.3a (waterholes in drainage lines) special values include high fauna diversity, particularly bird and mammal (including Koala - Gordon et al. 1988) species. This regional ecosystem captures the larger more permanent waterholes which provide important wetland and fauna refuge habitat. It is also floristically rich with more than 100 species/500m2. Regional ecosystems 5.3.20a (open woodland fringing waterholes connected to braided channel systems) and 5.3.20b (open woodland fringing waterholes in major river systems) special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4
wg_r_ec_02 *Headwater streams above 600m for Warrego and Maranoa catchments* 	The headwater streams of the Warrego and Maranoa catchments were identified by the panel as having unique and high aquatic habitat diversity. Set in a relatively arid landscape, these headwater watercourses are fed by surface run-off and are relatively clear and intact. Distinct or unique genetics are likely to occur.	6.3.1 6.4.1	4 4

Special Feature	Values	CIM	Rating
wg_r_ec_04 *Waterways feeding wetlands of key ecological significance across the state border* 	The decision captures selected reaches of a number of creeks and rivers known to feed wetlands with high biodiversity value across the QLD state border. Collectively these riverine systems have good longitudinal connectivity, diverse fish communities, support important waterbird habit, and provide ecosystem services further down the Darling system. This decision includes selected reaches of the Paroo River (below the confluence of the Paroo River and Yowah Creek), Cuttaburra Creek (below Cunnamulla), selected reaches of the Warrego river (below Cunnamulla), and the riverine spatial units traversed by the Bulloo River. Cuttaburra Creek is an important channel connecting the Warrego River to the lower Paroo. River red gum, coolabah and river cooba grow along channels and wetland areas. In wet years waters of the Warrego River system may flow through Cuttaburra Creek to the lower reaches of the Paroo River across the border. This process is important for gene flow and supporting large, nationally important terminal swamps and storages across the border (Yantabulla Swamp). The Paroo and Narran rivers feed RAMSAR wetlands across the border in NSW.	6.1.1 6.2.1 6.3.3	4 4 4
wg_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. wg_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
wg_r_ec_21 *Upper breakouts of the Warrego River, Noorama creek and Widgeegoara creek* 	In its middle reach (below Wyandra), the Warrego River has a series of flood breakouts which drain west into the Paroo River and east into the Nebine River. Baruna breakouts to Gum Holes and Moonjari Waterholes provide an important route for recruitment in the event of long droughts. Uniquely, the Paroo and Warrego Rivers are hydrologically connected through overland flow emanating from north-west of Cunnamulla to Eulo. These connections provide for species connectivity and are drivers of processes and functioning in these catchments.	6.3.4 6.4.1	3 3

Special Feature	Values	CIM	Rating
wg_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
wg_r_ec_31 *Upland riverine reaches with flows sustained by groundwater seeps* 	Groundwater connectivity with riverine ecosystems were viewed as important by the expert panel as inflow of groundwater, especially where granite geology exists, sustains rivers and creeks during drier periods. Water exchange can happen through fractured rock aquafers, but more typically coincides with sandy bottomed riverbeds. Flows are not necessarily perennial during drought.	7.2.1	4

Special Feature	Values	CIM	Rating
wg_r_ec_39 *Warrego River Waterholes (Charleville-Wyandra)* 	The Warrego River Waterholes (Charleville-Wyandra) listed in Directory of Important Wetlands Australia as QLD171 (DAWE, 2021) is a string of large, permanent, and intermittent waterholes/billabongs along the main Warrego River channel between Charleville and south of Wyandra. Seasonal flooding down the Warrego River replenishes these waterholes on a more-or-less annual basis. Most would be at least semi-permanent, only drying out during extended drought periods. Significant bodies of deep, open water in many of the holes provide substantial habitat for aquatic fauna - invertebrates, fish, turtles and birds. The dominant vegetation communities fringing the waterholes are river red gum (*Eucalyptus camaldulensis*) +/- Coolabah (*E. Coolabah*) +/- belalie (*Acacia stenophylla*) open forests to open woodlands, often with an understorey of lignum (*Muehlenbeckia florulenta*) and ground layer of sedges, grasses and forbs. Aquatic floating (e.g. *Azolla*) and emergent (e.g. *Ludwigia, Nymphoides*) vegetation would be present in some of the larger holes. Coolabah open woodland with open lignum/Queensland blue bush (*Chenopodium auricomum*) open - sparse shrubland and ephemeral grassland/forbland/chenopod low shrubland occurs on the adjacent floodplains. Significant populations of waterbirds may be found along this system of waterholes, especially after annual flooding. The larger, more permanent holes offer important drought refuge for a number of species and are captured by the riverine or non-riverine refugial waterholes decisions (wg_nr_ec_01, wg_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
wg_r_ec_42 *Warrego River Distributary System* 	The Warrego River Distributary System listed in Directory of Important Wetlands Australia as QLD169 (DAWE, 2021) is a vast distributary floodplain of the Warrego River, fanning out from about Cunnamulla to the New South Wales border. This has multiple special features. In a national context, it is a unique geological feature within Australia. The large pools near Wyandra are fish refugia, whilst numerous waterholes in this aggregation also support small populations of waterbirds for most of the year, mainly ducks, pelicans, cormorants and larger waders (egrets, etc.). During flood periods, especially larger, widespread floods, much larger numbers and a greater diversity of species visit the area. The more permanent waterholes provide a drought refuge for many smaller species, although probably do not support many piscivores. Hydrologically, the distributary system is an important driver of ecological processes. For example, currently more water diverts down the Cuttaburra Creek channel than the main channel of Warrego River. In large floods, flow breaks out and connects to Paroo system.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

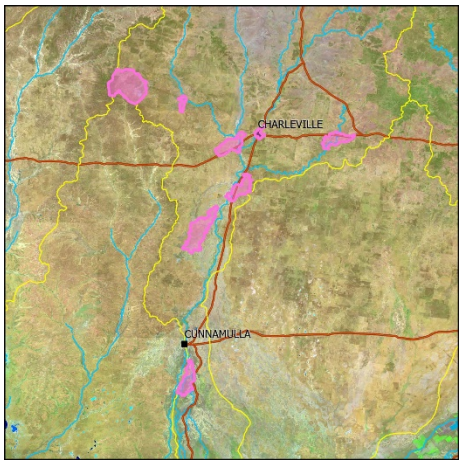
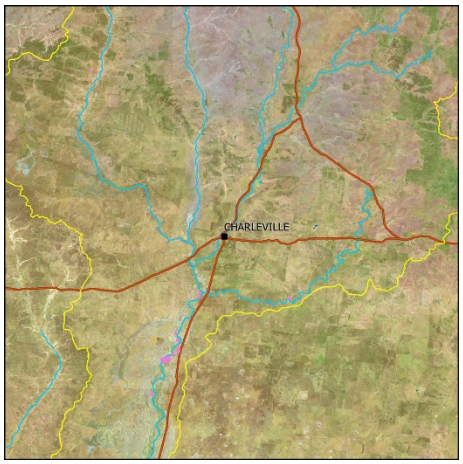
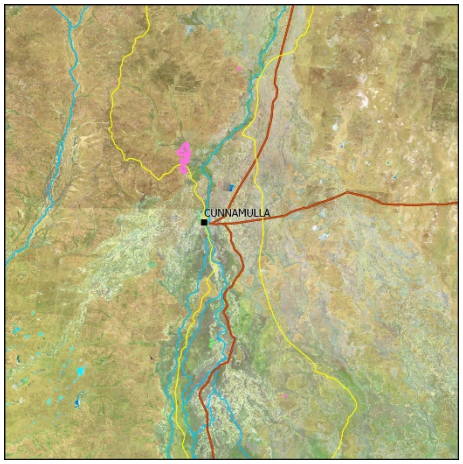
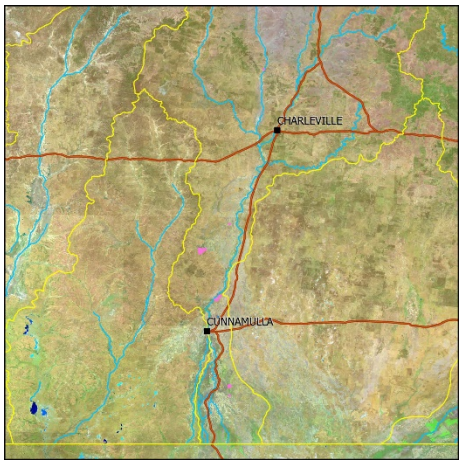
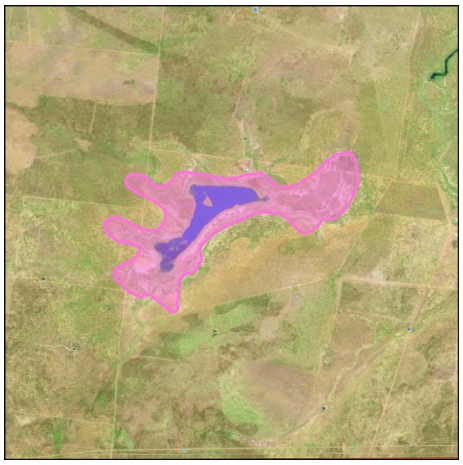
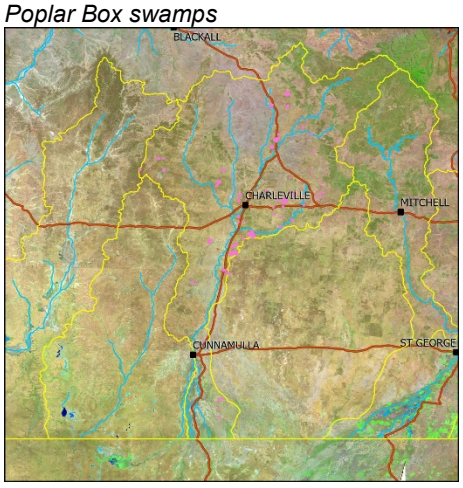
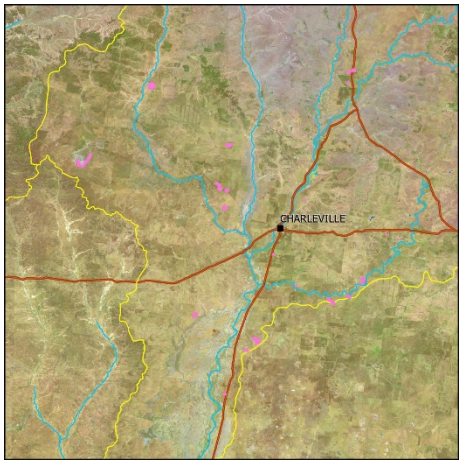
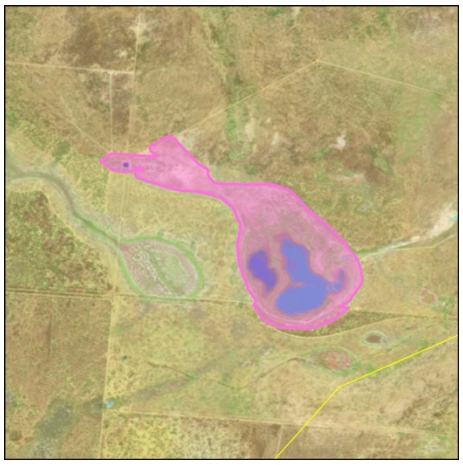
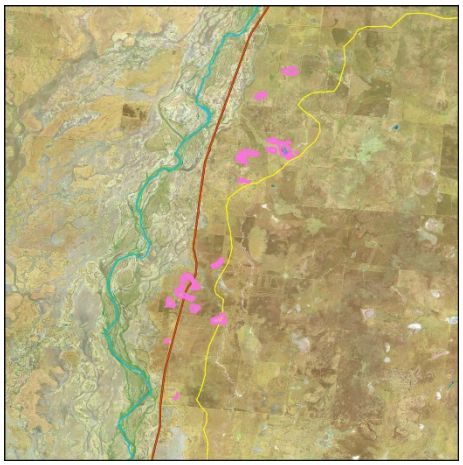
Special Feature	Values	CIM	Rating
wg_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. wg_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

Table 26. Warrego Non-Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
wg_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt Bioregion, 6.3.1a in the Mulga Lands Bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystems 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. An equivalent riverine expert panel decision (wg_r_fl_04) uses regional ecosystems 6.3.3x1 (v12.1 regional ecosystem mapping), 6.3.3a, 5.3.20a and 5.3.20b.	5.2.1	4
wg_nr_fl_03 *Lignum Wetlands* 	Wetlands that contain lignum (*Muehlenbeckia florulenta*) provide significant habitat values (including water bird breeding habitat when in expansive stands) and habitat for threatened fauna species including the freckled duck (*Stictonetta naevosa*). Lignum may also be a strong driver/indicator of healthy wetlands. Experts noted that lignum is often a sub-component of *Eucalyptus coolabah* and there is likely a lot more lignum, including dense lignum, present in the study areas and that is not mapped. Artificial wetlands within the area were assigned a rating of 2.	5.2.1	4
wg_nr_fl_05 *Bluebush swamp, with or without Lignum on alluvium* 	These sparse to open low shrub land occur in depressions on flood plains, braided channels, interdune flats, clay pans and clay plains and were identified by the experts as having significant flora and fauna values including important seasonal water bird habitat. Regional ecosystem 6.3.11x1 (v12.1 regional ecosystem) sits on alluvium, the more fertile and wet parts of the landscape. Centres of diversity including diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Regional ecosystem 4.3.24 (Seasonal swamps. *Chenopodium auricomum* +/- *Duma florulenta* dwarf shrubland in closed depressions on floodplains) is habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. Regional ecosystem 5.3.12b provides wetland water bird habitat including potential habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. It is also habitat for Grey Grasswrens, *Amytornis barbatus*. Regional ecosystem 5.3.18a is potential habitat for threatened fauna species including plains-wanderer *Pedionomus torquatus* and fierce snake (western taipan) *Oxyuranus microlepidotus*. It also provides wetland habitat for a wide range of water birds and other flora and fauna.	5.2.1	4

Special Feature	Values	CIM	Rating
wg_nr_fl_08 *Key lakes and associated communities of the Mulga Lands Bioregion* 	The lakes of the Mulga Lands bioregion have a series of vegetation communities of limited extent related specifically to the lakes themselves. They are fringed by *Tecticornia* succulent shrublands, one of only two vegetation communities dominated by *Tecticornia* in the bioregion. A sporadic sedgeland, dominated by *Cyperus gymnocaulos*, is restricted to the lake fringes. A variable wooded community often occurs on the lake fringing lunettes from Lake Bindegolly, south to the Currawinya lakes. The lunette vegetation includes *Eucalyptus largiflorens* and *Acacia ligulata*, both species with limited extent in the bioregion.	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
wg_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4
wg_nr_fl_13 *Herbland closed depressions, not on alluvium - open herblands on clays, associated with ephemeral lakes, billabongs and permanent waterholes* 	Regional ecosystem 6.3.11 (*Eleocharis pallens* + short grasses + *Eragrostis australasica* open forbland clay associated with ephemeral lakes: billabongs and permanent waterholes) sits on broad sand sheets. These ecosystems trap water for longer times and are associated with a diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Artificial wetlands within the area were assigned a value of 2.	5.2.1	2

Special Feature	Values	CIM	Rating
wg_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4
wg_nr_ec_12 *Wyandra-Cunnamulla Claypans aggregation* 	The Wyandra-Cunnamulla claypans aggregation listed in Directory of Important Wetlands Australia as QLD166 (DAWE, 2021) is a vast cluster of ephemeral claypans and lakes to the east of Wyandra and Cunnamulla. This aggregation has an interesting mix of water chemistry with both saline and fresh water in many small waterbodies. The diversity of geology and hydrology provides for various vegetation communities including a mixture of canegrass, wooded and bare swamps. Little is known of the fauna of these wetlands, but they may support numerous waterbirds from various feeding guilds when they are full. For example, in very wet periods, such as during the 1990 floods, when all or most of the lakes are full, large numbers of ducks, pelicans and cormorants (among others) visit the larger lakes, some of them may breed. The known breeders include pelicans and ibis. It is quite likely that migratory waders also make brief visits to the area during periods of inundation. Arid-zone invertebrates such as shield-shrimps and clam shrimps are common during inundation. Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

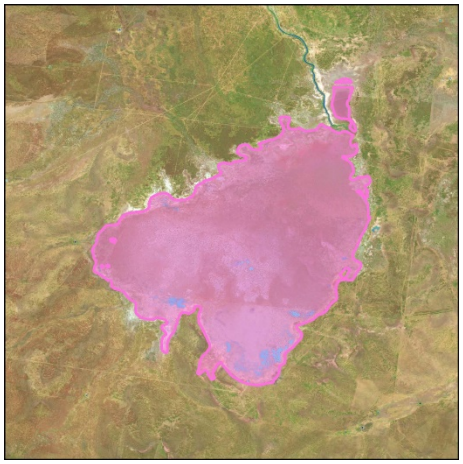
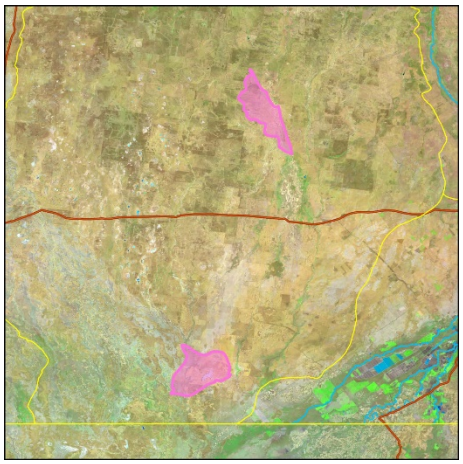
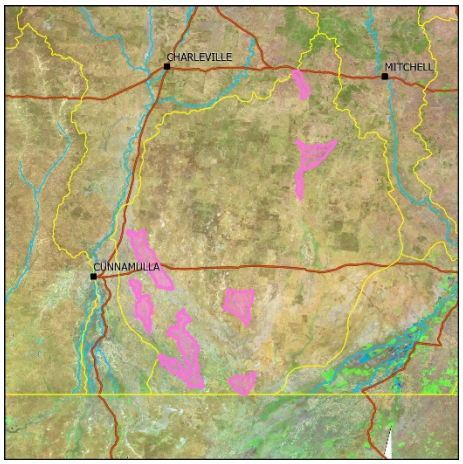
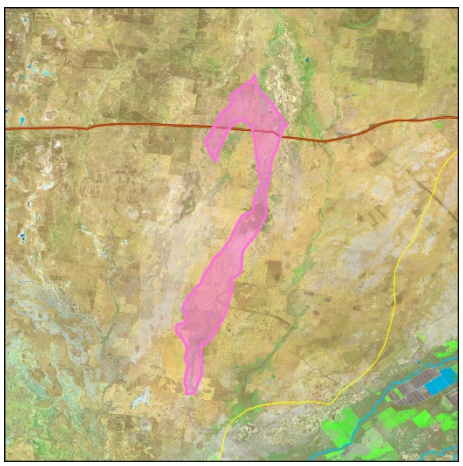
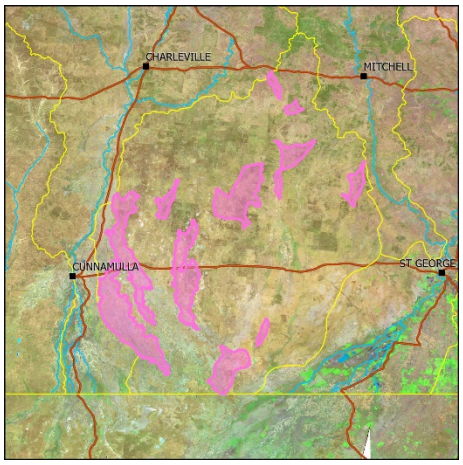
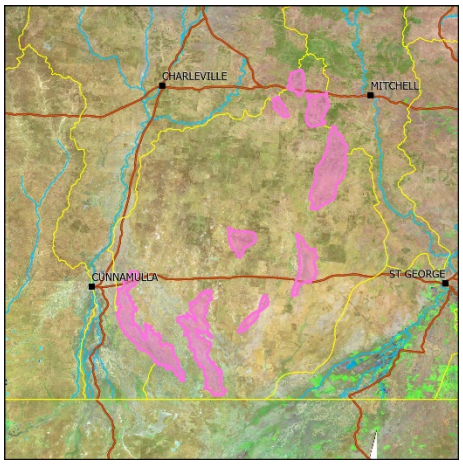
Special Feature	Values	CIM	Rating
wg_nr_ec_30 *Lake Dartmouth and Oak Swamp* 	Lake Dartmouth listed in Directory of Important Wetlands Australia - Lake Dartmouth Area, as QLD168 (DAWE, 2021), is a large ephemeral and terminal lake covering approximately 5,600ha 100km north-west of Charleville. The lake, fringing wetlands, and associated flood out areas support diverse vegetation and fauna and are also important waterbird breeding habitat. Lake Dartmouth and Oak Swamp also contain the largest *Casuarina cristata* swamp in the Mulga Lands. The extensive wooded swamp (coolabah woodland/*Aeschynomene indica* shrubland/mixed species grassland) on the Ambathalla Creek flood out at the northern end of Lake Dartmouth is an uncommon community in the northern Mulga Lands. Similarly, the vast lakebed with lignum sparse shrubland is the largest single such community in the part of the bioregion. The Belah (*Casuarina cristata*) open forest on "Oak Swamp" represents an isolated pocket of this species, approaching the western limits of its distribution in Queensland. Kingsford and Porter (1999) estimate Lake Dartmouth supports a waterbird population of 11,000. Oak Swamp to the east of Lake Dartmouth is infrequently flooded by overflow from Ambathalla Creek backed up when the lake is full.	6.1.1 6.2.1 6.3.1 6.3.2 6.3.4 8.2.5	3 3 3 3 3 3
wg_nr_ec_32 *Old Bando Swamp* 	Old Bando Swamp listed in Directory of Important Wetlands Australia as QLD0172 (DAWE, 2021) is a large depression on a tributary to the western side of the Warrego River. A periodically inundated freshwater swamp with a relatively small catchment. Partial inundation probably occurs most seasons, but extensive flooding probably occurs only one year in 5-10 and only for several months. Lignum and canegrass communities are typical of these ephemeral lakes and claypans in the Mulga Lands. When full, the swamp probably attracts numerous waterbirds, including ducks, pelicans, cormorants, and waders.	6.3.2 8.2.5	3 3

Table 27. Wallam Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
wm_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country Bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which is generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
wm_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. wm_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
wm_r_ec_19 *Mungalalla Creek* 	The decision captures instream waterholes along Mungalalla Creek. Tannins in the water result in a unique water chemistry leading to special ecological processes. This is unusual for the Queensland Murray-Darling and Bulloo Basins. Recent surveys by the Queensland Department of Environment and Science have found high abundance and diversity of crustaceans. The water source could be artificial (i.e. bores) and needs further study by experts.	6.2.1	3

Special Feature	Values	CIM	Rating
wm_r_ec_21 *Upper breakouts of the Warrego River, Noorama creek and Widgeegoara creek* 	In its middle reach (below Wyandra), the Warrego River has a series of flood breakouts which drain west into the Paroo River and east into the Nebine River. Baruna breakouts to Gum Holes and Moonjari Waterholes provide an important route for recruitment in the event of long droughts. Uniquely, the Paroo and Warrego Rivers are hydrologically connected through overland flow emanating from north-west of Cunnamulla to Eulo. These connections provide for species connectivity and are drivers of processes and functioning in these catchments.	6.3.4 6.4.1	3 3
wm_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
wm_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depend on refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. wm_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

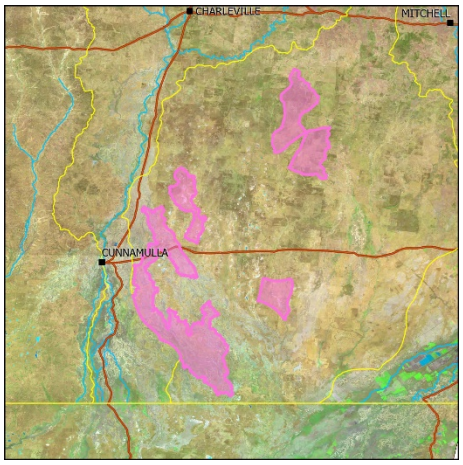
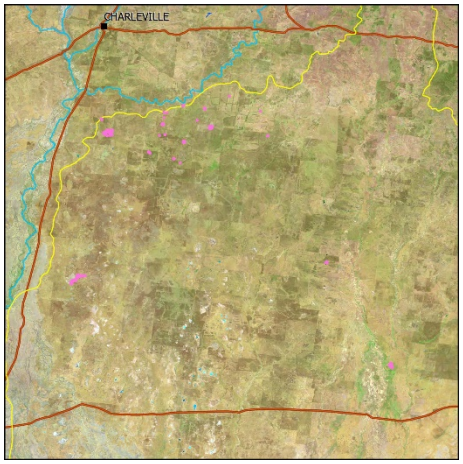
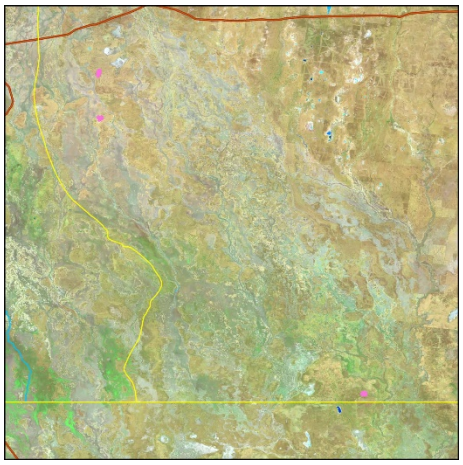
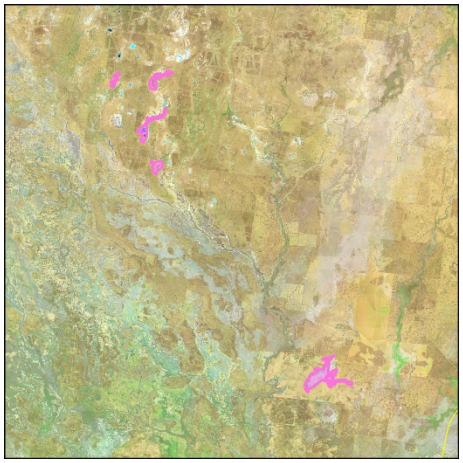
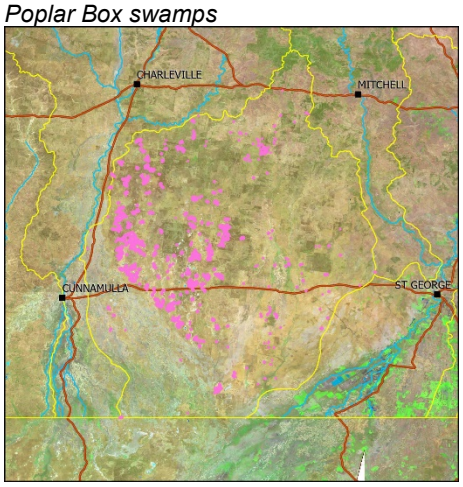
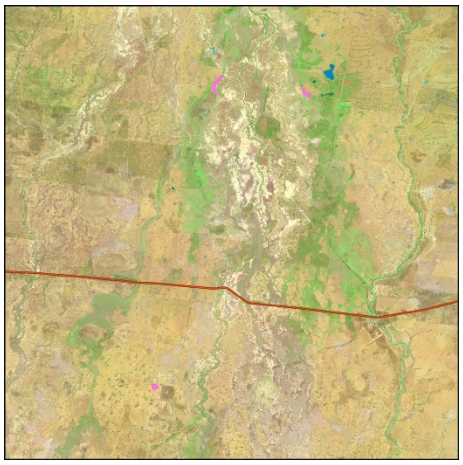
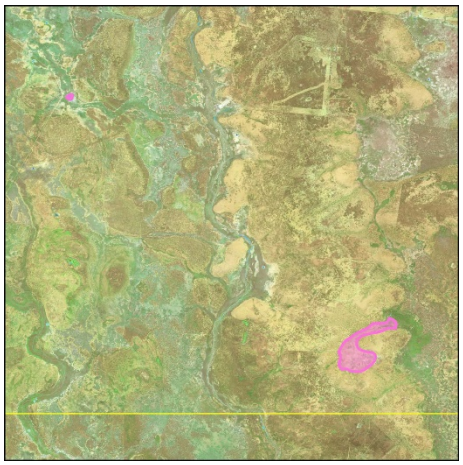
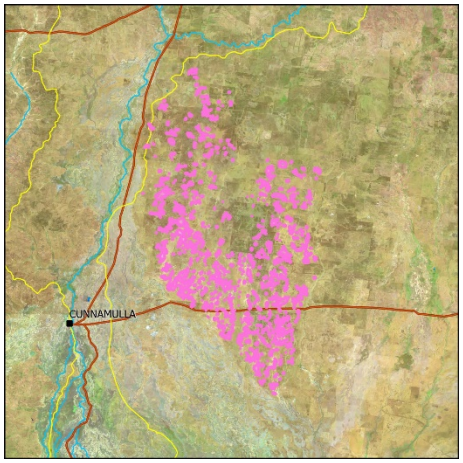
Special Feature	Values	CIM	Rating
wm_r_fl_04 *Freshwater wetlands (billabongs) - riverine systems* 	This expert panel decision is implemented using regional ecosystems 6.3.3a in the Mulga Lands Bioregion, and 5.3.20a and 5.3.20b in the Channel Country bioregion. Regional ecosystem 6.3.3a (waterholes in drainage lines) special values include high fauna diversity, particularly bird and mammal (including Koala - Gordon et al. 1988) species. This regional ecosystem captures the larger more permanent waterholes which provide important wetland and fauna refuge habitat. It is also floristically rich with more than 100 species/500m2. Regional ecosystems 5.3.20a (open woodland fringing waterholes connected to braided channel systems) and 5.3.20b (open woodland fringing waterholes in major river systems) special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4

Table 28. Wallam Non-Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
wm_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt Bioregion, 6.3.1a in the Mulga Lands Bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystems 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. An equivalent riverine expert panel decision (wm_r_fl_04) uses regional ecosystems 6.3.3x1 (v12.1 regional ecosystem mapping), 6.3.3a, 5.3.20a and 5.3.20b.	5.2.1	4
wm_nr_fl_04 *Herbland closed depressions, not on alluvium - open herblands on clays, associated with ephemeral lakes, billabongs and permanent waterholes* 	Regional ecosystem 6.3.11 (*Eleocharis pallens* + short grasses + *Eragrostis australasica* open forbland clay associated with ephemeral lakes: billabongs and permanent waterholes) sits on broad sand sheets. These ecosystems trap water for longer times and are associated with a diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006).	5.2.1	4

Special Feature	Values	CIM	Rating
wm_nr_fl_05 *Bluebush swamp, with or without Lignum on alluvium* 	These sparse to open low shrub land occur in depressions on flood plains, braided channels, interdune flats, clay pans and clay plains and were identified by experts as having significant flora and fauna values including important seasonal water bird habitat. Regional ecosystem 6.3.11x1 (v12.1 regional ecosystem) sits on alluvium, the more fertile and wet parts of the landscape. Centres of diversity including diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Regional ecosystem 4.3.24 (Seasonal swamps. *Chenopodium auricomum* +/- *Duma florulenta* dwarf shrubland in closed depressions on floodplains) is habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. Regional ecosystem 5.3.12b provides wetland water bird habitat including potential habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. It is also habitat for Grey Grasswrens, *Amytornis barbatus*. Regional ecosystem 5.3.18a is potential habitat for threatened fauna species including plains-wanderer *Pedionomus torquatus* and fierce snake (western taipan) *Oxyuranus microlepidotus*. It also provides wetland habitat for a wide range of water birds and other flora and fauna.	5.2.1	4
wm_nr_fl_08 *Key lakes and associated communities of the Mulga Lands Bioregion* 	The lakes of the Mulga Lands bioregion have a series of vegetation communities of limited extent related specifically to the lakes themselves. They are fringed by *Tecticornia* succulent shrublands, one of only two vegetation communities dominated by *Tecticornia* in the bioregion. A sporadic sedgeland, dominated by *Cyperus gymnocaulos*, is restricted to the lake fringes. A variable wooded community often occurs on the lake fringing lunettes from Lake Bindegolly, south to the Currawinya lakes. The lunette vegetation includes *Eucalyptus largiflorens* and *Acacia ligulata*, both species with limited extent in the bioregion.	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
wm_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with Gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4

Special Feature	Values	CIM	Rating
wm_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4
wm_nr_ec_02 *Natural artesian springs within existing wetlands* 	The expert panel identified artesian springs as significant wetlands having multiple values including endemic species, unique habitat values, connectivity to groundwater. The refugia nature of artesian springs has resulted in distinct flora and fauna assemblages including highly specialised and endemic species. Great Artesian basin springs are known to be evolutionary hotspots providing habitat for endemic plants, fish, snails and other invertebrates (Boyd 1990; Ponder 2002; Fensham and Fairfax 2003; Fensham and Price 2004; Fensham et al. 2004; Fairfax et al 2007) as well as refugia for non-endemic native plants isolated by over 500km from other populations (Fensham et al. 2004). Freshwater wetland areas containing unmodified modified springs were considered to have very high intrinsic conservation value.	6.1.1 6.3.1 6.4.1	4 4 4
wm_nr_ec_12 *Wyandra-Cunnamulla Claypans aggregation* 	The Wyandra-Cunnamulla claypans aggregation listed in Directory of Important Wetlands Australia as QLD166 (DAWE, 2021) is a vast cluster of ephemeral claypans and lakes to the east of Wyandra and Cunnamulla. This aggregation has an interesting mix of water chemistry with both saline and fresh water in many small waterbodies. The diversity of geology and hydrology provides for various vegetation communities including a mixture of canegrass, wooded and bare swamps. Little is known of the fauna of these wetlands, but they may support numerous waterbirds from various feeding guilds when they are full. For example, in very wet periods, such as during the 1990 floods, when all or most of the lakes are full, large numbers of ducks, pelicans and cormorants (among others) visit the larger lakes, some of them may breeding. The known breeders include pelicans and ibis. It is quite likely that migratory waders also make brief visits to the area during periods of inundation. Arid-zone invertebrates such as shield-shrimps and clam shrimps are common during inundation. Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3

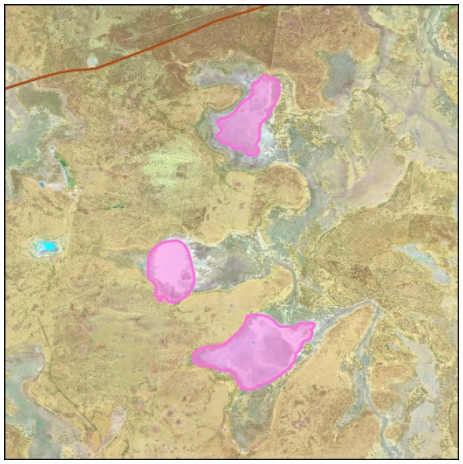
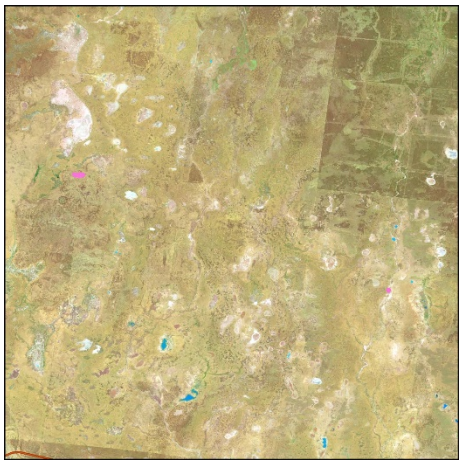
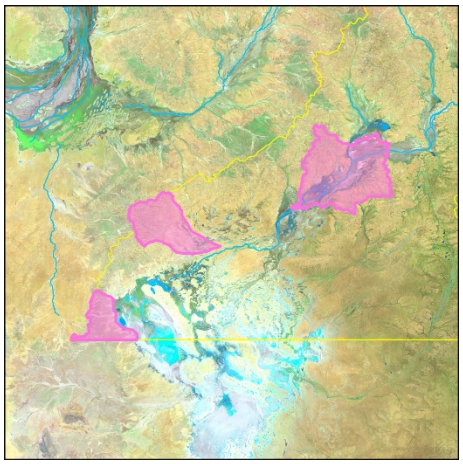
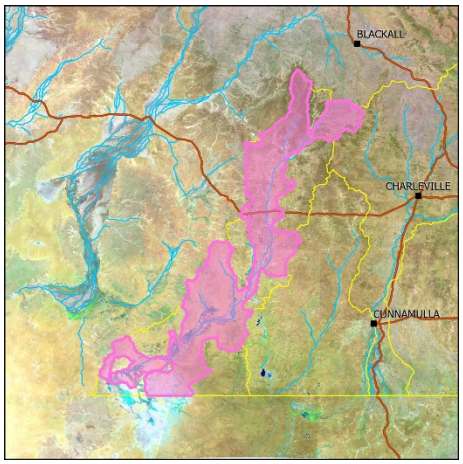
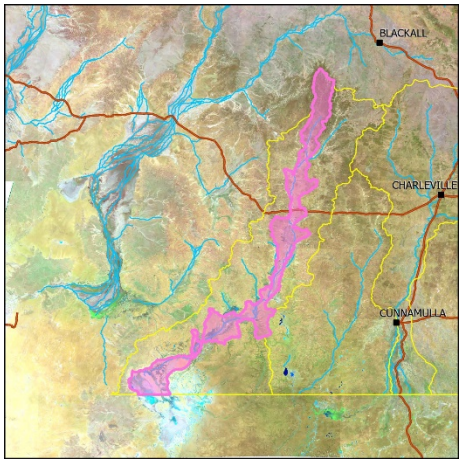
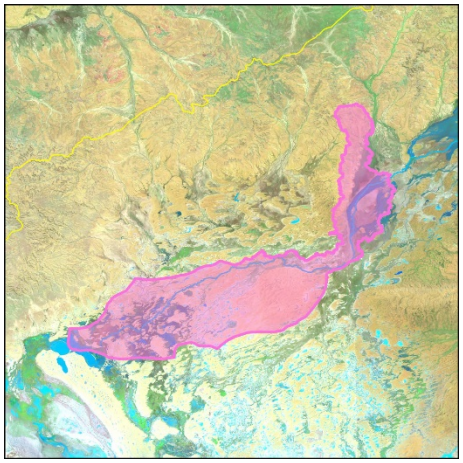
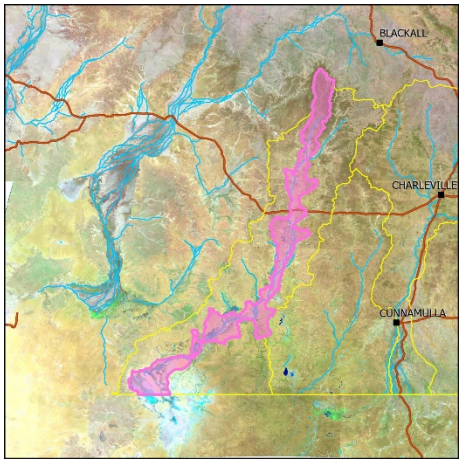
Special Feature	Values	CIM	Rating
wm_nr_ec_34 *Murrawondah Lakes* 	Three large ephemeral claypans and a number of smaller ones in the vicinity of Murrawondah Station, southeast of Cunnamulla are listed in Directory of Important Wetlands Australia as QLD174 (DAWE, 2021). Ephemeral claypans/lakes with an infrequent and unpredictable inundation regime (probably fill on year in 5-10). Probably less than half a metre deep.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
wm_nr_ec_38 *Myola - Mulga Downs Salt Lake and Claypans* 	Myola - Mulga Downs Salt Lake and Claypans wetland complex listed in Directory of Important Wetlands Australia as QLD173 (DAWE, 2021) includes a large, apparently saline, ephemeral lake and associated swamps and claypans, near the New South Wales border between Nebine Creek and the Cilgoa River floodplain. This system is likely dry during most years, only filling about once every 5-10 years, and then for only several months duration. It is likely that significant waterbird communities are present during extended periods of inundation, particularly at the salt lake. These may consist of significant numbers of waders, including trans-equatorial migratory species listed in the Japan-Australia and China-Australia Migratory Birds Agreements. Low samphire shrublands often provide habitat for chats (*Epthianura spp.*), and if present here, these birds would be nearing the eastern limits of their distributions.	6.3.2 8.2.5	3 3
wm_nr_ec_44 *Non-riverine refugia wetlands - slightly modified hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	3 3

Table 29. Bulloo Riverine flora and ecology special features

Special Feature	Values	CIM	Rating
ul_r_fl_01 *Riparian ecosystems with significant habitat values* 	Major watercourses in the Mulga Lands and Channel Country bioregions are the key sources of water and nutrients in these dry landscapes, particularly for nutrients in the Mulga Lands which if generally very poor in nutrients. Riparian ecosystems including fringing riverine wetlands along these rivers were identified by the panel as having significant ecological values including high flora and fauna diversity particularly birds and mammals.	5.2.1	4
ul_r_fl_04 *Freshwater wetlands (billabongs) - riverine systems* 	This expert panel decision is implemented using regional ecosystems 6.3.3a in the Mulga Lands Bioregion, and 5.3.20a and 5.3.20b in the Channel Country bioregion. Regional ecosystem 6.3.3a (waterholes in drainage lines) special values include high fauna diversity, particularly bird and mammal (including Koala - Gordon et al. 1988) species. This regional ecosystem captures the larger more-permanent waterholes which provide important wetland and fauna refuge habitat. It is also floristically rich with more than 100 species/500m2. Regional ecosystems 5.3.20a (open woodland fringing waterholes connected to braided channel systems) and 5.3.20b (open woodland fringing waterholes in major river systems) special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*.	5.2.1	4

Special Feature	Values	CIM	Rating
ul_r_ec_04 *Waterways feeding wetlands of key ecological significance across the state border* 	The decision captures selected reaches of a number of creeks and rivers known to feed wetlands with high biodiversity value across the QLD state border. Collectively these riverine systems have good longitudinal connectivity, diverse fish communities, support important waterbird habit, and provide ecosystem services further down the Darling system. This decision includes selected reaches of the Paroo River (below the confluence of the Paroo River and Yowah Creek), Cuttaburra Creek (below Cunnamulla), selected reaches of the Warrego River (below Cunnamulla), and the riverine spatial units traversed by the Bulloo River. Cuttaburra Creek is an important channel connecting the Warrego River to the lower Paroo. River red gum, coolabah and river cooba grow along channels and wetland areas. In wet years, waters of the Warrego River system may flow through Cuttaburra Creek to the lower reaches of the Paroo River across the border. This process is important for gene flow and supporting large, nationally important terminal swamps and storages across the border (Yantabulla Swamp). The Paroo and Narran Rivers feed RAMSAR wetlands across the border in NSW.	6.1.1 6.2.1 6.3.3	4 4 4
ul_r_ec_06 *Riverine drought refugia (Very High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Very High (4) and High (3) classes were used for this decision. Spatial units in the Medium class were used for Riverine drought refugia (High relative value) decision (i.e. ul_r_ec_45).	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 4
ul_r_ec_23 *Freeflowing rivers* 	The Paroo and Bulloo rivers are undoubtedly some of the last free flowing rivers, particularly in the Murray-Darling Basin. Hence they have many special and unique special features including relatively natural hydrological process, ecological functioning and instream habitat. The Bulloo system river is also significant due to the lack of exotic fish including carp.	6.1.1 6.3.1 6.3.3 6.4.1	4 4 4 4

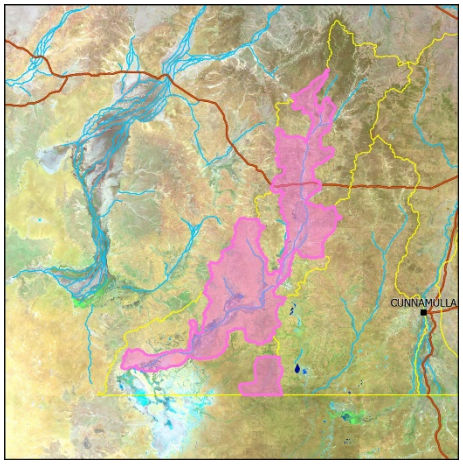
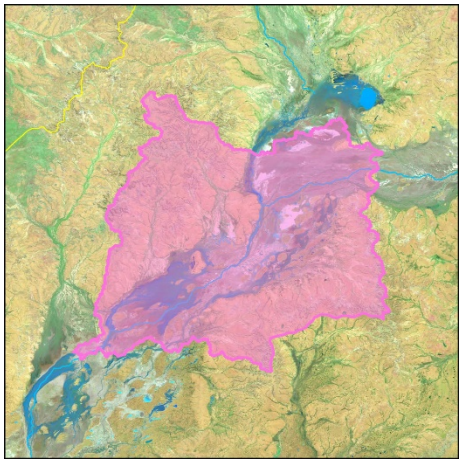
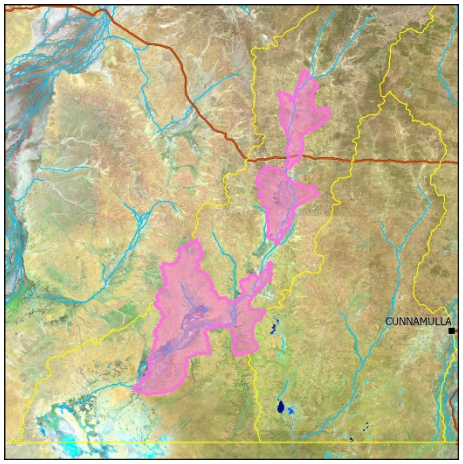
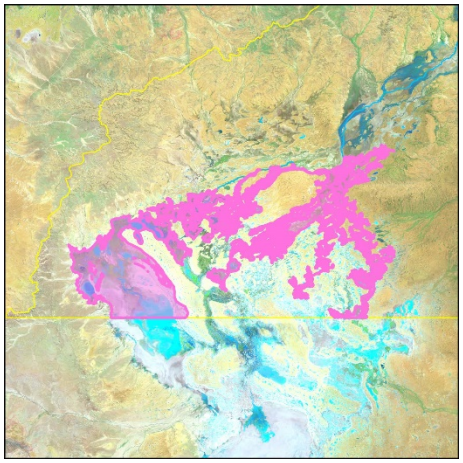
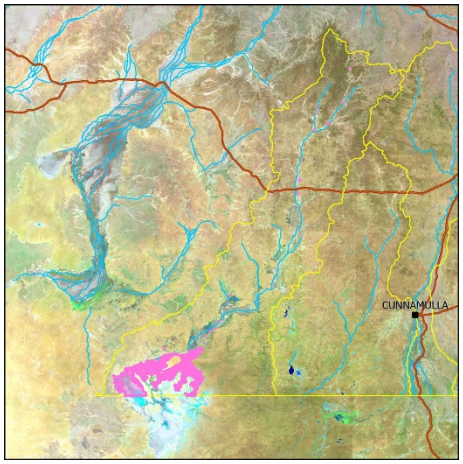
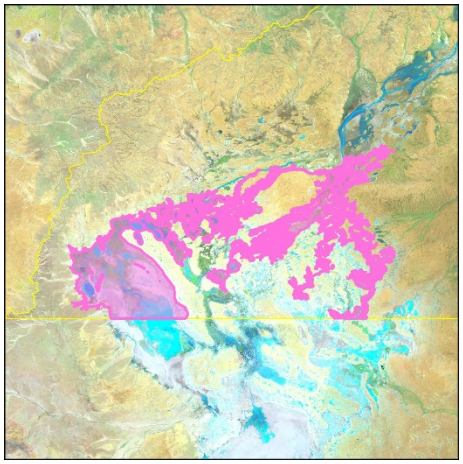
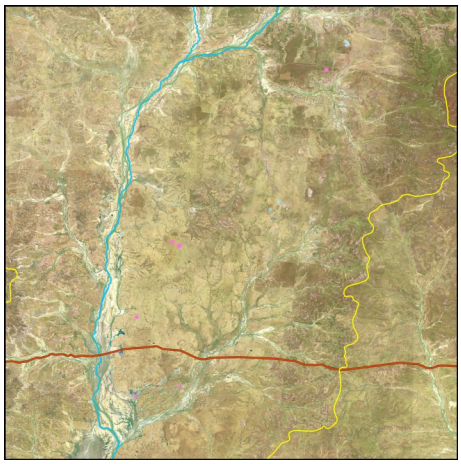
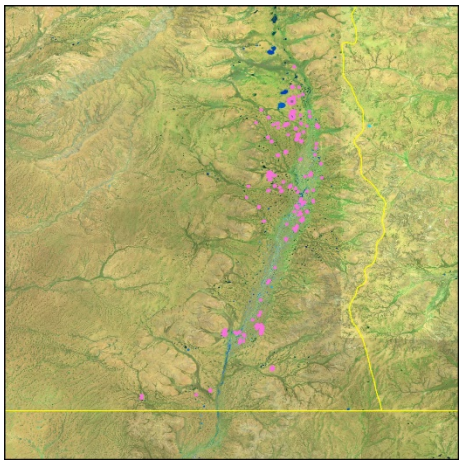
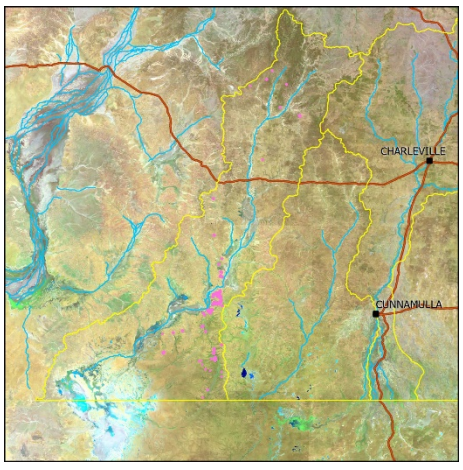
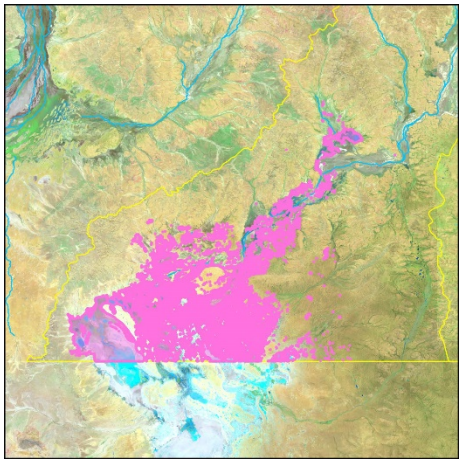
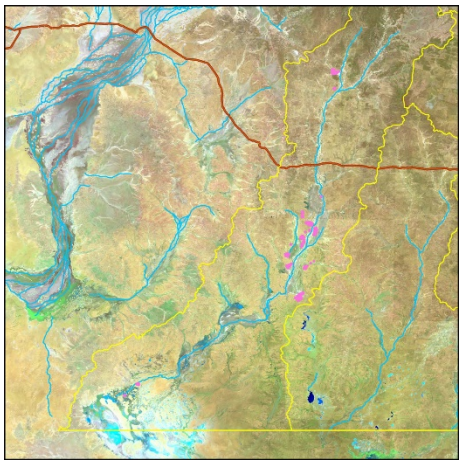
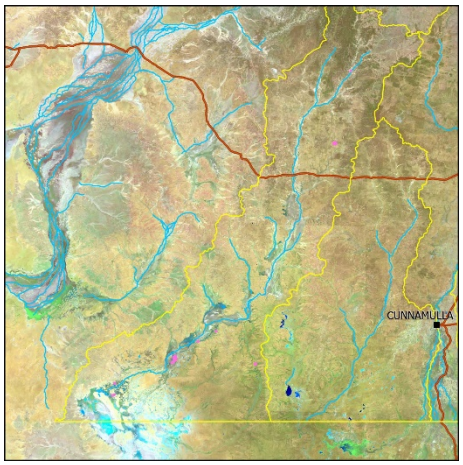
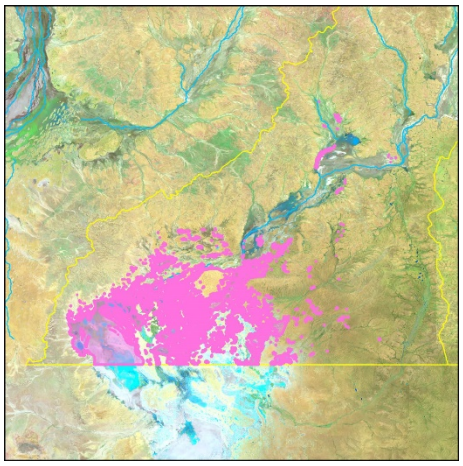
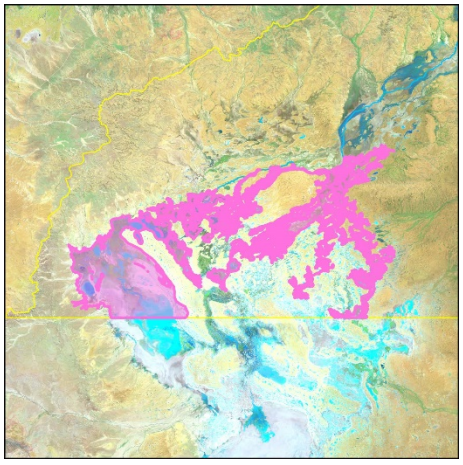
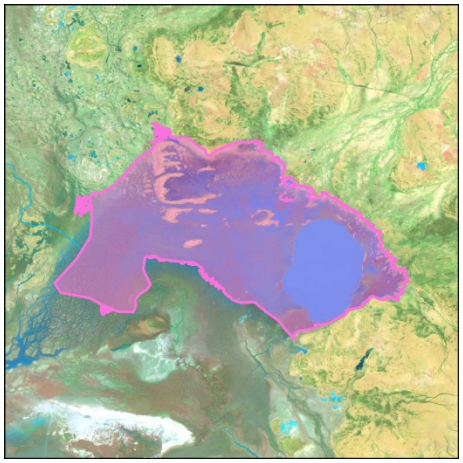
Special Feature	Values	CIM	Rating
ul_r_ec_24 *Semi-permanent waterholes (riverine)* 	Drought refugia are an important feature in a semi-arid landscape. Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). Other values include *Tandanus* (Ell tailed catfish). This decision was implemented using Water Observations from Space published by Geoscience Australia.	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3
ul_r_ec_41 *Nooyeah Downs Swamps Aggregation* 	The Nooyeah Downs Swamps Aggregation listed in Directory of Important Wetlands Australia as QLD041 (DAWE, 2021) is the floodplain and swamps along the right-hand channel section of the Bulloo River. Major habitat types include lignum (*Muehlenbeckia florulenta*) open shrubland dominates the swampy areas and coolabah (*Eucalyptus coolabah*) open woodland occurs adjacent to channels. These large swamps are typical of Channel Country landforms. A number of birds listed under JAMBA and CAMBA have been recorded from this aggregation, including the great egret (*Ardea alba*), rainbow bee-eater (*Merops ornatus*) and glossy ibis (*Plegadis falcinellus*). Implemented as a riverine special feature. The special values captured by the expert panel decision only occupy the north-eastern part of the spatial unit and are centred on 143.385°E 28.126°S.	6.3.2 8.2.5	3 3
ul_r_ec_45 *Riverine drought refugia (High relative value)* 	Drought refugia are an important feature in a semi-arid landscape. Values include *Tandanus* (Ell tailed catfish). Fish populations depends refugial waterholes to survive drought (resistance) and are where surviving fish repopulate the rivers by recruitment and dispersal once flow returns (resilience). This decision was implemented using persistent waterhole mapping help by DES. The percentage length of persistent waterholes per riverine spatial unit was calculated using Geofab v2.1 watercourses and DES persistent waterhole mapping. The Jenks Natural Breaks classification algorithm was used to categorise spatial units into four classes (i.e. Very High, High, Medium, Low). Spatial units in the Medium class were used for this decision. Spatial units in the Very High and High class were used for Riverine drought refugia (Very High relative value) decision (i.e. ul_r_ec_06).	6.1.1 6.2.1 6.3.1 6.3.4	3 3 3 3

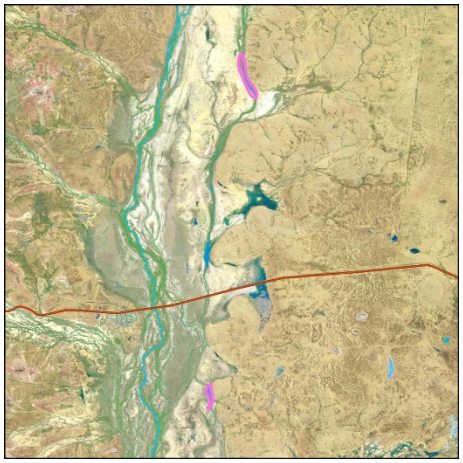
Table 30. Bulloo Non-Riverine fauna, flora and ecology special features

Special Feature	Values	CIM	Rating
ul_nr_fa_03 *Bulloo Lake - significant waterbird habitat* 	Bulloo Lake is a vast and terminal flood out of the Bulloo catchment. This wetland complex provides habitat for significant numbers of waterbirds. For example, 300,000 non-breeding waterbirds have been recorded in historical surveys. The lake is also used by freckled ducks and as stopover for migratory waders. It is also a stronghold for the grey grasswren subspecies.	5.1.4	3
ul_nr_fl_02 *Freshwater wetlands (billabongs) - non-riverine systems* 	This expert panel decision is implemented using regional ecosystems 11.3.27 (and all associated regional ecosystem vegetation communities) in the Brigalow Belt bioregion, 6.3.1a in the Mulga Lands bioregion, and 5.3.20c in the Channel Country Bioregion. Regional ecosystem 11.3.27 special values include habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Regional ecosystem 6.3.1a special values include high fauna diversity, particularly mammal and bird species. Regional ecosystem 5.3.20c special values include drought refuge and water bird habitat including habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. An equivalent riverine expert panel decision (ul_r_fl_04) uses regional ecosystems 6.3.3x1 (v12.1 regional ecosystem mapping), 6.3.3a, 5.3.20a and 5.3.20b.	5.2.1	4
ul_nr_fl_07 *Bulloo Lake cane grass swamps* 	The Bulloo Lake cane grass swamps are bigger and more extensive in area than elsewhere in the QMDBB. A significant proportion extends into northern NSW. Implemented using regional ecosystem 5.3.16b. Special values include habitat for threatened fauna species including grey grass wren (*Amytornis barbatus*). This decision is only applicable to the areas of cane grass swamp within the selected non-riverine spatial unit (ul_w04348). This can be identified by overlaying Queensland Wetland Mapping wetland areas with a WETRE of 5.3.16b.	5.2.1	3

Special Feature	Values	CIM	Rating
ul_nr_fl_10 *Poplar Box swamps* 	This special feature captures a series of palustrine wetlands not captured by other QMDBB ACA decisions. It is based on regional ecosystems: 6.3.24a, which is unique being the only swamp with Poplar Box in the Mulga Lands bioregion; 6.3.12, which is the only swamp with Gidgee and *A. microsperma* in the Mulga Lands; 11.3.2, which is a poplar box grassy woodlands on alluvial plains and habitat for threatened flora species *Homopholis belsonii*, as well as suitable habitat for koalas (*Phascolarctos cinereus*). Artificial wetlands within the area were assigned a rating of 2.	6.1.1 6.2.1 6.3.1 6.3.3 6.3.4	3 3 4 4 4
ul_nr_fl_12 *Tecticornia closed depressions in reticulate dunes* 	*Tecticornia* is a genus of succulent, salt tolerant plants, commonly referred to as samphires and which are largely endemic to Australia. Vegetation communities associated with this decision are a very specific form of vegetated palustrine wetland in closed depressions with a restricted distribution, related to reticulate dune fields in the Paroo and Bulloo catchments. In addition, these are one of only two vegetation communities supporting *Tecticornia* and associated species in the Mulga Lands bioregion. Situated on alluvium, the most fertile part of this semi-arid landscape, these ecosystems trap water for extended periods, leading to high species diversity.	5.2.1	4
ul_nr_fl_13 *Herbland closed depressions, not on alluvium - open herblands on clays, associated with ephemeral lakes, billabongs and permanent waterholes* 	Regional ecosystem 6.3.11 (*Eleocharis pallens* + short grasses + *Eragrostis australasica* open forbland clay associated with ephemeral lakes: billabongs and permanent waterholes) sits on broad sand sheets. These ecosystems trap water for longer times and are associated with a diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Artificial wetlands within the area were assigned a value of 2.	5.2.1	2

Special Feature	Values	CIM	Rating
ul_nr_fl_14 *Bluebush swamp, with or without Lignum on alluvium* 	These sparse to open low shrub land occur in depressions on flood plains, braided channels, interdune flats, clay pans and clay plains and were identified by the experts as having significant flora and fauna values including important seasonal water bird habitat. Regional ecosystem 6.3.11x1 (v12.1 regional ecosystem) sits on alluvium, the more fertile and wet parts of the landscape. Centres of diversity including diverse and abundant invertebrate and water bird fauna (Kingsford et al. 2001, Timms 2006). Regional ecosystem 4.3.24 (Seasonal swamps. *Chenopodium auricomum* +/- *Duma florulenta* dwarf shrubland in closed depressions on floodplains) is habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. Regional ecosystem 5.3.12b provides wetland water bird habitat including potential habitat for threatened fauna species including freckled duck *Stictonetta naevosa*. It is also habitat for Grey Grasswrens, *Amytornis barbatus*. Regional ecosystem 5.3.18a is potential habitat for threatened fauna species including plains-wanderer *Pedionomus torquatus* and fierce snake (western taipan) *Oxyuranus microlepidotus*. It also provides wetland habitat for a wide range of water birds and other flora and fauna.	5.2.1	3
ul_nr_fl_15 *Lignum Wetlands (Bulloo Catchment)* 	Wetlands that contain lignum (*Muehlenbeckia florulenta*) provide significant habitat values (including water bird breeding habitat when in expansive stands) and habitat for threatened fauna species including the freckled duck (*Stictonetta naevosa*). Lignum may also be a strong driver/indicator of healthy wetlands. Experts noted that lignum is often a sub-component of *Eucalyptus coolabah* and there is likely a lot more lignum, including dense lignum, present in the study areas and that is not mapped.	5.2.1	3
ul_nr_ec_01 *Non-riverine refugia wetlands - natural hydrology* 	Drought refugia are important features in a semi-arid landscape. The mapped wetlands were identified by selecting non-riverine spatial units intersecting grid cells classified as "wet" 70% to 100% of the time across Geoscience Australia's Wetland Observations from space filtered summary Landsat timeseries product.	6.3.1 6.4.1	4 4

Special Feature	Values	CIM	Rating
ul_nr_ec_17 *Temporary claypan wetlands* 	Several temporary claypan wetlands that are not fed by rivers, have different biota adapted to different desiccation cycles e.g., fairy shrimp. Temporary claypan swamps are also an important feeding and breeding site for waterbirds. These wetlands are generally rainfall fed and not very permanent i.e. only fill after a one in ten year flood. For the majority of the time these wetlands are dry and are susceptible to cattle damage and woody debris removal. The regional ecosystems associated with this decision include: 5.3.13b, 5.3.15a, 5.3.15b, 5.3.16a, 5.3.22a, 5.3.8b, 5.3.22d.	5.2.1	3
ul_nr_ec_18 *Bulloo Lake* 	The Bulloo Lake listed in Directory of Important Wetlands Australia as QLD024 (DAWE, 2021) is a large terminal lake that extends across the Queensland and NSW border. This wetland complex includes a large ephemeral lake, swamps and floodplains at the terminus of the Bulloo River. The lake is free of exotics and provides significant habitat values including habitat for significant numbers of waterbirds. Notable flora and fauna include tall lignum shrublands representative of Channel Country wetlands, freckled duck (*Stictonetta naevosa*) and grey grasswren (*Amytornis barbata*). A number of birds listed under JAMBA and CAMBA have also been recorded from this aggregation. This special feature picks up both the lake and adjacent and connected swamps and floodplain wetlands. Bulloo Lake is one of four large terminal lakes in the Queensland Murray-Darlin Basin catchments. Large terminal lakes are a unique geomorphic feature and important due to their isolation/lack of connectivity for most of the time creating unique ecological (biotic/abiotic) settings.	6.1.1 6.2.1 6.3.1 6.3.2 6.4.1 8.2.5	3 3 3 3 3 3
ul_nr_ec_19 *Lake Bullawarra* 	Lake Bullawarra listed in Directory of Important Wetlands Australia as QLD031 (DAWE, 2021) is a broad, shallow playa lake surrounded by low gradient floodplains and low lying swamps with anastomosing channels (Blackman et al 1999). When full the lake has a shallow open water area of some 1000 ha and is a significant water resource in an otherwise dry area. This lake is likely to provide significant drought refuge. The lake also contains an isolated, extralimital occurrence of black box *Eucalyptus largiflorens* (Blackman et al 1999). A number of birds listed under international conventions on migratory species (i.e. JAMBA, CAMBA) including the great egret (*Ardea alba*), rainbow bee-eater (*Merops ornatus*) and glossy ibis (*Plegadis falcinellus*) have been recorded in this location.	6.3.1 6.3.2 8.2.5	3 3 3

Special Feature	Values	CIM	Rating
ul_nr_ec_39 *Quilpie (Bulloo River Floodplain) Waterholes* 	The Quilpie (Bulloo River Floodplain) Waterholes listed in Directory of Important Wetlands Australia as QLD167 (DAWE, 2021) encompasses a series of permanent large waterholes or small lakes on the Bulloo River floodplain. One (Como Hole) is in the Bulloo River channel, north of Quilpie, the others (Lakes Youngwoman, Nancy and Houdraman and Dora Dora Hole) are in a tributary which runs parallel to the Bulloo River, along its floodplain to the east of Quilpie. These large waterholes are all more-or-less permanent, being topped up in all but the very driest of years. This system represents a major concentration of deep, open-water habitats which provide significant drought refugia for aquatic biota in the northern Mulga Lands. The waterholes support a good population of waterbirds, including pelicans, cormorants, ducks, coots and various large and small waders (egrets, spoonbills, plovers, etc.). The emergent and floating aquatic vegetation community in this system is worthy of mention due to its relative diversity and uncommon occurrence in the Mulga Lands. The northern (inflow) end of Lake Houdraman supports a small (several hectares) swamp forest of red gum and coolabah over dense, tall lignum. This community type is also uncommon in the Mulga Lands bioregion.	6.1.1 6.2.1 6.3.1 6.3.2 8.2.5	3 3 3 3 3
Unable to be implemented as nr spatial units are not defined enough for the Eulo Artesian Springs Supergroup. *Eulo Artesian Springs Supergroup*	Centroid 28 degrees 14' S, 144 degrees 48' E; Eulo Supergroup listed in Directory of Important Wetlands Australia as QLD177 (DAWE, 2021) represents more than 40 springs or small groups of springs, scattered over an extensive area, mostly to the south-west of Eulo. Artesian springs, including many mound springs, arising from the Great Artesian Basin, south-west of Eulo. Many are extinct or have severely restricted flow rates. Several tens of ha spread over some 100,000 ha. Habitats include small open pools and seeps, with or without emergent aquatic vegetation. Main vegetation types are sedges and rushes, aquatic forbs, and, on some, salt tolerant plants. An endangered species of Hydrobiid snail (*Jardinella eulo*) is restricted to springs in this group.	6.1.1 6.2.1 6.3.1 6.3.2 5.1.4 8.2.5	3 3 3 3 3 3
Not implemented, consider for next version. *Bulloo extended flood regimes - high productivity*	Areas of the Bulloo floodplain where flood durations are prolonged resulting in increased productivity which is important for the boom \ bust food web. During flooding areas stay connected for significantly longer times e.g., up to 50 days. The panel was less confident of the conservation values of the Bulloo River catchment than for the Cooper Creek.	6.4.1	4

7 Connectivity

Aquatic ecosystem connectivity refers to the connections between and within aquatic ecosystems. An understanding of the connections between wetlands and broader catchment processes and functioning is important for effective management decisions (DEHP 2017).

The principles for measuring AquaBAMM aquatic connectivity was originally developed by the Burnett River Aquatic Conservation Assessment ecology expert panel (Clayton et al. 2006). Subsequent ecology expert panels have discussed the importance of connectivity, and the principals and approach concepts that could be used to determine wetland connectivity.

7.1 Importance of connectivity

The importance of connectivity processes to the health and functioning of Queensland Murray-Darling freshwater wetlands is well understood. An inherent connectivity (or lack of connectivity in drier periods) is a significant feature of Queensland's riverine and non-riverine wetlands. For example, in arid-zones and most riverine floodplains, an irregular flow regime resulting in sporadic wetland connectivity events underpins the conservation of instream and floodplain wetland biota such as invertebrate assemblages (Sheldon et al. 2002). Similarly, this relationship evident for maintaining the health and productivity of end-of-river estuarine systems (Cullen 2003). A largely unknown and unseen linkage can also occur within the hyporheic zone between surface waters and groundwater ecosystems sustaining many endemic or relictual invertebrate fauna (Boulton et al. 2003). The expert panel made the following general comments regarding wetland connectivity across the study areas:

a. Connectivity can occur at different temporal and spatial scales within and between study area catchments.
b. Under natural QMDBB conditions opportunities for fish movement and dispersal is frequently constrained by flow intermittency (e.g., on average less than 44% of the time (Marshall et al., 2016)).
c. Appropriate/pre-European connectivity remains very high in the Bulloo and Paroo study areas and low in all other study areas, threatening fish population viability in those catchments.
d. Flow intermittency is a key process in all QMDBB rivers especially in the west.
e. Lateral connectivity between the aquatic riverine system and adjacent ecosystems was recognised by the panel as an important value.
f. During low or no-flow periods, persistent waterholes provide reach scale refugia habitat for fish and other aquatic/semi-aquatic species (i.e., birds, reptiles, amphibians, invertebrates).
g. To assess connectivity appropriately, the components of an ecosystem, and the processes affecting them, must be considered.

7.2 Applying principles for measuring connectivity

Experts at the QMDBB ACA version 2.1 workshops agreed that connectivity should be considered as part of this ACA. Experts also noted that the practicalities of measuring connectivity for aquatic environments are complex, making general principles and spatially explicit models difficult to develop and implement.

Connectivity in its broadest meaning incorporates hydrological processes (quantity and quality, temporal and spatial variability), organism dispersal (barriers) and disturbances from natural conditions. Connectivity can be bi-directional movements within a stream (e.g., fish passage), uni-directional contributions to downstream areas, or lateral connectivity between instream areas and non-riverine floodplain wetlands or groundwater ecosystems. These aspects of connectivity combine to provide a matrix of competing and differing values from an ecological conservation viewpoint.

7.2.1 Inverse exponential scoring of spatial units

The inverse exponential connectivity scoring method was developed by the Burnett River Aquatic Conservation Assessment ecology expert panel (Clayton et al. 2006). The method uses the spatial units rather than a distance to determine how they are scored. Every contributing spatial unit above a target component (i.e. special feature) is logarithmically scored with the spatial units immediately upstream being scored a four, the next adjoining upstream spatial units received a score of two and the remainder of spatial units above a special feature were scored a one. The spatial unit having special features located within it does not receive a score because it is already scored under Criterion six (i.e., special and unique features), however it may receive a score where it is upstream of another special feature. Where a spatial unit had more than one calculation (i.e., overlapping scores), the maximum value was incorporated.

This method aims to reflect the importance of spatial units immediately above a special feature by applying a logarithmic threshold to scoring. It is an efficient and practical solution for a complex issue. A disadvantage of this model is that it treats all special features (e.g. macrophyte bed, geomorphological feature, hydrological feature) equally where there may be reasons to differentiate between them. Also, this model can result in some variation of the real distances upstream of a special feature being scored.

7.3 Connectivity Measures

7.3.1 Maintenance of significant species or populations

Measure 7.1.1 (The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/or 6) assesses the contribution (upstream or downstream) of each spatial unit to the maintenance of significant species or populations. The principles for assessing relative connectivity conservation scores for Measure 7.1.1 were developed by the ecology expert panel from the Burnett River Aquatic Conservation Assessment (Clayton et al. 2006).

This measure uses inverse exponential scoring of spatial units upstream of spatial units given a conservation rating of 4 by the QMDBB ACA version 2.1 flora, fauna and ecology expert panels due to presence of (1) significant waterbird habitat (M5.1.4), (2) distinct, unique, or special habitat (M6.3.1), and (3) significant wetland identified through and accepted method (i.e., RAMSAR, Directory of Important Wetlands Australia, World Heritage Areas – M6.3.2).

7.3.2 Migratory or routine fish passage

Measure 7.1.2 (Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit) assesses migratory or routine passage of fish and other fully aquatic species (upstream, lateral or downstream movement). This measure uses hydrological connectivity risk (hydro risk) scores produced by the DES Water Ecology/Planning team. The data uses fish barrier locations (Kerr et al. 2018), revised drown-out height thresholds, stream gauge data, and timing (peak drought followed by 2020 drought breaking flow event) to assess fish movement opportunities (drought resilience), resistance and risk. Drown-out heights used were based on water spilling over the barrier by 0.2m. Hydrological connectivity risk to fish population resilience was high to extreme for all but eight of the 96 river segments.

Hydro risk scores relate to the reduction in longitudinal connectivity days in the presence of an in-stream barrier. Scores are displayed as low (<50% loss of connectivity flows), moderate (>50% loss of connectivity flows), high (>70% loss of connectivity flows), extreme (100% loss of connectivity flows). These scores were converted to AquaBAMM ratings for Measure 7.1.2 as shown in Table 31.

Table 31. Hydro Risk score

Hydro Risk score	M7.1.2 rating
Low (<50% loss of connectivity flows)	4
Moderate (>50% loss of connectivity flows)	3
High (>70% loss of connectivity flows)	2
Extreme (100% loss of connectivity flows)	1

7.3.3 Maintenance of floodplain and wetland ecosystems with significant biodiversity values

Lateral connectivity between the aquatic riverine system and adjacent ecosystems was recognised by the panel as an important value. Measure 7.3.1 (The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6) assesses the contribution of each spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values.

The principles for assessing relative connectivity conservation scores for Measure 7.1.1 were developed by the ecology expert panel from the Burnett River Aquatic Conservation Assessment (Clayton et al. 2006). This measure uses inverse exponential scoring of spatial units upstream of spatial units given a conservation rating of 4 by the QMDBB ACA version 2.1 flora, fauna and ecology expert panels because due to the presence of (1) priority ecosystems (M5.2.1), (2) distinct, unique or special ecological processes (M6.2.1), or distinct, unique or special

ecological processes (M6.2.1) or ecologically significant wetlands identified through expert opinion and/or documented studies (M6.3.3).

7.3.4 Wetlands retaining critical ecological or hydrological connectivity with floodplains, rivers, groundwater etc.

Measure 7.3.2 (Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.) assesses the extent to which each spatial unit retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc. The principles for assessing connectivity values for Measure 7.3.2 were developed by the ecology expert panel from the Burnett River Aquatic Conservation Assessment (Clayton et al. 2006).

This measure uses inverse exponential scoring of spatial units upstream of spatial units given a conservation rating of 4 by the QMDBB ACA version 2.1 flora, fauna and ecology expert panels because due to the presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, etc.) (M6.4.1).

8 Stratification

AquaBAMM stratification attempts to mitigate the effect of data averaging across large study areas. Stratification is particularly useful when ecological diversity is high. For example, in the Wet Tropics bioregion stratification would be appropriate because higher numbers of native amphibian species (i.e. Measure 3.1.1 Richness of native amphibians (riverine wetland breeders)) are known to inhabit upland areas compared to adjacent lowland floodplains. Stratification is unwarranted for measures where there is an equal probability of species throughout the study area.

Study area stratification is not mandatory for a successful assessment. In fact, the AquaBAMM makes provision for one or more measures to be stratified in any manner determined to be ecologically appropriate. Decisions concerning how to stratify are typically considered by the ecology expert panel. To date, assessments have been stratified based on elevation (e.g. 150m ASL for coastal catchments and 400 m ASL for catchments west of the Great Dividing Range in the Murray-Darling Basin) or bioregional boundaries.

For the Queensland Murray-Darling and Bulloo Basins, the ecology expert panel noted that fish, invertebrates and some frog assemblages are likely affected by elevation. The experts also noted that differences in flow regimes and water chemistry can exist between creeks, which may affect fish diversity.

On the panel's advice we stratified the Condamine-Balonne and Border Rivers study areas for the purpose of assessing like systems for Measures 3.1.1 (Richness of native amphibians (riverine wetland breeders), 3.1.2 (Richness of native fish) and 3.1.6 (Richness of native amphibians (non-riverine wetland breeders). The study areas were each stratified into two strata including uplands and lowlands based on the 400m ASL boundary (Figure 1).

Subsections and non-riverine wetlands were assigned to each stratum based on a majority rule (i.e. >= 50%). For example, riverine subsections were assigned the stratum containing the majority of the subsection; non-riverine spatial units were assigned the stratum of the subsection containing the majority of the non-riverine spatial unit.

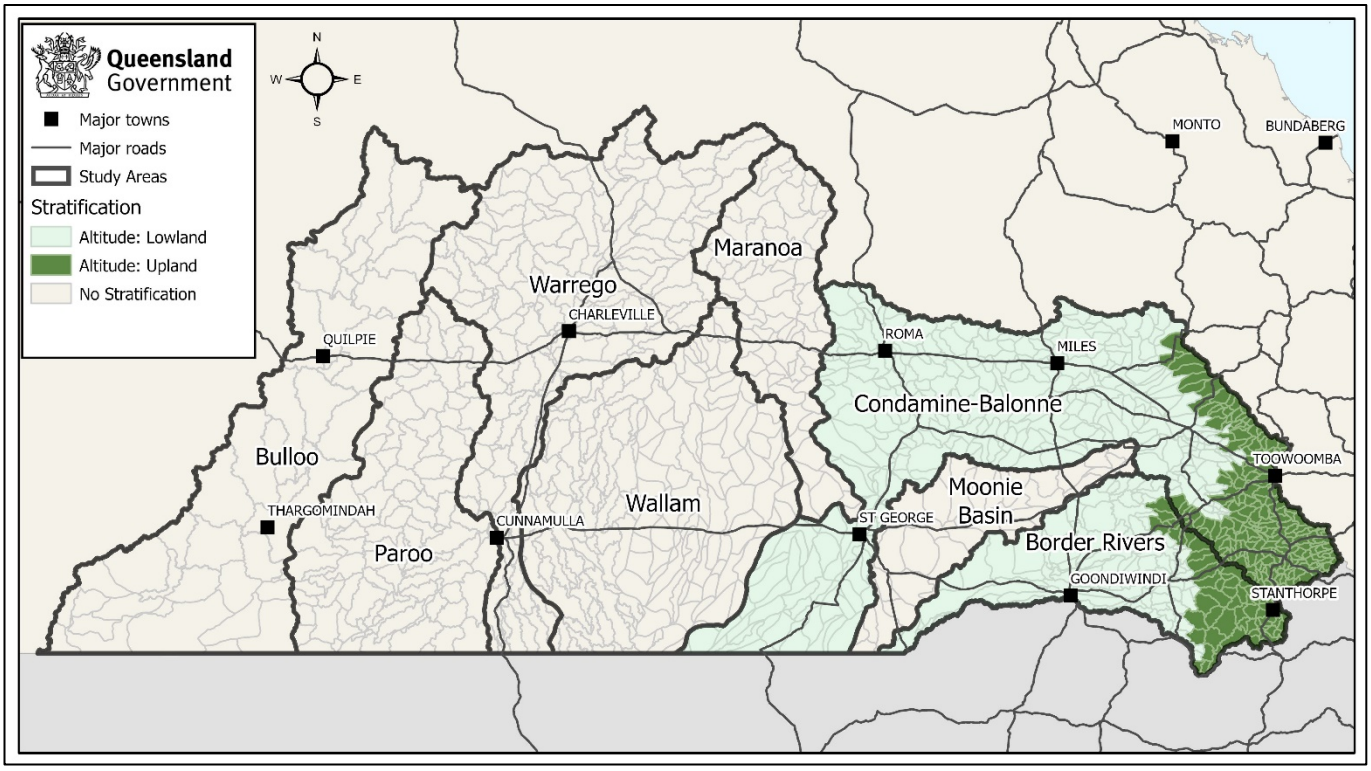


Figure 1. Stratification of spatial units based on 400m above sea level

9 Discussion

AquaBAMM expert panel processes draw on the knowledge and experience of experts and are based on the premise of scientific reasoning, multiple lines of evidence, and consensus building. This process also allows unpublished or anecdotal data to be incorporated into the assessment.

Wetland systems assessed as part of the QMDBB ACA are based on mapping provided by the Queensland Wetlands Mapping Program (DES). Wetland systems below the scale or minimum threshold size of the Queensland Wetlands Mapping have not been assessed as part of the QMDBB assessments and will not be present in any special feature implementations. Finer scale mapping of non-riverine wetlands would ultimately allow for more precise delineation of non-riverine special features and connectivity values.

Aquatic Conservation Assessments, use riverine spatial units based on fine-scale riverine catchments to represent specific stream reaches or groups of reaches. As such, riverine special features may only apply to specific reaches, sections of reaches or discrete locations (e.g. instream waterholes) within a riverine spatial unit. Where possible, descriptions of the precise location and extent of riverine special features have been included with the riverine special feature value descriptions and this information can be used to facilitate interpretation. Finer scale riverine wetland area mapping similar to the non-riverine wetlands would allow more precise delineation of riverine special features and connectivity values.

Three expert panel workshops were held at the Queensland Herbarium mid 2021. The flora panel was held 28 May, the fauna panel 7 June and the ecology panel 8 June. At these workshops experts helped to identify native and exotic aquatic dependent species used to calculate measures within AquaBAMM Criteria 1, 2, 3, 4 and 5. Experts also helped to identify significant bird habitat areas and priority ecosystems used for measures within Criterion 5, representative wetland types for Criterion 8 and special features for Criterion 6.

This report lists the aquatic dependent species compiled for the QMDBB. In total, the expert panels identified the following number of flora and fauna species relevant to the freshwater wetlands of the QMDBB:

Fauna

- Native fauna - 45 amphibians, 23 fish, 13 reptiles, 87 freshwater waterbirds, 5 mammals, 17 rare or threatened fauna, 28 priority fauna species and 18 migratory birds.
- Exotic fauna - Nine exotic vertebrates

Flora

- Native flora - 384 aquatic or semi-aquatic plants, 60 priority flora species, 13 rare or threatened flora species.
- Exotic flora - 44 exotic terrestrial plants

A decision was made not to include a measure relating to invertebrate richness. The basis for this decision is due to a number of factors including:

- Insufficient sampling effort across any individual catchment. This applies to both spatial and temporal elements of sampling.
- Issues with taxonomic consistency which would make comparisons between wetlands within a catchment difficult.

The above lists can be used to inform species inventories, to plan survey work, and for natural resource management and development assessment processes.

Special features are a critical ecological component of any ACA. The flora, fauna and ecology expert panels were asked to identify special and unique features relevant to the riverine and non-riverine wetlands within each study area. In total, 75 riverine and 85 non-riverine special features were implemented. Unless specifically recommended by an expert panel, artificial wetlands were either not included or they were assigned a rating of 2 for special feature measures for the non-riverine ACA. With respect to highly modified and artificial wetlands, the panel considered ecological values to be transient, especially for artificial wetlands. Many H3 storages are for irrigated agriculture and any values may only be there until they are emptied. The values that have been assigned to the wetlands are meant to serve primarily as an ecological inventory and are valued as playing a role in a special feature. Their inclusion is not meant to imply any policy, protective or legislative requirements.

In total, 448 (35%) of the 1276 riverine spatial units were identified as having one or more special features. For the non-riverine wetlands assessment 10,455 (57%) of the 18,443 non-riverine spatial units were identified as having one or more special features. For each decision, AquaBAMM measures (i.e. values) nominated by the panel have been included and where applicable, species names and regional ecosystem codes have also been included. In some cases, threats contributing to known degradation have also been listed but were not systematically

addressed for all special features. The end user is encouraged to corroborate or ground truth any listed threats or degradation processes prior to use.

The panels had numerous discussions around ecological and species issues and definitions. The riverine wetlands of the Bulloo catchment were highlighted as being significant due to the lack of exotic fish species. The catchment was considered to have a relatively high biomass of native fish species in comparison to other catchments. Lignum is considered not well mapped across the QMDBB as it tends to be mapped as a sub-dominant RE as part of a floodplain or riverine WETRE feature. There was discussion on whether vagrants should remain in the migratory birds list. By definition, the panel defined a vagrant to be less than 10 records over 10 years. The panels agreed that translocated species should be treated as exotics – sleepy cod is a good example.

Suggested improvements to AquaBAMM methodology include:

- Cultural values were recorded in the special feature descriptions where noted by the expert panel. The experts highlighted that engagement with Traditional Owners should be undertaken where possible to assist with identifying ecological values. Unfortunately, time constraints meant that detailed engagement with Traditional Owners during the expert panel process was limited.
- The incorporation of more abundance data into some measures.
- More research is required to fill in the gaps of data and knowledge for the western catchments.
- A separate assessment for springs is warranted. This would require significant adaptation to AquaBAMM which was out of the scope of this assessment. It was suggested that other spring assessment methodologies may be more applicable.
- An audit of QLD waterbird surveys and mapping may enhance finer scale mapping.

10 References

Bean, A.R., 1997. Microcarpaea agonis (Scrophulariaceae), a new species from south-eastern Queensland. *Austrobaileya*, pp.149-151.

Blackman, J.G., Perry, T.W., Ford, G.I., Craven, S.A., Gardiner, S.J. and De Lai, R.J., 1999. *Characteristics of Important Wetlands in Queensland*. Environmental Protection Agency, Queensland.

Boulton, A.J, Humphreys, W.F, Eberhard, S.M., 2003, Imperilled subsurface waters in Australia: Biodiversity, threatening processes and conservation. *Aquatic Ecosystem Health and Management* 6: 41-54.

Boyd, W.E., 1990. Mound springs. In: *Natural History of the North East deserts*. M.J.Tyler, C.R. Twidale, M. Davies and Wells C.B. (Eds.) Royal Society of South Australia, Adelaide. Pp. 107-118

Capon, S, Rolls, R, James, C & Mackay, S., 2012, *Regeneration of floodplain vegetation in response to large-scale flooding in the Condamine-Balonne and Border Rivers, Final report to Cotton Catchment Communities CRC, Australian Rivers Institute*, Griffith University, Brisbane.

Chessman, B., 2003, *Signal 2iv: A Scoring System for Macro-Invertebrates ('water bugs') in Australian Rivers - User Manual*, Department of Environment Heritage, Canberra.

Clayton, P.D., Fielder, D.F., Howell, S., Hill, CJ., 2006, *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment*, Environmental Protection Agency, Brisbane.

Conrick, D., Cockayne, B., 2000, *Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual*, Queensland Department of Natural Resources, Freshwater Biological Monitoring Unit, Rocklea.

Covacevich, J.A. and McDonald, K.R., 1993. Distribution and conservation of frogs and reptiles of Queensland rainforests. *Memoirs of the Queensland Museum. Brisbane*, *34*(1), pp.189-199.

Covacevich, J. & Wilson, S., 1995. Land snakes. In, *Wildlife of Greater Brisbane* Ryan; M. (ed)., Queensland Museum, with Environmental Management Branch of Brisbane City Council: Brisbane. pp. 191-216

Cullen, P., 2003, The Heritage River Proposal – Conserving Australia's undamaged rivers. In: Aquatic Protected Areas. What works best and how do we know? *Proceedings of the World Congress on Aquatic Protected Areas, Cairns, Australia – August 2002*. (eds. J.P. Beumer, A. Grant and D.C. Smith) University of Queensland Printery, St Lucia: Queensland, Australia. pp. 513-520.

DEH 2005. *A directory of important wetlands in Australia*. 3rd edition. Department of Environment and Heritage, Australian Government. <http://www.deh.gov.au/water/wetlands/database/index.html>

DEHP 2017, *Connectivity and the landscape*, Wetland*Info*, Department of Environment and Heritage Protection, Queensland, accessed 6 December 2017, <https://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/landscape/>

Department of Agriculture, Water and Environment (DAWE). *Australian Wetlands Database.* Australian Government, accessed 2021. <https://www.awe.gov.au/water/wetlands/australian-wetlands-database>

DES 2014. *Currawinya Lakes—a wetland of international importance,* accessed 31 May 2022. <https://wetlandinfo.des.qld.gov.au/resources/static/pdf/resources/fact-sheets/fs-currawinya-ramsar-13-11-2014.pdf>

DES 2022. *Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Murray-Darling and Bulloo Basins: Summary Report, Version 2.1*. Department of Environment and Science, Queensland Government.

Fairfax, R., Fensham, R., Wager, R., Brooks, S., Webb, A. and Unmack, P., 2007. Recovery of the red-finned blue-eye: an endangered fish from springs of the Great Artesian Basin. *Wildlife Research*, *34*(2), pp.156-166.

Fensham, R.J., 2006, Spring wetlands of the Great Artesian Basin, *paper for the 2006 Australian State of the Environment Committee,* Department of Environment and Heritage, Canberra.

Fensham R.J., Fairfax R.J., 2003 Spring wetlands of the Great Artesian Basin, Queensland, Australia. *Wetl Ecol Manag* 11:343–362

Fensham R., Fairfax R., 2005, *Great Artesian Basin Water Resource Plan. Ecological Assessment of GAB springs in Queensland*, Report for the Department of Natural Resources and Mines, Queensland Environmental Protection Agency, Brisbane.

Fensham R.J. and Price R.J., 2004. Ranking spring wetlands in the Great Artesian Basin of Australia using endemicity and isolation of plant species. *Biological Conservation*, *119*(1), pp.41-50.

Fensham R.J., Fairfax R.J., Sharpe P.R., 2004 Spring wetlands in seasonally arid Queensland: floristics, environmental relations, classification and conservation values. *Australian Journal of Botany* 52:583–595

Gordon G., Brown A. S., Pulsford T., 1988 A koala (*Phascolarctos cinereus Goldfuss*) population crash during drought and heatwave conditions in south-western Queensland. *Australian Journal of Ecology, 13(4), pp. 451-461*

Hando R. and Hando V., 1997 Going bush with Chinchilla Nats: thirty years of field observations. *Chinchilla Field Naturalists Club*. Chinchilla, QLD.

Healthy Waterways 2014-004, *Healthy Waterways Report Card Methods – How are the grades calculated?* Healthy Waterways, Brisbane. < https://hlw.org.au/report-card/>

Kerr J., Kimball A., Prior A., Ellaway C. & Luke L., 2018. *Barriers to fish passage in the Queensland Murray-Darling Basin* - A report for the south-west Queensland Environmental Flows Assessment Program. Brisbane.

Kingsford, R.T. and Porter, J.L., 1994. Waterbirds on an adjacent freshwater lake and salt lake in arid Australia. *Biological conservation*, *69*(2), pp.219-228.

Kingsford R.T. and Porter J.L., 1999. *Wetlands and waterbirds of the Paroo and Warrego Rivers. In A Free Flowing River: The ecology of the Paroo River*. R. T. Kingsford (Ed). New South Wales National Parks and Wildlife Services, Sydney. 23-50.

Kingsford, R.T., Thomas, R.F. and Curtin, A.L., 2001. Conservation of wetlands in the Paroo and Warrego River catchments in arid Australia. *Pacific Conservation Biology*, *7*(1), pp.21-33.

Marshall, J.C., Menke, N., Crook, D.A., Lobegeiger, J.S., Balcombe, S.R., Huey, J.A., et al. 2016. Go with the flow: the movement behaviour of fish from isolated waterhole refugia during connecting flow events in an intermittent dryland river. *Freshwater Biology*. 61, 1242–1258. <http://dx.doi.org/10.1111/fwb.12707>

Marshall J., Blessing J., Clifford S., Hodges K., Negus P., Steward A. 2019. Ecological impacts of invasive carp in Australian dryland rivers. *Aquatic Conservation: Marine and Freshwater Ecosystems*. John Wiley & Sons, Ltd. 2019;29:1870–1889.

Pearn, J., 1987. The rough-scaled snake (*Tropidechis carinatus*). In *Toxic Plants and Animals. A Guide for Australia* (pp. 471-479). Queensland Museum Brisbane.

Ponder, W.F., 2002, May. Desert springs of the Australian Great Artesian Basin. In *Proceedings of the meeting on Spring-fed wetlands: important scientific and cultural resources of the intermountain region* (pp. 7-9).

Power, R. E., Biggs, A. J. W., & Burton, D. W. G. 2007. *Salinity audit-Warrego and Paroo catchments, Queensland Murray-Darling basin*. Toowoomba: Department of Natural Resources and Water.

Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts (2020) *QLD Springs Dataset 2019*. <https://www.data.qld.gov.au/dataset/springs/resource/4cdc89ef-b583-446e-a5c7-0836a91a3767>

Sheldon, F., Boulton, A.J., Puckridge, J.T., 2002 Conservation value of variable connectivity: aquatic invertebrate assemblages of channel and floodplain habitats of a central Australian arid-zone river, Cooper Creek. *Biological Conservation* 103: 13-21.

Shine R. & Charles N. (1982). Ecology of the Australian elapid snake *Tropidechis carinatus*. *Journal of Herpetology* 16(4):383–7.

Timms, B.V. and McDougall, A., 2006. Changes in the waterbirds and other biota of Lake Yumberarra, an episodic arid zone wetland. *Wetlands Australia Journal*, *22*(1), pp.pp-11.

Timms, B. V., Booth, C. J., Newman, M.3 & McCann, J. A. 2020 The Ecology Of Gnammas (Weathering Pits) On The Stanthorpe Plateau, Northern New England Tablelands, With Special Reference To The Clam Shrimp *Paralimnadia Urukhai* (Webb & Bell) (Crustacea: Branchiopoda: Spinicaudata). Proceedings of The Royal Society of Queensland

Venz, M., Mathieson, M. and Schulz, M., 2002. *Fauna of the Dawson River Floodplain*. Queensland Parks and Wildlife Service.

Appendix I – Expert Panel Terms of Reference

Flora Expert Panel Terms of Reference

The role of the Flora Expert Panel is to provide expert advice on aquatic floristic values for the waterways and wetlands of the study area. This advice is a critical component of the Aquatic Conservation Assessment (ACA).

The panel membership will consist of experts in the field of aquatic flora values including species, communities and processes.

The advice provided by the expert panel at the workshop will be incorporated into the ACA results where appropriate.

The tasks to be undertaken by the panel include, but without limitation, the following:

- Review relevant existing spatial data (species point records) and available information (reports etc.).
- Provide advice on aquatic dependent rare or threatened flora species habitat and localities.
- Provide advice on aquatic dependent priority flora species habitat and localities.
- Identify priority ecosystems or areas important for significant flora communities or species.
- Provide advice on aquatic dependent exotic flora species localities and abundance.
- Weight Measures relative to their importance for an Indicator. Due to time this was not considered by the panel.
- Rank Indicators relative to their importance for a Criterion. Due to time this was not considered by the panel.

Fauna Expert Panel Terms of Reference

The role of the Fauna Expert Panel is to provide expert advice on aquatic fauna values for the waterways and wetlands of the study area. This advice is a critical component of the Aquatic Conservation Assessment (ACA).

The panel membership will consist of experts in the field of aquatic fauna values including species, communities and processes.

The advice provided by the expert panel at the workshop will be incorporated into the ACA results where appropriate.

The tasks to be undertaken by the panel include the following:

- Review relevant existing spatial data (species point records) and available information (reports etc.).
- Provide advice on aquatic dependent rare or threatened fauna species habitat and localities.
- Provide advice on aquatic dependent priority fauna species habitat and localities.
- Identify priority ecosystems or areas important for significant faunal communities or species.
- Provide advice on aquatic dependent exotic fauna species localities and abundance.
- Weight measures relative to their importance for an Indicator. Due to time this was not considered by the panel.
- Rank Indicators relative to their importance for a Criterion. Due to time this was not considered by the panel.

Ecology Expert Panel Terms of Reference

The role of the Ecology Expert Panel is to provide expert advice on aquatic values for the freshwater wetlands and waterways of the study area. This advice is a critical component of the Aquatic Conservation Assessment (ACA) and is based on experience and demonstrated scientific theory on natural geological, geomorphological and hydrological processes as well as identifying connectivity within and between aquatic systems.

The panel membership consists of experts in the fields of ecological and hydrological processes, geomorphology, connectivity, water quality and river health assessment.

The advice provided by the expert panel at the workshop will be incorporated into the ACA results where appropriate.

The tasks to be undertaken by the panel include the following:

- Identify areas of significant geomorphological, ecological or hydrological values (Special Features).
- Provide advice on biodiversity areas of particular significance for species or communities.
- Provide advice on identifying and applying the Connectivity Criterion for the study area.
- Provide advice on whether to stratify the study area.
- Weight measures relative to their importance for an Indicator. Due to time this was not considered by the panel.
- Rank Indicators relative to their importance for a Criterion. Due to time this was not considered by the panel.

Appendix II – Expert Panel Definitions

Flora Expert Panel

Wetland indicator Species (WIS)

Flora wetland indicator species are those species that are adapted to and dependent on living in wet conditions for all (aquatic species) or part (semi-aquatic species) of their life cycle and are found either within or immediately adjoining a riverine, non-riverine or estuarine wetland.

This definition of a flora wetland indicator species extends beyond the more traditional definition of submerged and floating aquatic plants to include plants inhabiting the littoral zone (water's edge) and plants that usually have 'wet feet' on the toe of the bank and other ground-water dependent species. The definition is designed to depict floristic richness at a given location.

For additional information on Flora Wetland Indicator Species, go to:

http://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/flora/flora-indicator-species-list.html

Aquatic Species (QLD Herbarium definition)

Aquatic flora species are defined as those growing in or on permanent water (obligate).

Semi-aquatic Species (QLD Herbarium definition)

Semi-aquatic flora species are defined as those that can withstand near-permanent shallow water and require only periodic temporary inundation – bordering permanent water, in bogs and shallow swamps.

Priority Species (Flora)

A priority species is not listed as Endangered, Vulnerable or Near-threatened and exhibits one or more of the following significant values:

1. It forms significant macrophyte beds (in shallow or deep water)
2. It is an important/critical food source
3. It is important/critical habitat
4. It is implicated in spawning or reproduction for other fauna and/or flora species
5. It is at its distributional limit or is a disjunct population
6. It provides stream bank or bed stabilisation or has soil-binding properties
7. It is a small population and subject to threatening processes
8. Taxa vulnerable to impacts of climate change - Species that are considered to be adversely affected by the predicted changes in climate, e.g. increasing temperatures, sea level rise and increasing frequency of extreme weather events (drought, flood & cyclones). Species can only be listed under this reason if there is sufficient knowledge of species' biology and its interaction with climate that would support an assessed impact under climate change scenarios.

Exotic Flora

Exotic flora species are defined as plants that cause, or have the potential to cause, significant detrimental impact on wetland ecosystems. Impact examples include outcompeting native species for light, air, space, nutrients; production of toxic substances; hybridisation with native plants; fouling of water and altering water flows etc.

For measure 1.1.2 (aquatic and semi-aquatic exotic flora species), these exotic species significantly impact wetland ecology and are adapted to and dependent on wet conditions for all or part of their life cycle. They are generally found within or adjacent to riverine or non-riverine wetlands.

For measure 2.1.1 (terrestrial exotic flora species), these species are plants that are not adapted to and dependent on wet conditions for all or part of their life cycle, that significantly affect wetland ecology. Examples include rubber vine, Cats claw creeper and Leucaena.

Aquatic Conservation Assessment – Flora species measures

Measure 1.1.2 – Presence of exotic aquatic and semi-aquatic plants within the wetland.

Measure 2.1.1 – Presence of exotic terrestrial plants in the assessment unit.

Measure 3.1.5 – Richness of native aquatic plants.

Measure 4.1.2 – Presence of rare or threatened aquatic ecosystem dependent fauna species – NC Act, EPBC Act.

Measure 5.1.2 – Presence of aquatic ecosystem dependent 'priority' flora species

Aquatic Conservation Assessment – Flora priority ecosystems measures

Measure 5.2.1 – Presence of priority Aquatic Ecosystem

Aquatic Conservation Assessment – Flora special feature measures

Measure 6.1.1 – Presence of distinct, unique or special geomorphic features

Measure 6.2.1 – Presence of (or requirement for) distinct, unique or special ecological processes

Measure 6.3.1 – Presence of distinct, unique or special habitat

Measure 6.3.3 – Ecologically significant wetlands identified through expert opinion and/or documented study.

Measure 6.3.4 – Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population

Measure 6.4.1 – Presence of distinct, unique or special hydrological regimes (e.g. spring fed stream, ephemeral stream, boggomoss)

Fauna Expert Panel

Wetland indicator species (WIS)

Fauna wetland indicator species are species that are adapted to and dependent on living in wetland conditions for all (aquatic species), or part (semi-aquatic species) of their life cycle.

Wetland ecosystems tend to include species evolved for wet conditions. Some of these species are dependent on the presence of water for every stage of their life cycle, and need to be immersed in water, or floating upon water, for their total life cycle, while others require water for most of their life cycle stages or for a critical stage in their development. These species are considered as WIS unlike those that may only access a wetland to drink.

The WIS includes the more common fauna species. Most rare species and all vagrant fauna species have not been included as they are considered too poorly known or erratic. Species, other than those listed, may be accepted as a wetland indicator for a certain locality given expert recommendation and reliable site-specific data.

Priority Species (Fauna)

A priority species must exhibit one or more of the following significant values:

1. It is endemic to the study area (>75% of its distribution is in the study area/catchment)
2. It has experienced, or is suspected of experiencing, a serious population decline
3. It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment
4. It is currently a small population and threatened by loss of habitat
5. It is a significant disjunct population
6. Migratory species (other than birds)
7. A significant proportion of the breeding population (>1% for waterbirds, >75% other species) occurs in the waterbody. (see Ramsar Criterion 6 for waterbirds)
8. Taxa vulnerable to impacts of climate change - Species that are considered to be adversely affected by the predicted changes in climate, e.g. increasing temperatures, sea level rise and increasing frequency of extreme weather events (drought, flood & cyclones). Species can only be listed under this reason if there is sufficient knowledge of species' biology and its interaction with climate that would support an assessed impact under climate change scenarios.

Waterbird

Bird species that are dependent on wetland environments. As a rule of thumb, if the wetland disappeared so too would the waterbird species.

Migratory Species

Bird species that are dependent on wetland environments whose entire population or any geographically separate part of the population cyclically and predictably cross one or more national jurisdictional boundaries. This definition excludes those species listed as "nomadising" or "range extensions" and those travelling less than 100 km.

(Based on Convention on Migratory Species; use JAMBA, CAMBA and ROKAMBA lists as a starting list)

Exotic Fauna Species

Exotic fauna species are defined as animals that cause, or have the potential to cause, significant detrimental

impact on wetland ecosystems. Impact examples include: outcompeting native species for light, air, space, nutrients; production of toxic substances; fouling of water and altering water flows etc.

Aquatic Conservation Assessment – Fauna species measures

Measure 1.1.1 – Presence of ‘alien' fish species within the wetland.

Measure 1.1.3 – Presence of exotic invertebrate fauna within the wetland.

Measure 1.1.4 – Presence of feral/exotic vertebrate fauna (other than fish) within the wetland.

Measure 3.1.1 – Richness of native amphibians (riverine wetland breeders).

Measure 3.1.2 – Richness of native fish.

Measure 3.1.3 – Richness of native aquatic dependent reptiles.

Measure 3.1.4 – Richness of native waterbirds.

Measure 3.1.6 – Richness of native amphibians (non-riverine wetland breeders).

Measure 3.1.7 – Richness of native aquatic dependent mammals.

Measure 4.1.1 – Presence of rare or threatened aquatic ecosystem dependent fauna species – NC Act, EPBC Act.

Measure 5.1.1 – Presence of aquatic ecosystem dependent 'priority' fauna species (expert panel list/discussion or other lists such as ASFB, WWF, etc).

Measure 5.1.3 – Habitat for, or presence of, migratory species (Expert Panel list/discussion and/or JAMBA / CAMBA agreement lists and/or Bonn Convention).

Aquatic Conservation Assessment – Fauna priority ecosystems measures

Measure 5.1.4 – Significant waterbird habitat areas

Measure 5.2.1 – Priority ecosystems

Aquatic Conservation Assessment – Fauna special feature measures

Measure 6.1.1 – Presence of distinct, unique or special geomorphic features

Measure 6.2.1 – Presence of (or requirement for) distinct, unique or special ecological processes

Measure 6.3.1 – Presence of distinct, unique or special habitat.

Measure 6.3.4 – Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population

Measure 6.4.1 – Presence of distinct, unique or special hydrological regimes (e.g. spring fed stream, ephemeral stream, boggomoss)

Ecology Expert Panel

Aquatic Conservation Assessment – Ecology priority measures

Measure 5.2.1 – Presence of 'priority' aquatic ecosystems (Ecosystems at risk)

Aquatic Conservation Assessment – Ecology Special feature measures

Measure 6.1.1 – Presence of distinct, unique or special geomorphic features

Measure 6.2.1 – Presence of (or requirement for) distinct, unique or special ecological processes.

Measure 6.3.1 – Presence of distinct, unique or special habitat.

Measure 6.3.3 – Ecologically significant wetlands identified through expert opinion and/or documented study.

Measure 6.3.4 – Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)

Measure 6.4.1 – Presence of distinct, unique or special hydrological regimes (e.g. spring fed stream, ephemeral stream, boggomoss)

Measure 8.2.5 – Wetland type representative of the study area non-riverine only)