Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Eastern Gulf of Carpentaria

Flora, Fauna and Ecology Expert Panel Report

Version 1.1

Queensland Government

Prepared by: Biodiversity Assessment, Conservation and Biodiversity Strategy, Department of Environment and Science.

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Citation

DES. 2018. Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Eastern Gulf of Carpentaria: Flora, Fauna and Ecology Expert Panel Report, Version 1.1. Department of Environment and Science, Queensland Government.

Acknowledgements

This report was prepared by Mark Kelton, Simon Goudkamp, Shane Chemello, David McFarland, Courtney Duncan and Ralph Trancoso. Special area decisions were refined by Jim Tait. The authors wish to thank all the experts who gave their time and knowledge at the expert panel workshops.

Cover Photo: Wetland near the Langdon river in the Gilbert river catchment. (S. Chemello, Dept. Environment and Science, 2017)

June, 2018

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Nb. 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 Eastern Gulf of Carpentaria: Summary Report, Version 1.1 (DES 2018).

Acronyms and abbreviations

ACA	Aquatic Conservation Assessment
AquaBAMM	Aquatic Biodiversity Assessment and Mapping Methodology
ASL	Above Sea Level
BAMM	Biodiversity Assessment and Mapping Methodology
BPA	Biodiversity Planning Assessment
CAMBA	China–Australia Migratory Bird Agreement
CIM	Criteria, indicators and measures (used in AquaBAMM)
CYP	Cape York Peninsula bioregion
DIWA	Directory of Important Wetlands in Australia
EGoC	Eastern Gulf of Carpentaria
DERM	Department of Environment and Heritage Protection
DES	Department of Environment and Science
EIU	Einasleigh Uplands bioregion
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
GUP	Gulf Plains bioregion
IBRA	Interim Biogeographic Regionalisation for Australia
JAMBA	Japan–Australia Migratory Bird Agreement
MDIA	Mareeba-Dimbulah Irrigation Area
MGD	Mitchell Grass Downs
NCA	*Nature Conservation Act 1992*
NP	National Park
QWS	Queensland Wetland System
Ramsar	Ramsar Convention on Wetlands
RE	Regional Ecosystem
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
SOR	State of the Rivers
WET	Wet Tropics bioregion

1 Introduction

The Department of Environment and Science (DES) has undertaken a series of aquatic conservation assessments for the freshwater wetlands within the Mitchell, Staaten, Norman, Gilbert, and Flinders hydrological basins. Aquatic conservation assessments involve a non-social, non-economic and tenure independent assessment of wetland conservation 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 wide body of national and international literature.

The AquaBAMM uses expert knowledge to acquire data for a number of measures within selected criteria (Clayton et al. 2006). This data is drawn from expert panel workshops comprised of individuals with expertise in the local aquatic dependent flora and fauna, and non-riverine and riverine wetland ecology including fish, macro invertebrates, water quality, hydrology, geomorphology and vegetation.

Three expert panel workshops (flora, fauna, and ecology) were held in Cairns from 5 to 11 April, 2017 and built on the outcomes from similar workshops held for the Flinders, Norman and Gilbert basins in 2010.

This report describes the findings and recommendations from the expert panel process completed for the Mitchell, Staaten, Norman, Gilbert, and Flinders (Eastern Gulf of Carpentaria) assessments. Terms of Reference for the expert panel workshops are provided in Appendix I. Expert Panel Terms of Reference.

The overall study area is referred to in this report as the Eastern Gulf of Carpentaria (EGoC).

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 Eastern Gulf of Carpentaria Summary Report - Version 1.1 (DES 2018).

2 Method

2.1 Study Area

The Eastern Gulf of Carpentaria study areas cover an area of 302,961 km^2 and include the Mitchell, Staaten, Norman, Gilbert, and Flinders hydrological basins. Each basin constitutes a separate study area. 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 (i.e. Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Eastern Gulf of Carpentaria Summary Report - Version 1.1 (DES 2018)).

2.2 Panel composition

The expert panel for the Eastern Gulf of Carpentaria assessments was comprised of the persons listed in Table 1. It included individuals with expertise in the local 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 panel 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 wiithin each study area. Organisation and technical support for the panels was provided by Mark Kelton, Shane Chemello, Simon Goudkamp, Courtney Duncan and Steven Howell.

Table 1. Composition and details of the expert panel

Name	Organisation	Expertise	Flora panel	Fauna panel	Ecology panel
Expert panel – 2017					
Chris Appelman	Principal Botanist, Department of Science Information Technology Innovation	Botanist	Attended		Attended
Dr Satish Choy	Retired	Aquatic ecologist			Attended
Nick Cuff	Senior Botanist, Department of Environment and Natural Resources	Botanist	Attended		
Dr Brendan Ebner	TropWater, James Cook University	Aquatic ecologist		Attended	
Peter Elliot	Senior Project Officer, Department of Agriculture and Fisheries	Landscape ecologist			Attended
Alastair Freeman	Senior Technical Officer, Department of Environment and Science	Zoologist		Out-of-session	
Dr Roger Jaensch	Consultant, Jaensch Ornithology & Conservation	Waterbird ecologist		Out-of-session	
Dr Col Limpus	Chief Scientist, Department of Environment and Science	Aquatic ecologist		Out-of-session	
Dr David McFarland	Senior Zoologist, Department of Environment and Science	Zoologist		Out-of-session	

Name	Organisation	Expertise	Flora panel	Fauna panel	Ecology panel
Gethin Morgan	President, Magnetic Island Nature Association	Landscape ecologist			Attended
Dr Jeff Shellberg	Griffith University	Fluvial geomorphologist, aquatic ecologist			Attended
Jim Tait	Consultant, Econcern Environmental Consulting	Aquatic ecologist			Attended
David Stewart	Senior Conservation Officer, Department of Environment and Science	Zoologist		Attended	
Bruce Wannan	Senior Planning Officer, Department of Environment and Science	Landscape ecologist	Attended		Attended
Experts Panel – 2010					
Chris Appleman	Principal Botanist, Department of Environment and Resource Management	Flora, aquatic ecology	Contributed post-panel		
Dr Damien Burrows	Aquatic ecologist, Australian Centre for Tropical Freshwater Research	Aquatic ecology and water quality		Attended	
Jason Carter	Business and Natural Resources Manager, Alluvium Consulting Pty Ltd	River and wetland management		Attended	
Dr Satish Choy	Principal Scientist Department of Natural Resources and water	Aquatic ecology, water quality, macroinvertebrates		Attended	
Dr Niall Connolly	Principal Conservation Officer, Department of Environment and Resource Management	Biodiversity planning - aquatic ecology and water quality	Attended	Attended	Attended
Mike Digby	Coordinator, Regional Mapping Services, Northern Gulf Resource Management Group	Aquatic ecology, geographic information systems	Attended		Attended
Hans Dillewaard	Principal botanist, Department of Environment and Resource Management	Mapping, flora, aquatic ecology	Out-of-session		
Dr Peter Driscoll	Consultant	Birds		Attended	
David Hinchley	Land and Sea Program Manager, Carpentaria Land Council Aboriginal Corporation				Attended
Alf Hogan	Alf Hogan and Associates	Fish ecologist		Attended	
Dr Christina Howley	Cape York Marine Advisory Group (CYMAG) Environmental Inc.	Flora, aquatic ecology	Sent draft report for comment		

Name	Organisation	Expertise	Flora panel	Fauna panel	Ecology panel
			and endorsement		
Jeff Johnson	Queensland Museum	Freshwater and estuarine fish		Out-of-session	
Dr Rob Kenyon	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Prawn ecology, water quality		Attended	
Warren Lee Long	Wetlands International	Wetland ecology, catchment, coastal and marine zone management	Attended		Attended
Jaye Lobegeiger	Senior Scientist, Department of Environment and Resource Management				Attended
Keith McDonald	Principal Technical Officer (threatened species), Environmental Protection Agency	Tropical ecology and conservation		Out-of-session	
Gethin Morgan	Principal Biodiversity Planning Officer, Department of Environment and Resource Management	Landscape ecology	Attended		Attended
Tony Morrison	Principal Planning Officer, Department of Environment and Resource Management	Aquatic and landscape ecology	Attended		Attended
Malcolm Pearce	Senior Fisheries Biologist, Department of Employment, Economic Development and Innovation	Fish		Attended	
Colton Perna	PhD Candidate, James Cook University	Freshwater Ecologist			Attended
Bruce Wannan	Principal Biodiversity Planning Officer, Department of Environment and Resource Management	Tropical flora and conservation planning	Attended		Attended
Gary Wilson	Technical Officer, Department of Environment and Resource Management	Fauna ecologist		Attended	

2.3 Workshop format

Three expert panel workshops were held in Cairns during April, 2017. The flora panel was held 5 to 6 April, the fauna panel 6 to 7 April, and the ecology panel 10 to 11 April. These workshops built on the outcomes from similar workshops held for the Flinders, Norman and Gilbert basins in 2010 (unpublished). The workshops involved a review and update of the 2010 results and the development of new results for the Staaten and Mitchell basins.

The workshops used ArcGIS Desktop software to display datasets, such as species sightings records and background topographic data, to help identify species, processes, and features of interest. Where possible, region specific data were sourced from technical reports and scietific publications.

3 Flora

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 that only exotic plants that cause, or have the potential to cause, significant detrimental impact on natural systems within a riverine or non-riverine landscape be used.

The panel identified 29 exotic flora taxa relevant to the riverine and non-riverine wetlands of the study areas (Table 2).

Pest distribution (species occurrence) maps produced by Biosecurity Queensland (Department of Agriculture and Fisheries) and point records for the listed species were used to pinpoint spatial units containing exotic flora species to calculate scores for the AquaBAMM measures 1.1.2 (Presence of exotic aquatic and semi-aquatic plants within the wetland) and 2.1.1 (Presence of exotic terrestrial plants in the assessment unit).

The panel also highlighted abundance and degree of infestation as important factors in determining the overall impact of exotic species on wetland ecosystems. The AquaBAMM project team is currently exploring the incorporation of abundance and degree of infestation into future assessments.

Table 2. Exotic flora taxa impacting study area wetland values

Scientific Name	Common Name	R[1]	NR[1]	M1.1.2	M2.1.1
Alternanthera ficoidea		Y	Y		Y
Azadirachta indica	Neem tree	Y	Y		Y
Calotropis procera	Captain Cook tree	Y			Y
Cascabela thevetia	yellow oleander	Y	Y		Y
Cryptostegia grandiflora	rubber vine	Y	Y		Y
Cyperus eragrostis		Y	Y	Y	
Cyperus esculentus	yellow nutgrass	Y	Y	Y	
Echinochloa colona	awnless barnyard grass	Y	Y	Y	
Echinochloa crus-galli	barnyard grass	Y	Y	Y	
Echinochloa polystachya cv. Amity		Y	Y	Y	
Eichhornia crassipes	water hyacinth	Y	Y	Y	
Hymenachne amplexicaulis cv. Olive		Y	Y	Y	
Jatropha gossypiifolia	bellyache bush	Y	Y		Y
Leucaena leucocephala subsp. *glabrata*	Leucaena	Y	Y		Y
Leucaena leucocephala subsp. leucocephala	Leucaena	Y	Y		Y
Mesosphaerum suaveolens		Y	Y		Y
Myriophyllum aquaticum	Brazilian water milfoil	Y	Y	Y	
Parkinsonia aculeata	parkinsonia	Y	Y		Y
Prosopis glandulosa var. *glandulosa*		Y	Y		Y

Scientific Name	Common Name	R[1]	NR[1]	M1.1.2	M2.1.1
Prosopis pallida	mesquite	Y	Y		Y
Ricinus communis	castor oil bush	Y	Y		Y
Salvinia molesta	salvinia	Y	Y	Y	
Senna obtusifolia		Y	Y		Y
Senna occidentalis	coffee senna	Y	Y		Y
Sida rhombifolia	Paddy's lucerne		Y		Y
Spathodea campanulata subsp. *nilotica*	african tulip tree	Y	Y		Y
Urochloa mutica		Y		Y	
Xanthium occidentale		Y	Y		Y
Ziziphus mauritiana	Indian jujube	Y	Y		Y

[1] R = Riverine, NR = Non-riverine.

3.2 Flora species richness

Flora species richness (total number of species) was calculated using wetland indicator species. The panel defined a '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 indicator is a measure of floristic richness of a particular spatial unit's aquatic environment, and hence, a broad definition will better depict the flora richness value at a given location.

The panel identified 465 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 and Herbrecs and from panel member records.

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

Table 3. Aquatic dependent native flora taxa

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Abildgaardia ovata			Y	
Abildgaardia vaginata			Y	
Acacia salicina	doolan	Y		
Acacia stenophylla	belalie	Y	Y	
Acmena smithii	lillypilly satinash	Y		
Acrostichum speciosum	mangrove fern	Y	Y	Tends to grow on soda springs. Geographically isolated
Aeschynomene indica	budda pea		Y	
Alternanthera denticulata	lesser joyweed	Y		
Alternanthera nana	hairy joyweed	Y		
Alternanthera nodiflora	joyweed	Y		
Ammannia multiflora	jerry-jerry	Y	Y	
Aphananthe philippinensis		Y		
Aponogeton queenslandicus		Y	Y	
Aponogeton vanbruggenii		Y	Y	
Archontophoenix alexandrae	Alexandra palm		Y	
Arthropodium strictum		Y	Y	
Arthrostylis aphylla			Y	
Avicennia marina		Y		
Azolla pinnata	ferny azolla	Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Bacopa floribunda		Y	Y	
Bacopa monnieri		Y	Y	
Banksia robur	broad-leaved banksia		Y	
Baumea juncea	bare twigrush	Y	Y	
Baumea rubiginosa	soft twigrush		Y	
Bergia ammannioides		Y	Y	No valid records
Bergia pedicellaris			Y	
Bergia pusilla			Y	
Bergia trimera		Y	Y	
Blechnum cartilagineum	gristle fern	Y		
Blyxa aubertii		Y		
Blyxa octandra		Y		No valid records
Bruguiera gymnorhiza	large-fruited orange mangrove	Y		No valid records
Bulbostylis barbata			Y	
Bulbostylis densa		Y	Y	
Bulbostylis pyriformis		Y	Y	
Byblis liniflora			Y	
Caesalpinia hymenocarpa		Y		
Caldesia acanthocarpa		Y	Y	
Caldesia oligococca			Y	
Carex maculata		Y	Y	
Cartonema brachyantherum			Y	
Casuarina cunninghamiana		Y		
Casuarina cunninghamiana subsp. *cunninghamiana*		Y		
Cathormion umbellatum subsp. *moniliforme*		Y	Y	
Cathormion umbellatum subsp. *umbellatum*		Y	Y	
Cenchrus purpurascens			Y	
Centella asiatica		Y	Y	
Centipeda borealis			Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Centipeda minima			Y	
Centrolepis banksii		Y	Y	
Centrolepis exserta		Y	Y	
Ceratophyllum demersum	hornwort	Y		
Ceratopteris thalictroides		Y	Y	
Chenopodium auricomum			Y	
Chorizema parviflorum	eastern flame pea	Y		
Christella dentata	creek fern	Y		
Commelina agrostophylla			Y	
Commelina diffusa	wandering jew	Y		
Commersonia bartramia	brown kurrajong	Y		
Corymbia tessellaris	Moreton Bay ash	Y		
Corypha utan		Y	Y	
Crinum flaccidum	Murray lily	Y	Y	
Crinum pedunculatum	river lily	Y	Y	
Cryptocarya triplinervis		Y		
Cyanotis axillaris			Y	
Cyathea cooperi		Y		
Cyclosorus interruptus			Y	
Cycnogeton dubius		Y	Y	
Cycnogeton multifructus		Y	Y	
Cycnogeton procerus		Y	Y	
Cyperus alopecuroides		Y	Y	
Cyperus alterniflorus		Y	Y	
Cyperus aquatilis		Y	Y	
Cyperus betchei		Y	Y	
Cyperus betchei subsp. *betchei*		Y	Y	
Cyperus bifax	western nutgrass	Y	Y	
Cyperus bowmannii		Y	Y	
Cyperus brevifolius	Mullumbimby couch	Y		

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Cyperus castaneus		Y	Y	
Cyperus concinnus		Y		
Cyperus conicus		Y	Y	
Cyperus conicus var. *conicus*		Y	Y	
Cyperus cuspidatus		Y		
Cyperus cyperoides		Y	Y	
Cyperus dactylotes		Y	Y	
Cyperus decompositus		Y	Y	
Cyperus dietrichiae		Y	Y	
Cyperus dietrichiae var. *brevibracteatus*		Y	Y	
Cyperus dietrichiae var. *dietrichiae*		Y	Y	
Cyperus difformis	rice sedge	Y	Y	
Cyperus digitatus		Y	Y	
Cyperus distans		Y		
Cyperus enervis		Y		
Cyperus exaltatus	tall flatsedge	Y	Y	
Cyperus flaccidus		Y	Y	
Cyperus flavidus		Y	Y	
Cyperus fulvus		Y	Y	
Cyperus gilesii		Y	Y	
Cyperus gracilis		Y	Y	
Cyperus gunnii subsp. *gunnii*		Y	Y	
Cyperus gunnii subsp. *novae-hollandiae*		Y	Y	
Cyperus haspan		Y	Y	
Cyperus haspan subsp. *haspan*		Y	Y	
Cyperus haspan subsp. *juncoides*		Y	Y	
Cyperus holoschoenus		Y	Y	
Cyperus iria		Y	Y	
Cyperus isabellinus			Y	
Cyperus javanicus		Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Cyperus kyllingia		Y		
Cyperus laevigatus		Y	Y	
Cyperus laevis		Y	Y	
Cyperus leiocaulon		Y	Y	
Cyperus lucidus		Y	Y	
Cyperus nervulosus		Y	Y	
Cyperus nutans var. *eleusinoides*	flatsedge	Y	Y	
Cyperus perangustus		Y	Y	
Cyperus pilosus		Y	Y	
Cyperus platystylis			Y	
Cyperus polystachyos		Y	Y	
Cyperus polystachyos var. *polystachyos*		Y	Y	
Cyperus procerus		Y	Y	
Cyperus pulchellus		Y	Y	
Cyperus pygmaeus	dwarf sedge	Y	Y	
Cyperus rotundus	nutgrass	Y	Y	
Cyperus sanguinolentus		Y	Y	
Cyperus scaber		Y		
Cyperus scariosus		Y	Y	
Cyperus sphaeroideus		Y	Y	
Cyperus squarrosus	bearded flatsedge	Y	Y	
Cyperus subulatus		Y	Y	
Cyperus tetraphyllus		Y	Y	
Cyperus trinervis		Y	Y	
Cyperus unioloides		Y	Y	
Cyperus vaginatus		Y	Y	
Cyperus victoriensis		Y	Y	
Dichanthium setosum		Y		
Dicranopteris linearis var. *linearis*			Y	
Dinebra decipiens		Y		

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Diplachne fusca		Y	Y	
Diplachne fusca var. *fusca*			Y	
Drosera auriculata		Y	Y	
Drosera burmanni			Y	
Drosera finlaysoniana			Y	
Drosera lanata		Y	Y	
Drosera lunata		Y	Y	
Drosera peltata	pale sundew		Y	
Drosera spatulata		Y	Y	
Drosera spatulata var. *spatulata*		Y	Y	
Duma florulenta		Y	Y	
Echinochloa telmatophila	swamp barnyard grass	Y	Y	
Echinochloa turneriana	channel millet	Y	Y	
Eclipta prostrata	white eclipta	Y	Y	
Ectrosia blakei		Y	Y	
Elaeocarpus grandis	blue quandong	Y		
Elaeocarpus obovatus	blueberry ash	Y		
Elaphoglossum callifolium		Y		
Elatine gratioloides	waterwort	Y	Y	
Eleocharis acutangula			Y	
Eleocharis atropurpurea			Y	
Eleocharis brassii			Y	
Eleocharis cylindrostachys		Y	Y	
Eleocharis dulcis		Y	Y	
Eleocharis geniculata			Y	
Eleocharis minuta			Y	
Eleocharis nuda		Y	Y	
Eleocharis ochrostachys		Y	Y	
Eleocharis pallens	pale spikerush	Y	Y	
Eleocharis philippinensis		Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Eleocharis sphacelata	tall spikerush	Y	Y	
Eleocharis spiralis			Y	
Eleocharis tetraquetra			Y	
Enchylaena tomentosa			Y	
Eremophila bignoniiflora	eurah	Y	Y	
Eriocaulon athertonense		Y	Y	
Eriocaulon carsonii			Y	
Eriocaulon carsonii subsp. *orientale*			Y	
Eriocaulon cinereum		Y	Y	
Eriocaulon nanum		Y	Y	
Eriocaulon pygmaeum		Y	Y	
Eriocaulon scariosum		Y	Y	No valid records
Eriocaulon setaceum			Y	
Eryngium plantagineum	long eryngium		Y	
Eucalyptus camaldulensis		Y	Y	
Eucalyptus camaldulensis subsp. *acuta*		Y	Y	
Eucalyptus camaldulensis subsp. *acuta* Brooker & M.W.McDonald x *E.platyphylla*		Y	Y	
Eucalyptus camaldulensis subsp. *arida*		Y	Y	
Eucalyptus camaldulensis subsp. *obtusa*		Y	Y	
Eucalyptus camaldulensis subsp. *simulata*		Y	Y	
Eucalyptus coolabah	coolabah	Y	Y	
Eucalyptus grandis	flooded gum	Y		
Eucalyptus microtheca	coolibah	Y	Y	
Eucalyptus platyphylla	poplar gum		Y	
Eucalyptus tereticornis		Y	Y	
Exocarya scleroides			Y	
Fabaceae gen. nov. (AQ735607)		Y		
Ficus coronata	creek sandpaper fig	Y		
Ficus racemosa		Y		
Ficus racemosa var. *racemosa*		Y		

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Ficus virens		Y		
Fimbristylis acicularis		Y		
Fimbristylis aestivalis		Y	Y	
Fimbristylis bisumbellata		Y	Y	
Fimbristylis carolinii			Y	
Fimbristylis cinnamometorum		Y		
Fimbristylis depauperata		Y		
Fimbristylis dichotoma	common fringe-rush	Y	Y	
Fimbristylis ferruginea			Y	
Fimbristylis littoralis		Y	Y	
Fimbristylis micans			Y	
Fimbristylis microcarya		Y	Y	
Fimbristylis neilsonii		Y	Y	
Fimbristylis nuda		Y	Y	
Fimbristylis nutans		Y	Y	
Fimbristylis odontocarpa		Y	Y	
Fimbristylis oxystachya		Y	Y	
Fimbristylis pauciflora		Y	Y	
Fimbristylis polytrichoides			Y	No valid records
Fimbristylis rara			Y	
Fimbristylis schoenoides		Y	Y	
Fimbristylis sieberiana			Y	
Fimbristylis tristachya		Y		
Fimbristylis velata		Y	Y	
Fuirena ciliaris		Y	Y	
Fuirena incrassata		Y	Y	
Fuirena nudiflora		Y		
Fuirena umbellata		Y	Y	
Gahnia aspera		Y		
Gahnia sieberiana	sword grass		Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Gleichenia dicarpa	pouched coral fern	Y	Y	
Glinus lotoides	hairy carpet weed	Y	Y	
Glochidion ferdinandi		Y		
Glochidion sumatranum	umbrella cheese tree	Y		
Glossostigma diandrum		Y	Y	
Gossia bidwillii		Y		
Haloragis heterophylla	rough raspweed		Y	
Hibiscus tiliaceus	cotton tree	Y		
Hydrilla verticillata	hydrilla	Y	Y	
Hydrocotyle grammatocarpa			Y	
Hydrocotyle verticillata	shield pennywort	Y	Y	
Hydrolea zeylanica			Y	
Hygrophila angustifolia		Y	Y	
Hymenachne acutigluma		Y	Y	
Hymenosporum flavum	native frangipani	Y		
Ipomoea aquatica			Y	
Isachne globosa	swamp millet		Y	
Ischaemum australe var. *australe*			Y	
Ischaemum fragile			Y	
Isoetes muelleri	quillwort	Y	Y	
Isolepis inundata	swamp club rush	Y	Y	
Juncus aridicola	tussock rush	Y	Y	
Juncus continuus		Y	Y	
Juncus planifolius		Y	Y	
Juncus polyanthemus		Y	Y	
Juncus prismatocarpus	branching rush	Y	Y	
Juncus usitatus		Y	Y	
Leersia hexandra	swamp rice grass	Y	Y	
Lemna aequinoctialis	common duckweed	Y	Y	
Lemna trisulca			Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Lepidosperma laterale		Y	Y	
Lepidosperma laterale var. *laterale*			Y	
Lepironia articulata		Y	Y	
Leptochloa digitata		Y	Y	
Leptospermum brachyandrum	weeping tea-tree	Y		
Limnophila aromatica		Y	Y	
Limnophila brownii		Y	Y	
Limnophila fragrans		Y	Y	
Limosella curdieana	large mudwart	Y	Y	
Lindernia anagallis			Y	
Lindernia antipoda			Y	
Lindernia aplectra		Y	Y	
Lindernia hyssopoides			Y	
Lindernia stantonii			Y	
Lindernia tenuifolia			Y	
Lipocarpha chinensis			Y	
Lipocarpha microcephala		Y	Y	
Lomandra confertifolia subsp. *pallida*		Y		
Lomandra hystrix		Y	Y	
Lomandra longifolia		Y		
Lomandra multiflora		Y		
Lophostemon grandiflorus		Y		
Lophostemon grandiflorus subsp. *riparius*		Y		
Lophostemon suaveolens	swamp box	Y	Y	
Ludwigia adscendens		Y	Y	
Ludwigia octovalvis	willow primrose	Y	Y	
Ludwigia peploides subsp. *montevidensis*		Y	Y	
Ludwigia perennis		Y		
Lycopodiella cernua			Y	
Lygodium microphyllum	snake fern	Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Lythrum paradoxum		Y	Y	
Marsilea costulifera	narrow-leaved nardoo		Y	
Marsilea crenata			Y	
Marsilea drummondii	common nardoo	Y	Y	
Marsilea exarata	sway-back nardoo		Y	
Marsilea hirsuta	hairy nardoo	Y	Y	
Marsilea mutica	shiny nardoo	Y	Y	
Megathyrsus maximus		Y	Y	
Melaleuca argentea	silver tea-tree	Y		
Melaleuca bracteata		Y	Y	
Melaleuca dealbata	swamp tea-tree	Y	Y	
Melaleuca fluviatilis		Y		
Melaleuca leucadendra	broad-leaved tea-tree	Y	Y	
Melaleuca linariifolia	snow-in summer	Y	Y	
Melaleuca quinquenervia	swamp paperbark	Y	Y	
Melaleuca saligna		Y		
Melaleuca trichostachya		Y	Y	
Melaleuca viminalis		Y	Y	
Melaleuca viridiflora			Y	
Melaleuca viridiflora var. *viridiflora*		Y	Y	
Melastoma malabathricum subsp. *malabathricum*			Y	
Millettia pinnata		Y		
Monochoria australasica		Y	Y	
Monochoria cyanea			Y	
Monochoria vaginalis			Y	
Muehlenbeckia gracillima		Y	Y	
Muehlenbeckia rhyticarya		Y	Y	
Murdannia graminea	murdannia	Y	Y	
Myriophyllum dicoccum		Y	Y	
Myriophyllum filiforme			Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Myriophyllum gracile		Y	Y	
Myriophyllum implicatum		Y	Y	
Myriophyllum simulans		Y	Y	
Myriophyllum striatum			Y	
Myriophyllum verrucosum	water milfoil	Y	Y	
Myrmecodia beccarii			Y	
Najas browniana		Y	Y	Collector is wetland specialist
Najas tenuifolia	water nymph	Y	Y	
Nauclea orientalis	Leichhardt tree	Y		
Nelumbo nucifera	pink waterlily	Y	Y	
Nitella pseudoflabellata		Y	Y	No valid records
Nymphaea alexii			Y	
Nymphaea atrans			Y	
Nymphaea carpentariae			Y	
Nymphaea elleniae		Y	Y	
Nymphaea gigantea		Y	Y	
Nymphaea immutabilis		Y	Y	
Nymphaea macrosperma		Y	Y	
Nymphaea violacea		Y	Y	More prevalent than specimens suggest. Taxonomically difficult group.
Nymphoides aurantiaca		Y	Y	
Nymphoides crenata	wavy marshwort	Y	Y	
Nymphoides exiliflora		Y	Y	
Nymphoides geminata		Y	Y	
Nymphoides indica	water snowflake	Y	Y	
Nymphoides parvifolia			Y	
Nymphoides quadriloba			Y	
Nymphoides triangularis		Y		
Ornduffia sp. (Laura C.Dalliston CC18*)*			Y	No valid records
Oryza australiensis			Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Oryza meridionalis			Y	
Oryza rufipogon		Y	Y	
Ottelia alismoides		Y	Y	
Ottelia ovalifolia	swamp lily	Y	Y	
Pandanus cookii		Y		
Pandanus spiralis		Y	Y	
Panicum larcomianum		Y	Y	
Panicum paludosum	swamp panic		Y	
Panicum trachyrhachis			Y	
Paspalum distichum	water couch	Y	Y	
Paspalum longifolium		Y		
Paspalum scrobiculatum	ditch millet	Y		
Paspalum vaginatum	saltwater couch		Y	
Persicaria attenuata		Y	Y	
Persicaria barbata		Y	Y	
Persicaria decipiens	slender knotweed	Y	Y	
Persicaria hydropiper	water pepper	Y	Y	No valid records
Persicaria lapathifolia	pale knotweed	Y	Y	
Persicaria orientalis	princes feathers	Y	Y	
Persicaria prostrata	creeping knotweed	Y	Y	No valid records
Persicaria strigosa		Y	Y	
Persicaria subsessilis	hairy knotweed	Y	Y	
Philydrum lanuginosum	frogsmouth	Y	Y	
Phragmites australis	common reed	Y	Y	
Phragmites karka		Y	Y	No valid records
Phyla nodiflora	carpetweed	Y	Y	
Platyzoma microphyllum	braid fern	Y	Y	
Polygonum plebeium	small knotweed	Y	Y	
Potamogeton crispus	curly pondweed	Y	Y	
Potamogeton octandrus		Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Potamogeton tepperi		Y	Y	
Potamogeton tricarinatus	floating pondweed	Y	Y	
Pseudoraphis spinescens	spiny mudgrass		Y	
Rhamphicarpa australiensis			Y	
Rhynchospora brownii	beak rush	Y	Y	
Rhynchospora corymbosa		Y	Y	
Rhynchospora heterochaeta		Y	Y	
Rotala diandra		Y	Y	
Rotala mexicana		Y	Y	
Rotala occultiflora		Y	Y	
Rotala tripartita			Y	
Rumex crystallinus	shiny dock	Y	Y	
Sacciolepis indica	Indian cupscale grass		Y	
Sankowskya stipularis			Y	
Schoenoplectiella dissachantha		Y	Y	
Schoenoplectiella laevis		Y	Y	
Schoenoplectiella lateriflora		Y	Y	
Schoenoplectiella mucronata		Y	Y	
Schoenoplectus subulatus		Y	Y	
Schoenoplectus tabernaemontani		Y	Y	
Schoenus apogon var. *apogon*		Y	Y	
Schoenus falcatus			Y	
Schoenus kennyi		Y	Y	
Schoenus sparteus			Y	
Scleria brownii		Y	Y	
Scleria laxa			Y	
Scleria mackaviensis		Y	Y	
Scleria rugosa		Y	Y	
Scleria sphacelata		Y	Y	
Sesbania cannabina		Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Sesbania cannabina var. *cannabina*			Y	
Sesbania erubescens			Y	
Sesuvium portulacastrum	sea purslane		Y	
Sparganium subglobosum	floating bur-reed	Y		
Sphaeromorphaea australis		Y	Y	
Sphaeromorphaea subintegra		Y	Y	
Sphenoclea zeylanica		Y	Y	Subject to alluvial and tidal action. RE 2.1.5
Spirodela punctata	thin duckweed	Y	Y	
Sporobolus partimpatens			Y	
Sporobolus virginicus	sand couch		Y	
Sticherus flabellatus var. *flabellatus*		Y	Y	
Stuckenia pectinata		Y	Y	
Stylidium eglandulosum		Y	Y	
Stylidium elachophyllum			Y	
Stylidium eriorhizum			Y	
Stylidium graminifolium	grassy-leaved trigger-flower		Y	
Stylidium schizanthum		Y	Y	
Stylidium tenerum			Y	
Stylidium trichopodum			Y	
Stylidium velleioides			Y	
Syzygium australe	scrub cherry	Y		
Syzygium oleosum	blue cherry	Y		
Syzygium tierneyanum	river cherry	Y		
Tapheocarpa calandrinioides			Y	
Tecticornia indica			Y	
Tecticornia indica subsp. *leiostachya*			Y	
Tecticornia pergranulata			Y	
Terminalia sericocarpa	damson	Y		
Tetraria capillaris		Y	Y	

Scientific Name	Common Name	R[1]	NR[1]	Panel Comments
Trachystylis stradbrokensis			Y	
Trentepohlia abietina var. *tenue*		Y		
Trentepohlia arborum		Y		
Trentepohlia bosseae var. *brevicellulis*		Y		
Trentepohlia bosseae var. *samoensis*		Y		
Trentepohlia peruana		Y		
Trentepohlia rigidula		Y		
Tristaniopsis exiliflora	kanuka box	Y		
Typha domingensis		Y	Y	
Typha orientalis	broad-leaved cumbungi	Y	Y	
Utricularia aurea	golden bladderwort	Y	Y	
Utricularia bifida		Y	Y	
Utricularia caerulea	blue bladderwort	Y	Y	
Utricularia chrysantha			Y	
Utricularia dichotoma	fairy aprons		Y	
Utricularia gibba	floating bladderwort	Y	Y	
Utricularia limosa			Y	
Utricularia minutissima			Y	
Utricularia muelleri			Y	
Utricularia quinquedentata			Y	
Utricularia stellaris		Y	Y	
Utricularia uliginosa	asian bladderwort	Y	Y	
Vallisneria annua			Y	
Vallisneria caulescens			Y	
Vallisneria nana		Y	Y	
Viola hederacea		Y	Y	
Walwhalleya subxerophila		Y	Y	
Xyris complanata	yellow-eye		Y	
Xyris juncea	dwarf yellow-eye		Y	

3.3 Near threatened and threatened flora

The panel identified 10 near-threatened or threatened flora taxa relevant to the riverine and non-riverine wetlands of study areas (Table 4). Only species judged to be aquatic, semi-aquatic or riparian dependent and scheduled as near threatened, vulnerable, endangered, or critically endangered under the Queensland *Nature Conservation Act 1992* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were considered.

Point records for the listed species were used to pinpoint spatial units containing priority flora taxa to calculate scores for the AquaBAMM measure 4.1.2 (Presence of near threatened or threatened aquatic ecosystem dependent flora species).

Table 4. Aquatic dependent near threatened and threatened flora taxa

Scientific Name	Common Name	R[1]	NR[1]	NCA[2]	EPBC[3]	Panel Comments
Caesalpinia hymenocarpa		Y		NT		
Dichanthium setosum		Y		LC	V	Riparian species. Very localised. May be outside study area
Elaphoglossum callifolium		Y		NT		
Eriocaulon carsonii			Y	E	E	
Eriocaulon carsonii subsp. *orientale*			Y	E	E	
Fimbristylis carolinii			Y	NT		
Fimbristylis micans			Y	V		
Myrmecodia beccarii			Y	V	V	Perched *Melaleuca quinquinerva* swamps in that particular area - spatial unit ml_00162
Stylidium elachophyllum			Y	E		
Stylidium trichopodum			Y	NT		

[1] R = Riverine, NR = Non-riverine.

[2] NCA—*Queensland Nature Conservation Act 1992*: E = endangered, V = vulnerable, NT = near threatened, LC = least concern.

[3] EPBC—Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: Ex = extinct, CE = critically endangered, E = endangered, V = vulnerable.

3.4 Priority flora

Priority taxa are defined as those not listed as critically endangered, endangered, vulnerable or near threatened 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

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 72 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 pinpoint spatial units containing priority flora taxa to calculate scores for the AquaBAMM measure 5.1.2 (Presence of aquatic ecosystem dependent 'priority' flora species).

Table 5. Aquatic dependent priority flora taxa

Scientific Name	Common Name	R[1]	NR[1]	Priority Number[2]	Panel Comments
Acrostichum speciosum	mangrove fern	Y	Y	6,7	Tends to grow on soda springs. Geographically isolated
Azolla pinnata	ferny azolla	Y	Y	1,2,3,4	
Bacopa monnieri		Y	Y	1,6	
Baumea rubiginosa	soft twigrush		Y	2,3,4,6	
Casuarina cunninghamiana		Y		2,3,6	
Casuarina cunninghamiana subsp. *cunninghamiana*		Y		2,3,6	
Cathormion umbellatum subsp. *moniliforme*		Y	Y	2	
Cathormion umbellatum subsp. *umbellatum*		Y	Y	2	
Ceratopteris thalictroides		Y	Y	2,3,4	
Commelina agrostophylla			Y	3	
Corypha utan		Y	Y	2,3,5	
Cyperus exaltatus	tall flatsedge	Y	Y	2,3,4,6	
Duma florulenta		Y	Y	3	
Eleocharis atropurpurea			Y	2,3,4,6	
Eleocharis brassii			Y	2,3,4,6	
Eleocharis cylindrostachys		Y	Y	2,3,4,6	

Scientific Name	Common Name	R[1]	NR[1]	Priority Number[2]	Panel Comments
Eleocharis dulcis		Y	Y	1,2,3	
Eleocharis geniculata			Y	2,3,4,6	
Eleocharis minuta			Y	2,3,4,6	
Eleocharis pallens	pale spikerush	Y	Y	1	
Eleocharis philippinensis		Y	Y	2,3,4,6	
Eleocharis sphacelata	tall spikerush	Y	Y	1,2,3	
Eleocharis spiralis			Y	2,3,4,6	
Eleocharis tetraquetra			Y	2,3,4,6	
Eucalyptus camaldulensis		Y	Y	2,3,6	
Eucalyptus coolabah	coolabah	Y	Y	2,3,6	
Eucalyptus tereticornis		Y	Y	2,3,6	
Fabaceae gen. nov. (AQ735607*)*		Y		7	
Hydrilla verticillata	hydrilla	Y	Y	2,3,4	
Leersia hexandra	swamp rice grass	Y	Y	2,3,4,6	
Lepidosperma laterale		Y	Y	1,2	
Limnophila brownii		Y	Y	1,2	
Lindernia hyssopoides			Y	7	
Lindernia tenuifolia			Y	7	
Lomandra longifolia		Y		6	
Ludwigia adscendens		Y	Y	2	
Ludwigia peploides subsp. *montevidensis*		Y	Y	2,3,4,6	
Marsilea costulifera	narrow-leaved nardoo		Y	1,2	
Marsilea crenata			Y	1,2	
Marsilea drummondii	common nardoo	Y	Y	2,3,4,6	
Marsilea exarata	sway-back nardoo		Y	1,2	
Marsilea hirsuta	hairy nardoo	Y	Y	2,3,4,6	
Marsilea mutica	shiny nardoo	Y	Y	2,3,4,6	
Melaleuca bracteata		Y	Y	3,6	
Melaleuca fluviatilis		Y		2,3,6	

Scientific Name	Common Name	R[1]	NR[1]	Priority Number[2]	Panel Comments
Melaleuca leucadendra	broad-leaved tea-tree	Y	Y	2,3,6	
Melaleuca viminalis		Y	Y	2,3,6	
Monochoria cyanea			Y	2,3,4	
Myriophyllum simulans		Y	Y	2,3,4	
Myriophyllum verrucosum	water milfoil	Y	Y	1,2,3,4,6	
Najas tenuifolia	water nymph	Y	Y	1,2,3,4	
Nauclea orientalis		Y		2,6	
Nelumbo nucifera	pink waterlily	Y	Y	5	
Nymphaea gigantea		Y	Y	2	
Nymphaea violacea		Y	Y	1,2	More prevalent than specimens suggest. Taxonomically difficult group
Nymphoides exiliflora		Y	Y	2,3,4	
Nymphoides indica	water snowflake	Y	Y	2,3,4	
Oryza australiensis			Y	1,2,3,4,6,7	
Oryza rufipogon		Y	Y	1,2,3,4,6,7	
Ottelia alismoides		Y	Y	2	
Ottelia ovalifolia	swamp lily	Y	Y	1,2,3,4	
Pandanus cookii		Y		2,3	
Pandanus spiralis		Y	Y	2,3	
Panicum trachyrhachis			Y	2,3	
Persicaria barbata		Y	Y	2,3	
Phragmites australis	common reed	Y	Y	3,5,7	
Pseudoraphis spinescens	spiny mudgrass		Y	2,3,4,6	
Schoenoplectiella mucronata		Y	Y	2,3,4,6	
Scleria mackaviensis		Y	Y	2,3	
Sphenoclea zeylanica		Y	Y	1,2,5,8	Subject to alluvial and tidal action. RE 2.1.5
Typha domingensis		Y	Y	2,3,6	
Vallisneria nana		Y	Y	2,3,4	

[1] R = Riverine, NR = Non-riverine.

[2] The priority number is the priority attribute each species exhibit.

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 values and/or native species were considered. The panel identified 16 exotic fauna taxa relevant to the riverine and non-riverine wetlands of the study areas (Table 6).

Pest distribution (species occurrence) maps produced by Biosecurity Queensland (Department of Agriculture and Fisheries) and point records for the listed species were used to pinpoint spatial units containing exotic fauna taxa to calculate scores for the AquaBAMM measures 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) within the wetland).

The panel also highlighted abundance and degree of infestation as important factors in determining the overall impact of exotic species on wetland ecosystems. The AquaBAMM project team is currently exploring the incorporation of abundance and degree of infestation into future assessments.

Table 6. Exotic fauna taxa impacting study area wetland values

Scientific name	Common name	R[1]	NR[1]	M1.1.1	M1.1.3	M1.1.4	Panel comments
Invertebrate							
Melanoides tuberculata	snail		Y		Y		Recorded in spring on Talaroo Station
Fish							
Carassius auratus	goldfish	Y	Y	Y			Only one very old record
Gambusia holbrooki	eastern gambusia	Y	Y	Y			
Poecilia reticulata	guppy	Y	Y	Y			
Tilapia mariae	spotted tilapia	Y	Y	Y			
Xiphophorus hellerii	swordtail	Y	Y	Y			
Amphibian							
Rhinella marina	cane toad	Y	Y			Y	Impact on native predators/ frogs. Influences food webs at catchment scale. Eggs can influence water quality through the poison emanating from the eggs
Bird							
Lonchura punctulata	nutmeg mannikin	Y	Y			Y	Resource competitor for native finches
Mammal							
Bos indicus	zebu	Y	Y			Y	Wetland degradation
Bos spp.	cattle spp.	Y	Y			Y	Wetland degradation
Bos taurus	European cattle	Y	Y			Y	Wetland degradation

Scientific name	Common name	R[1]	NR[1]	M1.1.1	M1.1.3	M1.1.4	Panel comments
Canis familiaris	dog	Y	Y			Y	Predation on waterbirds. Use DAFF raster
Equus caballus	horse	Y	Y			Y	Wetland degradation. Use DAFF raster
Felis catus	cat	Y	Y			Y	Predation on waterbirds. Use DAFF raster
Sus scrofa	pig	Y	Y			Y	Wetland degradation and predation on turtle nests. Use DAFF raster
Vulpes vulpes	red fox	Y	Y			Y	Predation on waterbirds

[1] R = Riverine, NR = Non-riverine.

4.2 Fauna species richness

Fauna species richness (total number of species) was calculated using wetland dependent species. Such a species as is 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 57 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 pinpoint spatial units containing native amphibian taxa to calculate species richness scores for the 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	R[1] (M3.1.1)	NR[1] (M3.1.6)	Panel comments
Crinia deserticola	chirping froglet	Y	Y	
Crinia remota	northern froglet		Y	
Cyclorana alboguttata	greenstripe frog		Y	
Cyclorana australis	northern snapping frog		Y	
Cyclorana brevipes	superb collared frog		Y	
Cyclorana cryptotis	earless frog		Y	Disjunct populations (EHP 2015a)
Cyclorana cultripes	grassland collared frog		Y	
Cyclorana manya	little collared frog		Y	Largely restricted to study area (EHP 2015a)
Cyclorana novaehollandiae	eastern snapping frog		Y	
Limnodynastes convexiusculus	marbled frog		Y	

Scientific name	Common name	R[1] (M3.1.1)	NR[1] (M3.1.6)	Panel comments
Limnodynastes peronii	striped marshfrog	Y	Y	
Limnodynastes tasmaniensis	spotted grassfrog		Y	
Limnodynastes terraereginae	scarlet sided pobblebonk	Y	Y	
Litoria bicolor	northern sedgefrog	Y	Y	
Litoria caerulea	common green treefrog	Y	Y	
Litoria dahlii	northern waterfrog	Y	Y	Largely restricted to study area (EHP 2015a)
Litoria dayi	Australian lacelid	Y		Check with Harry Hines as there are many invalid records. Also Keith McDonald.
Litoria electrica	buzzing treefrog		Y	
Litoria fallax	eastern sedgefrog	Y	Y	
Litoria gracilenta	graceful treefrog	Y	Y	
Litoria inermis	bumpy rocketfrog	Y	Y	
Litoria infrafrenata	white Lipped treefrog	Y	Y	
Litoria jungguy	northern stony creek frog	Y	Y	
Litoria latopalmata	broad palmed rocketfrog	Y	Y	
Litoria lorica	little waterfall frog	Y		
Litoria microbelos	javelin frog		Y	
Litoria myola	Kuranda treefrog	Y		
Litoria nannotis	waterfall frog	Y		
Litoria nasuta	striped rocketfrog	Y	Y	
Litoria nigrofrenata	tawny rocketfrog	Y	Y	
Litoria nyakalensis	mountain mistfrog	Y		
Litoria pallida	pallid rocketfrog	Y	Y	
Litoria rheocola	common mistfrog	Y		
Litoria rothii	northern laughing Treefrog	Y	Y	
Litoria rubella	ruddy treefrog	Y	Y	
Litoria serrata	tapping green-eyed treefrog	Y		
Litoria sp. *'wilcoxii/jungguy'*	stony creek frog	Y	Y	
Litoria tornieri	black-shinned rocketfrog		Y	

Scientific name	Common name	R[1] (M3.1.1)	NR[1] (M3.1.6)	Panel comments
Litoria wilcoxii	eastern stony creek frog	Y	Y	
Litoria xanthomera	orange thighed treefrog	Y	Y	
Mixophyes carbinensis	Carbine barred frog	Y	Y	
Mixophyes coggeri	mottled barred frog	Y	Y	
Mixophyes schevilli	northern barred-frog	Y	Y	
Mixophyes schevilli (spp. complex)	northern barred-frog complex	Y	Y	
Notaden melanoscaphus	brown shovelfoot		Y	
Notaden nichollsi	desert shovelfoot		Y	Small disjunct population (EHP 2015a)
Papurana daemeli	Australian woodfrog	Y	Y	
Platyplectrum ornatum	ornate burrowing frog	Y	Y	
Pseudophryne covacevichae	magnificent broodfrog		Y	
Pseudophryne major	great brown broodfrog	Y	Y	
Taudactylus acutirostris	sharp snouted dayfrog	Y		
Taudactylus rheophilus	northern tinkerfrog	Y		
Uperoleia altissima	tableland gungan	Y	Y	
Uperoleia lithomoda	stonemason gungan		Y	
Uperoleia littlejohni	Einasleigh gungan	Y	Y	
Uperoleia mimula	mimicking gungan		Y	
Uperoleia trachyderma	orange shouldered gungan		Y	

R = Riverine, NR = Non-riverine.

4.2.2 Fish richness

The panel identified 102 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 pinpoint spatial units containing native fish taxa to calculate species richness scores for the AquaBAMM measure 3.1.2 (Richness of native fish).

Table 8. Aquatic dependent native fish taxa

Scientific name	Common name	R[1]	NR[1]	Panel comments
Acanthopagrus berda/pacificus	pikey bream	Y		
Ambassis agassizii	Agassiz's glassfish	Y	Y	
Ambassis agrammus	sailfin glassfish	Y	Y	
Ambassis elongatus	elongate glassfish	Y	Y	Restricted to Gulf catchments
Ambassis macleayi	Macleay's glassfish	Y	Y	
Ambassis miops	flagtail glassfish	Y		Disjunct population. Recorded by T. Vallance on 2 separate occasions at Mutton Hole Wetlands near Normanton.
Ambassis nalua	scalloped glassfish	Y		
Ambassis sp.	glassfish sp.	Y	Y	
Ambassis sp. 'Northwest' (*mulleri*)	northwest glassfish	Y	Y	
Ambassis vachelli	Vachell's glassfish	Y		
Amniataba caudavittata	yellowtail grunter	Y		
Amniataba percoides	barred grunter	Y	Y	
Anodontiglanis dahli	toothless catfish	Y		
Arrhamphus sclerolepis	snubnose garfish	Y	Y	
Bostrychus zonatus	sunset gudgeon	Y	Y	
Brachirus salinarum	saltpan sole	Y		
Brachirus selheimi	freshwater sole	Y		
Brachirus sp.	sole sp.	Y		
Butis butis	crimsontip gudgeon	Y		
Carcharhinus leucas	bull shark	Y		Top predator in freshwater, one of only 4. Juveniles remain in freshwater for first 4 or 5 years and as adult, then move in to estuaries. Migratory species in this context
Chanos chanos	milkfish	Y		
Chlamydogobius ranunculus	tadpole goby		Y	Found in bores in Flinders & Norman. Taxonomy unresolved
Chlamydogobius sp.	goby sp.	Y	Y	

Scientific name	Common name	R[1]	NR[1]	Panel comments
Cinetodus froggatti	smallmouth catfish	Y		
Clupeoides cf. *papuensis*	Papuan sprat/toothed river herring	Y	Y	Possible undescribed taxon
Craterocephalus munroi	Munro's hardyhead	Y		
Craterocephalus sp.	hardyhead sp.	Y	Y	
Craterocephalus stercusmuscarum	flyspecked hardyhead	Y	Y	
Denariusa australis	pennyfish	Y	Y	
Eleotris sp.	gudgeon sp.	Y		
Gerres filamentosus	threadfin silverbiddy	Y		
Gerres sp.	silver biddy sp.	Y		
Glossamia aprion	mouth almighty	Y	Y	
Glossogobius aureus	golden flathead goby	Y		
Glossogobius giurus	tank goby	Y		
Glossogobius munroi	square-blotch/Munro's goby	Y		
Glossogobius sp.	goby sp.	Y	Y	Possibly undescribed taxon in Gilbert
Glossogobius sp. 3 - dwarf	dwarf goby	Y		Only vague record from Mitchell catchment
Hephaestus carbo	coal grunter	Y	Y	
Hephaestus fuliginosus	sooty grunter	Y	Y	Migratory within main channel. Uses riffles and runs as spawning grounds. Especially found in Mitchell
Himantura dalyensis	freshwater whipray	Y		Poorly known. One of only 3-4 obligate freshwater elasobrachii. Only freshwater stingray in Aust. Grows to 2.5 m in diameter and can be 5 m long. Gulf is stronghold
Hypseleotris compressa	empire gudgeon	Y	Y	
Hypseleotris sp.	gudgeon sp.	Y	Y	
Hypseleotris sp. 1	Midgley's carp gudgeon	Y	Y	
Iriatherina werneri	threadfin rainbowfish	Y	Y	
Kurtus gulliveri	nurseryfish	Y	Y	Poorly known. Relictual. Puts eggs on head in a hook. Very unusual reproduction strategies. Primarily estuarine but also in freshwater. Restricted to lower end of southern gulf catchments. Considered potentially vulnerable (Le Feuvre et al. 2016)
Lates calcarifer	barramundi	Y	Y	Massive abundance and also migratory

Scientific name	Common name	R[1]	NR[1]	Panel comments
Leiopotherapon unicolor	spangled perch	Y	Y	Flood colonist species. Persists where others can't (Brendan Ebner)
Lutjanus argentimaculatus	mangrove jack	Y		
Megalops cyprinoides	oxeye herring/tarpon	Y	Y	
Melanotaenia nigrans	blackbanded rainbowfish	Y	Y	
Melanotaenia sp.	rainbowfish sp.	Y	Y	
Melanotaenia splendida	eastern rainbowfish	Y	Y	
Melanotaenia trifasciata	banded rainbowfish	Y	Y	
Mogurnda adspersa	southern purplespotted gudgeon	Y		
Mogurnda mogurnda	northern purplespotted gudgeon	Y		
Mogurnda sp.	gudgeon sp.	Y		
Mugil cephalus	sea mullet	Y	Y	
Nematalosa erebi	bony bream	Y	Y	
Neoarius berneyi	highfin catfish	Y		
Neoarius graeffei	blue catfish	Y	Y	
Neoarius midgleyi	silver cobbler	Y	Y	
Neoarius sp.	fork-tailed catfish sp.	Y	Y	
Neosilurus ater	black catfish	Y	Y	Moves in to ephemeral creeks to breed (Brendan Ebner)
Neosilurus hyrtlii	Hyrtl's catfish	Y	Y	Moves in to ephemeral creeks to breed (Brendan Ebner)
Neosilurus sp.	eel-tailed catfish sp.	Y	Y	Migratory upstream within freshwater to breeding areas.
Ophiocara porocephala	spangled gudgeon	Y	Y	Contact Brendan to check.
Ophisternon gutturale	swamp eel	Y	Y	
Ophisternon sp.	swamp eel sp.	Y	Y	
Oxyeleotris lineolata	sleepy cod	Y	Y	
Oxyeleotris selheimi	blackbanded gudgeon	Y	Y	
Oxyeleotris sp.	gudgeon sp.	Y	Y	
Parambassis gulliveri	giant glassfish	Y	Y	
Pingalla gilberti	Gilbert's grunter	Y		Endemic to study areas
Porochilus argenteus	silver catfish	Y	Y	Old identification. Confirmed by Michael

Scientific name	Common name	R[1]	NR[1]	Panel comments
				Hammer
Porochilus rendahli	Rendahl's catfish	Y	Y	
Porochilus sp. 3	Delta Downs catfish sp.	Y	Y	Endemic, undescribed taxon of conservation concern
Porochilus sp. Flinders	Flinders River catfish sp.	Y		Endemic, undescribed taxon? Biggest species in the genus in Indopacific
Prionobutis microps	smalleye gudgeon	Y		
Pristis pristis	freshwater sawfish	Y	Y	Records can be high up. Can be occasionally found in non-riverine wetlands
Psammogobius biocellatus	sleepy goby	Y		
Pseudogobius sp.	goby sp.		Y	Possible undescribed taxon
Pseudomugil sp.	blue-eye sp.	Y	Y	
Pseudomugil tenellus	delicate blue eye		Y	
Redigobius bikolanus	speckled goby	Y	Y	
Scatophagus argus	spotted scat	Y		
Sciades leptaspis	boofhead catfish	Y		
Sciades paucus	shovelnose catfish	Y	Y	
Scleropages jardinii	northern saratoga	Y	Y	
Scortum ogilbyi	gulf grunter	Y	Y	Endemic to study areas
Scortum sp.	grunter sp.	Y	Y	
Selenotoca multifasciata	striped scat	Y		
Strongylura krefftii	freshwater longtom	Y	Y	Accesses range of habitats. Spawns under low or no flow. Very unlike other species. (Brendan Ebner)
Terapon jarbua	crescent grunter	Y		
Thryssa scratchleyi	freshwater thryssa	Y	Y	Restricted range with important core habitat in southern Gulf (Mike Hammer)
Thryssa sp.	thryssa sp.	Y	Y	Possible undescribed taxon
Toxotes chatareus	sevenspot archerfish	Y	Y	
Toxotes jaculatrix	banded archerfish	Y		
Variichthys lacustris	lake grunter		Y	Highly disjunct population; very limited distribution. Possible indicator of a different geomorphological wetland type. Warrants further investigation/intensive surveys. Considered potentially vulnerable (Le Feuvre et al 2016)
Zenarchopterus buffonis	northern river garfish	Y		

Scientific name	Common name	R[1]	NR[1]	Panel comments
Zenarchopterus dispar	spoonfin river garfish	Y		
Zenarchopterus novaeguineae	Fly River garfish	Y		

[1] R = Riverine, NR = Non-riverine.

4.2.3 Reptile richness

The panel identified 20 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 pinpoint spatial units containing native reptile taxa to calculate scores for the AquaBAMM measure 3.1.3 (Richness of native aquatic dependent reptiles).

Table 9. Aquatic dependent native reptile taxa

Scientific name	Common name	R[1]	NR[1]	Panel comments
Acrochordus arafurae	Arafura file snake	Y	Y	
Acrochordus granulatus	little file snake	Y	Y	
Chelodina canni	Cann's longneck turtle	Y	Y	
Chelodina oblonga/rugosa	northern snake-necked turtle	Y	Y	Impact of pig predation (Fordham et al. 2006)
Chelodina sp.	turtle sp.	Y	Y	
Crocodylus johnstoni	Australian freshwater crocodile	Y		
Crocodylus porosus	estuarine crocodile	Y	Y	
Crocodylus sp.	crocodile sp.	Y		
Elseya sp.	turtle sp.	Y	Y	
Emydura macquarii krefftii	Krefft's river turtle	Y	Y	
Emydura sp.	turtle sp.	Y	Y	
Emydura subglobosa worrelli	diamond head turtle	Y	Y	
Emydura tanybaraga	northern yellow-faced turtle	Y	Y	Largely restricted to study area (EHP 2015a) but current taxonomic status uncertain (A. Freeman)
Intellagama lesueurii	eastern water dragon	Y	Y	
Liasis mackloti	water python	Y	Y	
Pseudoferania polylepis	Macleay's water snake	Y	Y	
Tropidonophis mairii	freshwater snake	Y	Y	
Varanus mertensi	Mertens' water monitor	Y	Y	Impacted by cane toads
Varanus mitchelli	Mitchell's water monitor	Y	Y	Impacted by cane toads
Wollumbinia latisternum	saw-shelled turtle	Y	Y	

[1] R = Riverine, NR = Non-riverine.

4.2.4 Waterbird richness

The panel identified 109 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 natural life functions were considered.

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

Table 10. Aquatic dependent native bird taxa

Scientific name	Common name	R[1]	NR[1]	Panel comments
Acrocephalus australis	Australian reed-warbler	Y	Y	
Actitis hypoleucos	common sandpiper	Y		
Amaurornis cinerea	white-browed crake	Y	Y	
Amaurornis moluccana	pale-vented bush-hen	Y	Y	
Anas castanea	chestnut teal	Y	Y	Vagrant occurrence
Anas gracilis	grey teal	Y	Y	
Anas querquedula	garganey	Y	Y	Vagrant occurrence
Anas rhynchotis	Australasian shoveler	Y	Y	Vagrant occurrence
Anas superciliosa	Pacific black duck	Y	Y	
Anhinga novaehollandiae	Australasian darter	Y	Y	
Anseranas semipalmata	magpie goose	Y	Y	
Ardea ibis	cattle egret	Y	Y	
Ardea intermedia	intermediate egret	Y	Y	
Ardea modesta	eastern great egret	Y	Y	
Ardea pacifica	white-necked heron	Y	Y	
Ardea sumatrana	great-billed heron	Y	Y	
Aythya australis	hardhead	Y	Y	
Biziura lobata	Musk Duck	Y	Y	Vagrant occurrence
Butorides striata	striated heron	Y		
Calidris acuminata	sharp-tailed sandpiper		Y	
Calidris ferruginea	curlew sandpiper		Y	
Calidris melanotos	pectoral sandpiper		Y	
Calidris ruficollis	red-necked stint		Y	
Ceyx azureus	azure kingfisher	Y	Y	
Ceyx pusillus	little kingfisher	Y	Y	

Scientific name	Common name	R[1]	NR[1]	Panel comments
Charadrius dubius	little ringed plover		Y	Vagrant occurrence
Charadrius ruficapillus	red-capped plover		Y	
Charadrius veredus	Oriental plover		Y	
Chenonetta jubata	Australian wood duck	Y	Y	
Chlidonias hybrida	whiskered tern	Y	Y	
Chlidonias leucopterus	white-winged black tern	Y	Y	
Chroicocephalus novaehollandiae	silver gull	Y	Y	
Circus approximans	swamp harrier		Y	
Cisticola exilis	golden-headed cisticola	Y	Y	
Cisticola juncidis normani	Zitting cisticola (Normanton subsp.)		Y	Endemic subspecies
Cygnus auratus	black swan	Y	Y	
Dendrocygna arcuata	wandering whistling-duck	Y	Y	
Dendrocygna eytoni	plumed whistling-duck	Y	Y	
Dendrocygna guttata	spotted whistling-duck	Y	Y	Vagrant occurrence
Egretta garzetta	little egret	Y	Y	
Egretta novaehollandiae	white-faced heron	Y	Y	
Egretta picata	pied heron	Y	Y	
Elanus scriptus	letter-winged kite	Y	Y	Boom and bust species. After rain, it breeds along creek lines. Lives in floodplains along creeks and around waterholes. Nest in riparian trees/shrubs
Elseyornis melanops	black-fronted dotterel	Y	Y	
Ephippiorhynchus asiaticus	black-necked stork	Y	Y	
Epthianura crocea	yellow chat		Y	
Erythrogonys cinctus	red-kneed dotterel	Y	Y	
Erythrotriorchis radiatus	red goshawk	Y	Y	Breeding within 1km of river. Hunting within 100m of river. A major part of red goshawk's life cycle is dependent upon freshwater habitats. Non-riverine wetlands used for breeding
Eulabeornis castaneoventris	chestnut rail	Y	Y	
Fulica atra	Eurasian coot	Y	Y	

Scientific name	Common name	R[1]	NR[1]	Panel comments
Gallinago hardwickii	Latham's snipe	Y	Y	Normanton area record (Roger Jaensch)
Gallinago megala	Swinhoe's snipe	Y	Y	Normanton area record (Roger Jaensch)
Gallinula tenebrosa	dusky moorhen	Y	Y	
Gallirallus philippensis	buff-banded rail	Y	Y	
Gelochelidon nilotica	gull-billed tern	Y	Y	
Glareola maldivarum	Oriental pratincole		Y	Many thousands can gather in open shallow wetlands for drinking/resting in the hot middle part of the day; recorded on Karumba Plain (Roger Jaensch)
Grus antigone	sarus crane		Y	
Grus rubicunda	brolga	Y	Y	Swampy watercourses
Haliaeetus leucogaster	white-bellied sea-eagle	Y	Y	
Haliastur indus	brahminy kite	Y	Y	
Himantopus himantopus	black-winged stilt	Y	Y	
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	
Lewinia pectoralis	Lewin's rail	Y	Y	
Limosa limosa	black-tailed godwit		Y	
Malacorhynchus membranaceus	pink-eared duck	Y	Y	
Megalurus gramineus	little grassbird	Y	Y	
Megalurus timoriensis	tawny grassbird	Y	Y	
Microcarbo melanoleucos	little pied cormorant	Y	Y	
Myiagra alecto	shining flycatcher	Y		Riparian habitat
Myiagra nana	paperbark flycatcher	Y		Riparian habitat dependent
Neochmia phaeton evangelinae	Crimson finch (white-bellied subsp.)	Y	Y	Feeds and nests in riparian habitat
Neochmia phaeton phaeton	crimson finch	Y	Y	Feeds and nests in riparian habitat
Nettapus coromandelianus	cotton pygmy-goose	Y	Y	
Nettapus pulchellus	green pygmy-goose	Y	Y	

Scientific name	Common name	R[1]	NR[1]	Panel comments
Numenius minutus	little curlew		Y	Many thousands occur on Karumba Plain using the *Xerochloa* grasslands and included non-riverine grass-sedge wetlands, on a daily basis in the Wet season, though with erratic abundance and timing
Nycticorax caledonicus	nankeen night-heron	Y	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	
Phalaropus fulicarius	grey phalarope		Y	Vagrant occurrence
Platalea flavipes	yellow-billed spoonbill	Y	Y	
Platalea regia	royal spoonbill	Y	Y	
Plegadis falcinellus	glossy ibis	Y	Y	
Pluvialis fulva	Pacific golden plover		Y	
Podiceps cristatus	great crested grebe	Y	Y	
Poliocephalus poliocephalus	hoary-headed grebe	Y	Y	
Porphyrio porphyrio	purple swamphen	Y	Y	
Porzana fluminea	Australian spotted crake	Y	Y	
Porzana pusilla	Baillon's crake	Y	Y	
Porzana tabuensis	spotless crake	Y	Y	
Rallina tricolor	red-necked crake		Y	
Recurvirostra novaehollandiae	red-necked avocet		Y	
Rhipidura dryas	Arafura fantail	Y		Riparian habitat
Rostratula australis	Australian painted snipe		Y	Recorded on Karumba Plain (Roger Jaensch)
Stictonetta naevosa	freckled duck	Y	Y	Recorded in small numbers on the seasonal swamps on Karumba Plain (Roger Jaensch)
Tachybaptus novaehollandiae	Australasian grebe	Y	Y	
Tadorna radjah	radjah shelduck	Y	Y	
Threskiornis molucca	Australian white ibis	Y	Y	

Scientific name	Common name	R[1]	NR[1]	Panel comments
Threskiornis spinicollis	straw-necked ibis	Y	Y	
Tribonyx ventralis	black-tailed native-hen	Y	Y	
Tringa glareola	wood sandpiper		Y	
Tringa nebularia	common greenshank	Y	Y	
Tringa stagnatilis	marsh sandpiper	Y	Y	
Vanellus miles	masked lapwing	Y	Y	

R = Riverine, NR = Non-riverine.

4.2.5 Mammal richness

Only 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 pinpoint spatial units containing mammal taxa to calculate species richness scores for the AquaBAMM measure 3.1.7 (Richness of native aquatic dependent mammals).

Table 11. Aquatic dependent native mammal taxa

Scientific name	Common name	R[1]	NR[1]	Panel comments
Hydromys chrysogaster	water rat	Y	Y	
Myotis macropus	large-footed myotis	Y	Y	
Ornithorhynchus anatinus	platypus	Y	Y	Upper Mitchell is the only Gulf river distribution of this species. Consider nominating as priority species
Pipistrellus westralis	northern/mangrove pipistrelle	Y		
Rattus lutreolus	swamp rat	Y	Y	

[1] R = Riverine, NR = Non-riverine.

4.2.6 Macroinvertebrate richness

The panel advised against use of wetland-dependent macroinvertebrate taxa lists to calcuate macroinvertebrate diversity for the study areas. They based this recommendation on the lack of detailed macroinvertebrate surveys across the region. The expert panel instead suggested the use of maximum richness scores based on higher-level macroinvertebrates studies undertaken using recognised survey and analysis methods (i.e. such as those use dby by Conrick & Cockayne 2000, Chessman 2003, and Healthy Waterways 2012). While such methods estimate macroinvertebrate diversity at the broad taxonomic group level (e.g. sub-family, family, order or class), the view of the panel was that such an approach would provide a more realistic 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).

Maximum macroinvertebrate richness values were used to estimate macroinvertebrate richness for AquaBAMM measure 3.2.1 (Richness of macroinvertebrate taxa).

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 near threatened, vulnerable, endangered, or critically endangered under the Queensland *Nature Conservation Act 1992* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were considered.

Point records for the listed species were used to pinpoint spatial units containing near threatened or threatened fauna taxa to calculate scores for the 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	R[1]	NR[1]	NCA[2]	EPBC[3]	Panel comments
Fish						
Pristis pristis	freshwater sawfish	Y	Y		V	
Amphibian						
Litoria dayi	Australian lacelid	Y		E	E	
Litoria lorica	little waterfall frog	Y		E	CE	
Litoria myola	Kuranda treefrog	Y		E	E	
Litoria nannotis	waterfall frog	Y		E	E	
Litoria nyakalensis	mountain mistfrog	Y		E	CE	
Litoria rheocola	common mistfrog	Y		E	E	
Litoria serrata	tapping green-eyed treefrog	Y		V		
Pseudophryne covacevichae	magnificent broodfrog		Y	V	V	
Taudactylus rheophilus	northern tinkerfrog	Y		E	E	
Reptile						
Crocodylus porosus	estuarine crocodile	Y	Y	V		
Emydura subglobosa worrelli	diamond head turtle	Y	Y	NT		
Bird						
Calidris ferruginea	curlew sandpiper		Y	E	CE	
Epthianura crocea	yellow chat		Y	V		
Erythrotriorchis radiatus	red goshawk	Y	Y	E	V	Breeding within 1km of river. Hunting within 100m of river. A major part of red goshawk's life cycle is dependent upon freshwater habitats. Non-riverine wetlands used for breeding
Neochmia phaeton evangelinae	Crimson finch (white-bellied subsp.)	Y	Y	E	V	

Scientific name	Common name	R[1]	NR[1]	NCA[2]	EPBC[3]	Panel comments
Rostratula australis	Australian painted snipe	Y	Y	V	E	

[1] R = Riverine, NR = Non-riverine.

[2] NCA—Queensland Nature Conservation Act *1992*: E = endangered, V = vulnerable, NT = near threatened, LC = least concern.

[3] EPBC—Commonwealth Environment Protection and Biodiversity Conservation Act *1999*: Ex= extinct, CE = critically endangered, E = endangered, V = vulnerable.

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 critically endangered, endangered, vulnerable or near threatened under 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 41 priority fauna taxa relevant to the riverine and non-riverine wetlands of study areas (Table 13). Of these, nine were invertebrates (crustaceans and mollusc) and 32 were vertebrates (fish, amphibians, reptiles, birds and mammals).

Point records for the listed species were used to pinpoint spatial units containing priority fauna taxa to calculate scores for the AquaBAMM measure 5.1.1 (Presence of aquatic ecosystem dependent 'priority' fauna species).

Table 13. Aquatic dependent priority fauna taxa

Scientific name	Common name	R[1]	NR[1]	Priority number[2]	Panel comments
Invertebrate					
Austrothelphusa agassizi		Y		8	Life history makes it susceptible to impacts of climate change/reduced water flow (Waltham 2016)
Austrothelphusa sp.	Crab sp.	Y		8	Life history makes it susceptible to impacts of climate change/reduced water flow (Waltham 2016)
Austrothelphusa tigrina		Y		1, 4, 5, 8	Localised distribution mainly in Alice River
Austrothelphusa transversa	freshwater crab	Y		8	Life history makes it susceptible to impacts of climate change/reduced water flow (Waltham 2016)
Austrothelphusa wasselli		Y		8	Life history makes it susceptible to impacts of climate change/reduced water flow (Waltham 2016)
Cherax depressus 'White Mts'		Y	Y	1	Small streams. May be new spp. in White Mtns if so then should be priority species
Cherax wasselli		Y		1, 4, 5	Found in Kuranda area then into Mitchell. Population tends to be in upper Mitchell. Very localised. At interface of uplands and human impact.
Euastacus fleckeri	freshwater crayfish	Y		1?, 4, 5	Listed under IUCN. Approx 50% of species

Scientific name	Common name	R[1]	NR[1]	Priority number[2]	Panel comments
					distribution is in the Mitchell catchment. Located predominately above 800m. There are 52 spp. in the genus. Evolutionary split
Lamprellia angulata	Copperfield River keeled snail	Y		1	Restricted to riparian habitat in Copperfield River
Fish					
Ambassis elongatus	elongate glassfish	Y	Y	1	Restricted to Gulf catchments
Ambassis miops	flagtail glassfish	Y		5	Disjunct population. Unlikely to be in Gulf (Brendan Ebner). Recorded by T. Vallance on 2 separate occasions at Mutton Hole Wetlands
Carcharhinus leucas	bull shark	Y		6	Top predator in freshwater, one of only 4. Juveniles remain in freshwater for first 4 or 5 years and as adult, then move in to estuaries. Migratory species in this context
Clupeoides cf. *papuensis*	Papuan sprat/toothed river herring	Y	Y	5	Possible undescribed taxon
Hephaestus fuliginosus	sooty grunter	Y	Y	6	Migratory within main channel. Uses riffles and runs as spawing grounds. Especially found in Mitchell
Himantura dalyensis	freshwater whipray	Y		4	Poorly known. One of only 3-4 obligate freshwater elasobrachii. Only freshwater stingray in Australia. Grows to 2.5 m in diameter and can be 5 m long. Gulf is stronghold
Kurtus gulliveri	nurseryfish	Y	Y	1?, 4	Poorly known. Relictual. Puts eggs on head in a hook. Very unusual reproduction strategies. Primarily estuarine but also in freshwater. Restricted to lower end of southern gulf catchments. Considered potentially vulnerable (Le Feuvre et al. 2016)
Lates calcarifer	barramundi	Y	Y	6	Massive abundance and also migratory
Leiopotherapon unicolor	spangled perch	Y	Y	6	Flood colonist species. Persists where others can't (Brendan Ebner).
Neosilurus ater	black catfish	Y	Y	6	Moves in to ephemeral creeks to breed (Brendan Ebner)
Neosilurus hyrtlii	Hyrtl's catfish	Y	Y	6	Moves in to ephemeral creeks to breed (Brendan Ebner)
Neosilurus sp.	Eel-tailed catfish sp.	Y	Y	6	Migratory upstream within freshwater to breeding areas
Pingalla gilberti	Gilbert's grunter	Y		1	Endemic to study areas
Porochilus sp. 3	Delta Downs catfish sp.	Y	Y	1	Endemic, undescribed taxon of conservation concern (Mike Hammer)
Porochilus sp. Flinders	Flinders River catfish sp.	Y		1	Endemic, undescribed taxon? Biggest species in the genus in Indopacific

Scientific name	Common name	R[1]	NR[1]	Priority number[2]	Panel comments
Scortum ogilbyi	gulf grunter	Y	Y	1	Endemic to study areas
Strongylura krefftii	freshwater longtom	Y	Y	6	Accesses range of habitats. Spawns under low or no flow. Very unlike other species. (Brendan Ebner)
Thryssa scratchleyi	freshwater thryssa	Y	Y	5	Restricted range with important core habitat in southern Gulf (Mike Hammer)
Variichthys lacustris	lake grunter		Y	4, 5	Highly disjunct population; very limited distribution. Possible indicator of a different geomorphological wetland type. Warrants further investigation/intensive surveys. Considered potentially vulnerable (Le Feuvre et al. 2016)
Amphibian					
Cyclorana cryptotis	earless frog		Y	5	Disjunct populations (EHP 2015a)
Cyclorana manya	little collared frog		Y	1	Largely restricted to study area (EHP 2015a)
Litoria dahlii	northern waterfrog	Y	Y	1, 8	Largely restricted to study area (EHP 2015a)
Notaden nichollsi	desert shovelfoot		Y	4, 5	Small disjunct population (EHP 2015a)
Reptile					
Chelodina oblonga/rugosa	northern snake-necked turtle	Y	Y	2	Impact of pig predation (Fordham et al. 2006)
Varanus mertensi	Mertens' water monitor	Y	Y	2	Impacted by cane toads
Varanus mitchelli	Mitchell's water monitor	Y	Y	2	Impacted by cane toads
Bird					
Calidris acuminata	sharp-tailed sandpiper		Y	7	
Calidris ruficollis	red-necked stint		Y	7	
Cisticola juncidis normani	Zitting cisticola (Normanton subsp.)		Y	1	Endemic subspecies confined to wetlands
Limosa limosa	black-tailed godwit		Y	7	
Numenius minutus	little curlew		Y	7	
Mammal					
Ornithorhynchus anatinus	platypus	Y	Y	4	Upper Mitchell is the only Gulf river distribution of this species

[1] R = Riverine, NR = Non-riverine.

[2] The priority number is the priority attributes exhibited by each species.

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 25 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 pinpoint spatial units containing migratory taxa to calculate the scores for the AquaBAMM measure 5.1.3 (Habitat for, or presence of, migratory species).

Table 14. Migratory taxa listed on international agreements

SCIENTIFIC NAME	COMMON NAME	R[1]	NR[1]	MIGRATORY AGREEMENT
Fish				
Pristis pristis	freshwater sawfish	Y	Y	Bonn
Reptile				
Crocodylus porosus	estuarine crocodile	Y	Y	Bonn
Bird				
Actitis hypoleucos	common sandpiper	Y		CAMBA / JAMBA / ROKAMBA / Bonn
Anas querquedula	garganey	Y	Y	CAMBA / JAMBA / ROKAMBA / Bonn
Calidris acuminata	sharp-tailed sandpiper		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Calidris ferruginea	curlew sandpiper		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Calidris melanotos	pectoral sandpiper		Y	JAMBA / ROKAMBA / Bonn
Calidris ruficollis	red-necked stint		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Charadrius dubius	little ringed plover		Y	CAMBA / JAMBA / ROKAMBA
Charadrius veredus	Oriental plover		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Chlidonias leucopterus	white-winged black tern	Y	Y	CAMBA / JAMBA / ROKAMBA
Gallinago hardwickii	Latham's snipe	Y	Y	JAMBA / ROKAMBA / Bonn
Gallinago megala	Swinhoe's snipe	Y	Y	CAMBA / JAMBA / ROKAMBA / Bonn
Gelochelidon nilotica	gull-billed tern	Y	Y	CAMBA
Glareola maldivarum	Oriental pratincole		Y	CAMBA / JAMBA / ROKAMBA
Hydroprogne caspia	Caspian tern	Y	Y	JAMBA
Limosa limosa	black-tailed godwit		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Numenius minutus	little curlew		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Pandion cristatus	eastern osprey	Y	Y	Bonn
Phalaropus fulicarius	grey phalarope		Y	Bonn
Plegadis falcinellus	glossy ibis	Y	Y	Bonn

Pluvialis fulva	Pacific golden plover		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Tringa glareola	wood sandpiper		Y	CAMBA / JAMBA / ROKAMBA / Bonn
Tringa nebularia	common greenshank	Y	Y	CAMBA / JAMBA / ROKAMBA / Bonn
Tringa stagnatilis	marsh sandpiper	Y	Y	CAMBA / JAMBA / ROKAMBA / Bonn

[1] R = Riverine, NR = Non-riverine.

5 Special Features

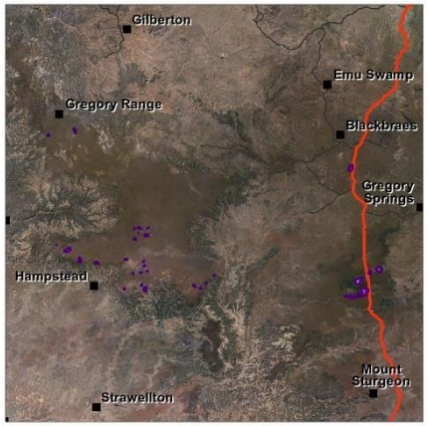
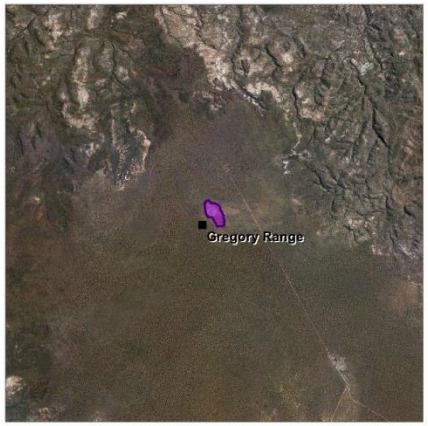
5.1 Special Features

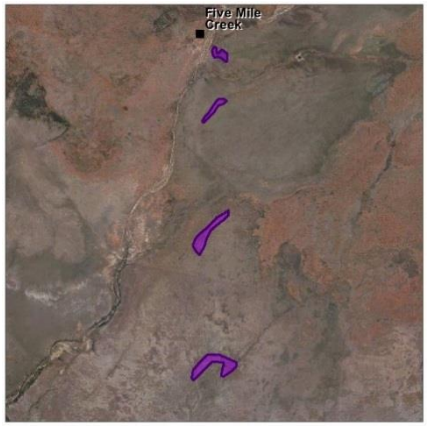
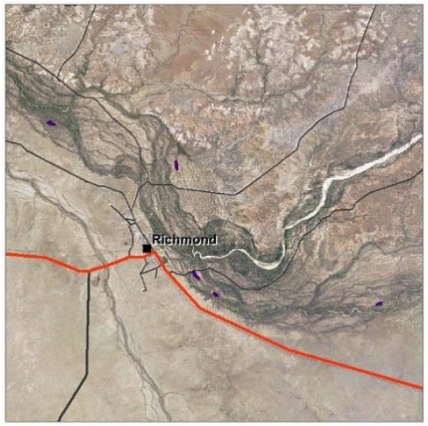
The panel identified flora, fauna and ecology special features relevant to the riverine and non-riverine wetlands of each study area. Where a single special feature decision crossed a number of study areas, the decision has been duplicated for each study area. Each special feature was assigned a conservation rating between 1 (Low) and 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 a lack of readily available data or unconfirmed values are indicated as "Not Implemented" in the special feature tables.

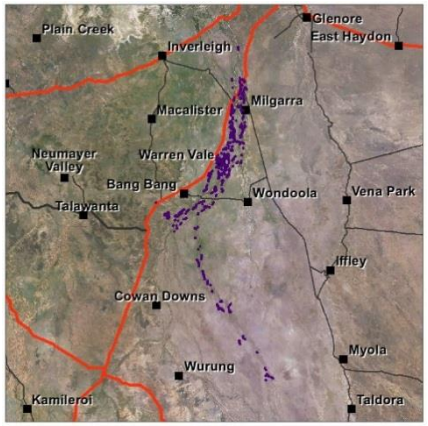
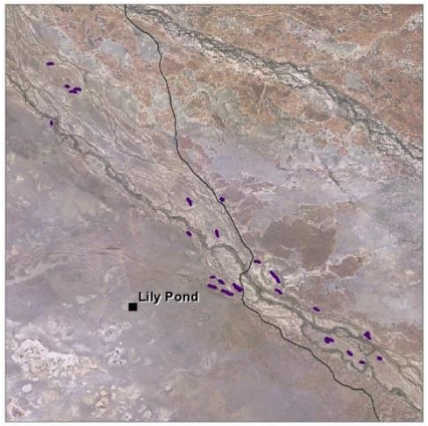
Special features are used to calculate scores for the AquaBAMM measures 5.1.4 (Habitat for significant numbers of waterbirds), 5.2.1 (Presence of 'priority' aquatic ecosystem), 6.1.1 (Presence of distinct, unique or special geomorphic features), 6.2.1 (Presence of or requirement for distinct, unique 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), and 8.2.5 (Wetland type representative of the study area).

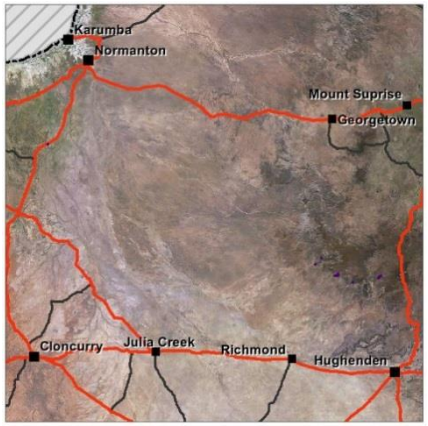
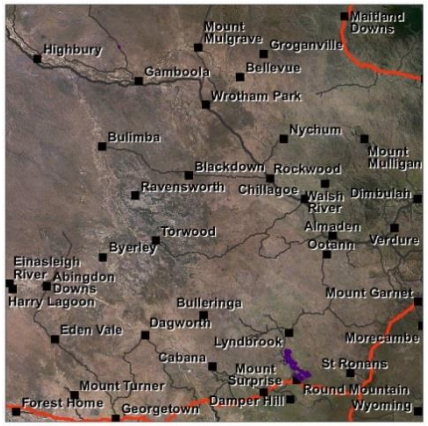
The non-riverine and riverine special features are listed in Table 15 and Table 16 respectively. Each feature may have fauna, flora and/or ecology values, either singularly or in combination. Where appropriate, special feature decisions were derived from the Gulf Plains, Cape York Peninsula and Einasleigh Uplands Biodiverosty Plannign Assessments (DERM 2009a,b; EHP 2012b,c; 2015a,b).

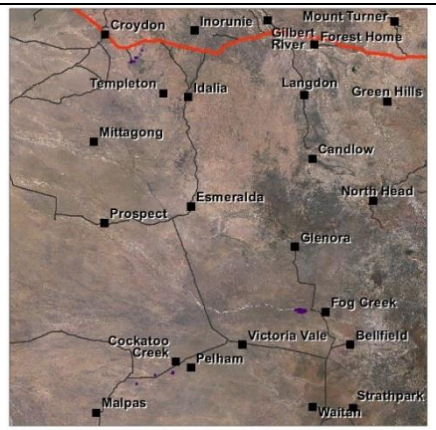
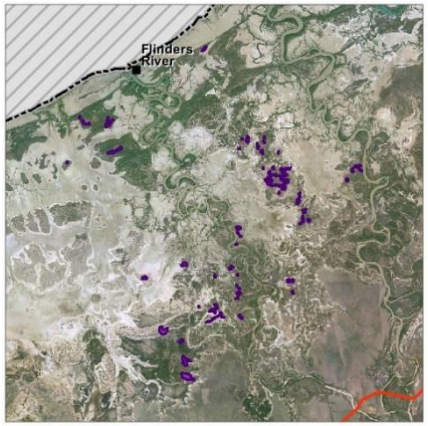
Table 15. Non riverine special features and their values

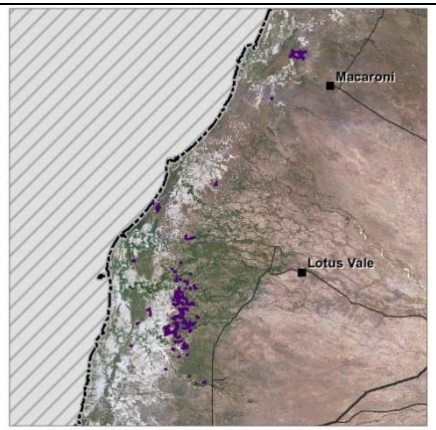
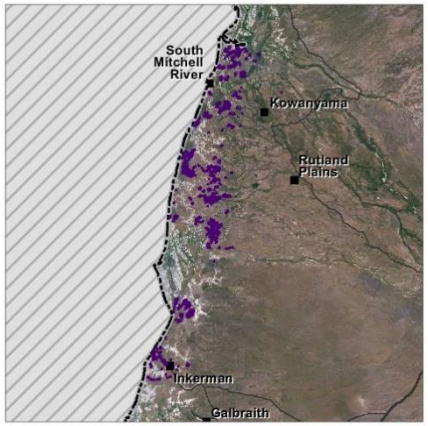
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Sandstone tablelands	 	Flinders Gilbert			Y	These sandstone tablelands are located in the upper part of the Flinders Norman and Gilbert catchments contain nested wetlands which are characteristic and unusual. The full extent of some of the large lakes in the region doesn't currently appear in the wetland mapping. There are no other wetlands like this in the catchment. This is the greatest remaining extent of these plateau sandstone systems in Queensland. The geomorphology of the area is unique and it is thought to also contain unique ecological values. This is an area that would benefit from more study.	6.1.1 6.2.1	3 3	fl_nr_ec_01 gi_nr_ec_12

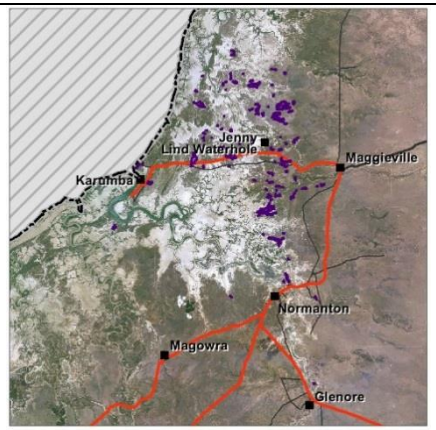
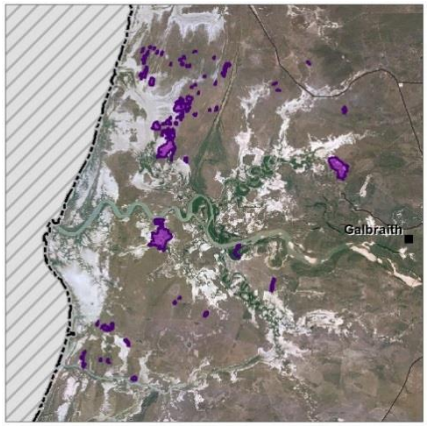
Soda Valley area		Flinders		Y	Y	The Soda Valley area contains a significant local cluster of unique sodic springs in upper tributaries. Currently there are no springs mapped in the wetlands mapping for this area. The palustrine wetlands covered by this special area contain regional ecosystem RE 9.3.10. Additionally the springs in this region discharge on shale not basalt which is unlike other basalt springs in the area.	6.1.1 6.4.1	3 3	fl_nr_ec_02
Flinders River near Marathon		Flinders			Y	This section of the Flinders River contains first time braided systems that appear deeply incised. The area experiences lateral connectivity and provides refugia in and around the semi-permanent/permanent waterbodies.	6.1.1 6.3.1 6.3.4	3 3 3	fl_nr_ec_03

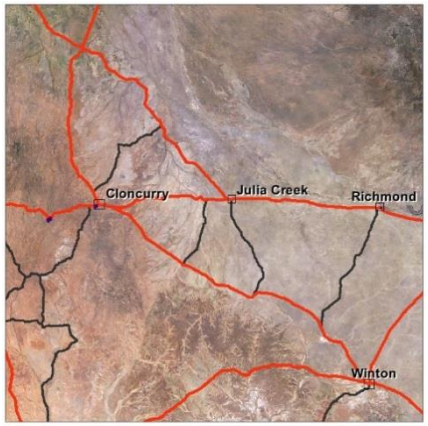
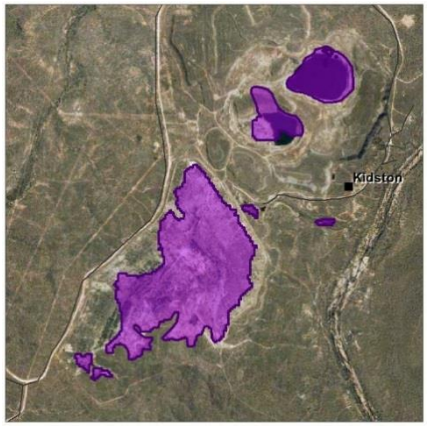
Intersection of Flinders & Saxby Rivers		Flinders	Y		Y	The intersection of the Flinders and Saxby rivers has a good diversity and concentration of deep waterholes within the drainage channel. These waterholes provide refugia and habitat that are connected to the estuarine systems making them important for fish migration and spawning. There is also high potential for waterbird colonies of sarus crane *Grus antigone* pelican *Pelecanus conspicillatus* black-necked stork *Ephippiorhynchus asiaticus* and brolga *Grus rubicunda.*	6.3.1 6.3.4 7.1.2	4 4 4	fl_nr_ec_05
Washpool Lagoon complex		Flinders	Y		Y	The Washpool Lagoon complex is formed by a constriction from the shale hills and sand sheets. The complex is the best development of deep pools and braiding on the Flinders River. With good lateral connectivity persistent waterholes and a large concentration of palustrine systems the area contains significant ecological values.	6.2.1	4	fl_nr_ec_06

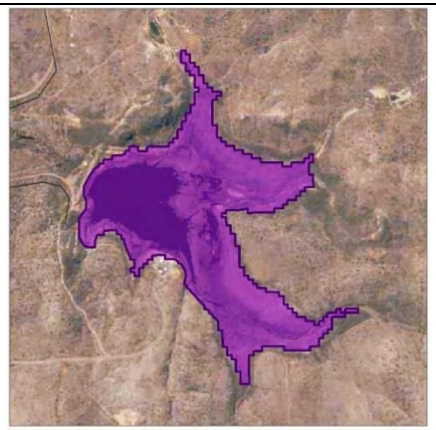
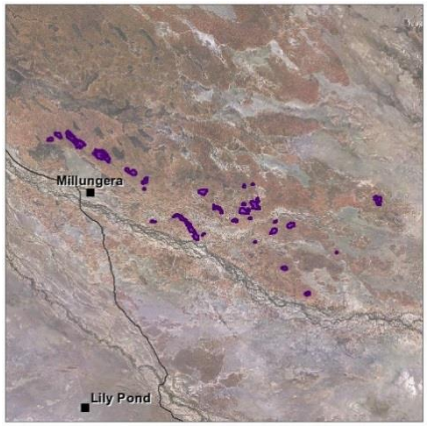
Wetlands fed by Great Artesian Basin springs (Fensham et al. 2006 - Class 1 & 2)	 	Flinders Gilbert Mitchell Norman Staaten			Y	Springs of the Great Artesian Basin feed permanent wetlands that provide oases for unique aquatic life forms in otherwise dry landscapes. For example, an abundance of specialised invertebrates including ostracods, snails, spiders, flatworms and dragonflies are known to occur only in wetlands associated with GAB springs. Likewise, certain grass, herb and sedge species are often restricted to wetlands associated with GAB springs (Fensham 2006). Note: This decision applies to all catchments assessed as part of the EGoC ACA v1.1. In arid environments, a spring with a permanent saturation regime and fixed spatial location may only support surface expression groundwater dependent ecosystems extending less than one hectare from the spring vent. For this reasons a standard distance of 100m was used to identify the location and extent of wetlands dependent upon spring flows. In reality this distance will vary depending on local hydrological characteristics, spring flow rates and extent.	6.3.1 6.3.4 7.2.1	4 4 4	fl_nr_ec_08 ml_nr_ec_17 nn_nr_ec_06

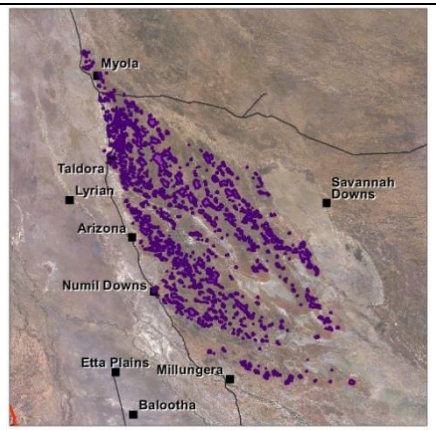
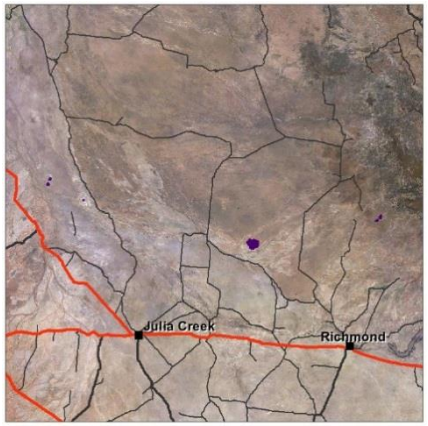
								
Transitional areas adjacent to estuarine zone (Landzone 1)		Flinders Gilbert Mitchell Norman Staaten	Y		Y	Coastal wetlands of the north eastern Gulf are recognised to be vulnerable to impacts associated with predicted sea level rise (Close et al. 2012). Freshwater wetlands that occur at the tidal interface are particularly vulnerable. Unhindered landward migration of coastal wetland complexes in response to sea level rise presents some opportunity for the maintenance of habitat values and ecological processes associated with these ecosystems (Lovelock et al. 2012). Coastal floodplains that can accommodate the landward migration of these wetlands are the focus of this value decision. These will be areas where seasonal freshwater - brackish swamps (important to waterbirds and migratory waders (6.3.1) can still form under conditions of higher sea level and where mangroves and other marine vegetation can establish landward of the current tidal influence boundary. Discharge zones around edge of sands are likely to be particularly important as transitional refugia for waterbirds as sea level rises (6.3.4). Two coastal floodplain regional ecosystems have been identified as defining these areas RE 2.3.1b: Mixed tussock grasslands occurring on raised sandy or silty areas adjacent to the tidal zone with many depressions or distributary channels and RE 2.3.59a: Mixed tall open shrubland occurring on coastal alluvial surfaces adjacent to the tidal	6.3.1 6.3.4	4 4	fl_nr_ec_10 gi_nr_ec_06 ml_nr_ec_14 nn_nr_ec_11 sn_nr_ec_07

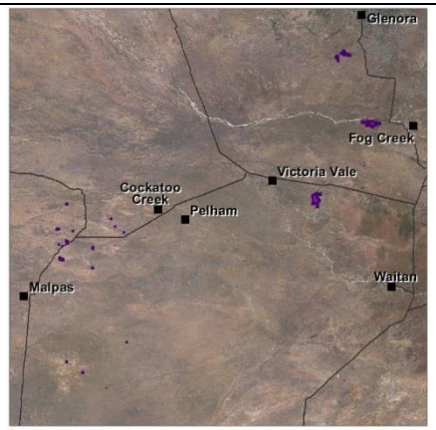
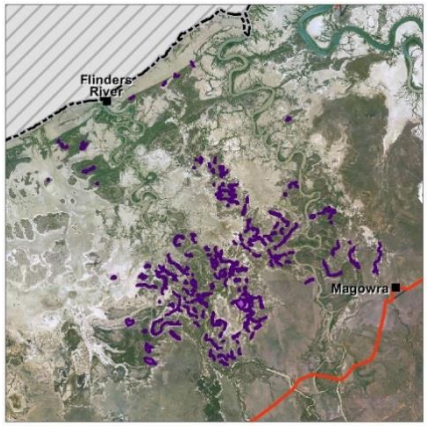
	 Macaroni Lotus Vale  South Mitchell River Kowanyama Rutland Plains Inkerman Galbraith					zone.			

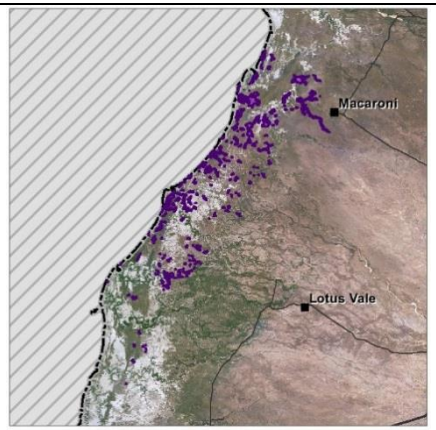
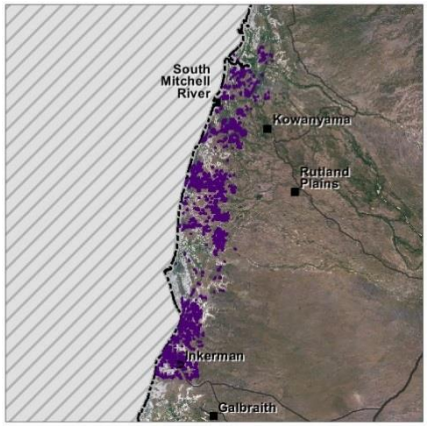
	 Jenny Lind Waterhole Maggieville Karumba Normanton Magowra Glenore  Galbraith								

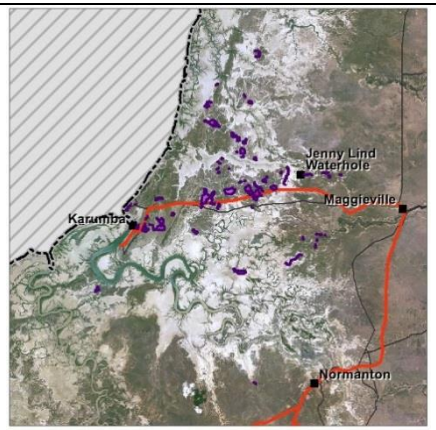
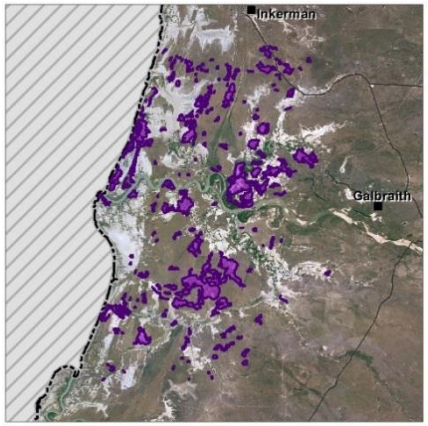
Impoundments and Reservoirs (e.g. Chinaman Creek Dam Lake Fred Tritton & Corella Dam)	 	Flinders Gilbert Mitchell Norman Staaten	Y		Y	Impoundments and reservoirs were identified because of their potential to contain ecological values including refugia for some native fish habitat, for birds' persistence in a dry environment and the provision of system recharge after drought. However these areas often do not have good genetic diversity with many species present having been stocked. The genetics of native fish is mixed with gene pools from disparate areas.	5.1.4 6.3.1 6.3.4	2 2 2	fl_nr_ec_14 gi_nr_ec_16 nn_nr_ec_08

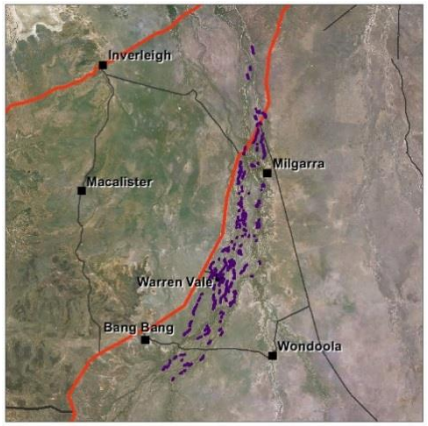
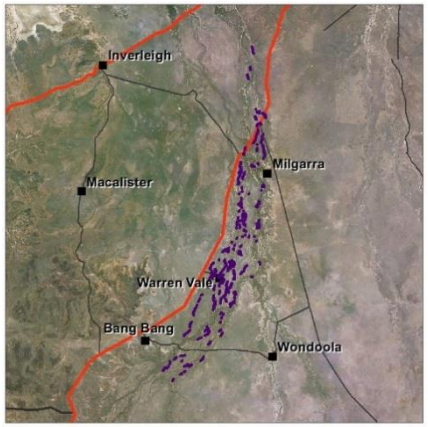
									
Bylong sand plain		Flinders Norman			Y	The Bylong sand plain is an old level sand plain with depressions that are like windows through to clay. The area contains many distinct surfaces including intact sand and redistributed material. The area is like an island in the landscape. It contains significant seasonal wetland values.	6.1.1	3	fl_nr_ec_16 nn_nr_ec_02

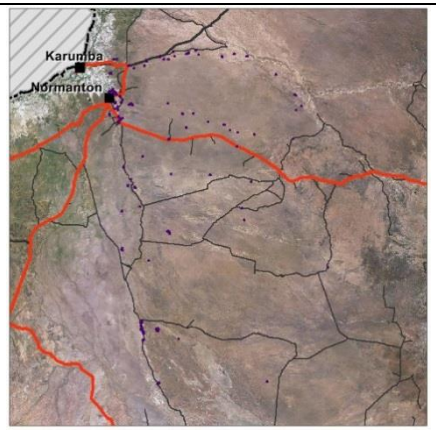
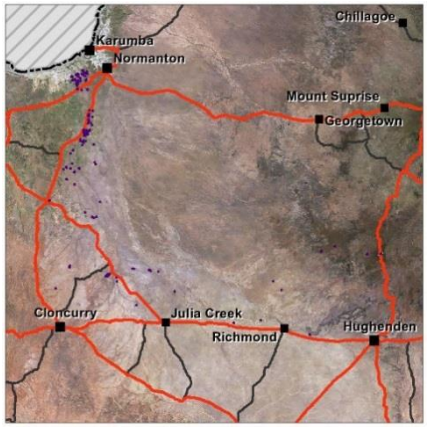
									
Springs on recent alluvium		Flinders Norman		Y	Y	RE 2.3.39 springs on recent alluvium is a palustrine wetland regional ecosystem that has an Endangered VMA and biodiversity status (5.2.1) and is rare within the Gulf Plains. It is comprised of *Aristida hygrometrica* or *Eriachne mucronata* or *Oxychloris* spp. tussock grassland with *Eucalyptus camaldulensis* +/- *Pandanus tectorius* woodland or *Eucalyptus microtheca* woodland or *Corymbia confertiflora* woodland. The RE includes special geomorphic features (6.1.1) including active artesian springs and also often extinct mound springs (6.4.1) and rare examples of peat development (6.2.1) in tropical environments. Values associated with these springs have been documented in a number of studies (6.3.3) (Fairfax & Fensham 2002; Fensham et al. 2004). In some instances the springs are discharging to deep red sands (RE 2.5.27) which surround and seep to the palustrine wetland occurrence. Springs are a very ecologically important in the arid landscape in which they occur providing primary productivity and refugia (6.3.1) for dependent wildlife.	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.4.1	4 4 4 4 4 4	fl_nr_ec_18 nn_nr_ec_14

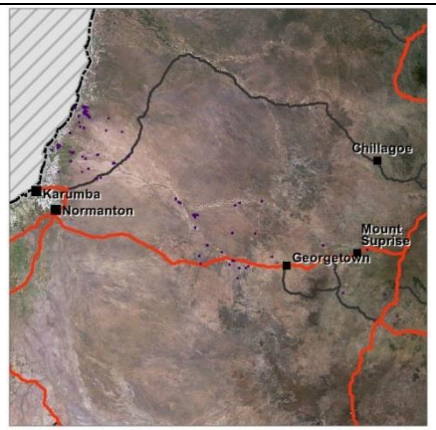
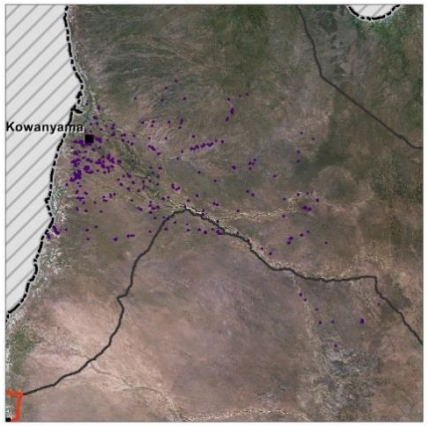
									
Coastal wetlands of the Southern Gulf Southeast Karumba Plain and Macaroni Swamp Aggregations		Flinders Gilbert Mitchell Norman Staaten	Y	Y	Y	These coastal wetlands form part of three nationally important directory listed aggregations (6.3.2) (Southern Gulf Southeast Karumba Plain and Macaroni Swamp Aggregations) that lie within the Karumba Plains province or the adjoining coastal zone of the Gulf bioregion (Blackman et al. 1999). The significance of these aggregations has been reiterated by NAWFA expert panel assessments across all of northern Australia (6.3.3) (Kennard et al. 2011). Occurring in the coastal zone the form and function of these wetlands represents the outcomes of the dominating influences of tidal action and massive freshwater flooding in the wet season (6.2.1). Salinity regimes of many of the wetlands vary from fresh to saline. Palustrine and lacustrine components of these aggregations include a diverse range of types and habitats including brackish and freshwater swamps and lagoons semi-permanent freshwater lakes beach ridge swale swamps tree swamps sedgelands open water habitats and floating rooted submerged and emergent aquatic macrophyte beds. The listed aggregations also include extensive estuarine marine and some lower riverine wetlands. While the broader aggregations meet all six criteria for national directory listing five are met by the palustrine and lacustrine components with most values also being relevant to the EGoC ACA. These	5.1.4 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 4 4 4 4 3 4	fl_nr_ec_19 gi_nr_ec_15 ml_nr_ec_13 nn_nr_ec_16 sn_nr_ec_06

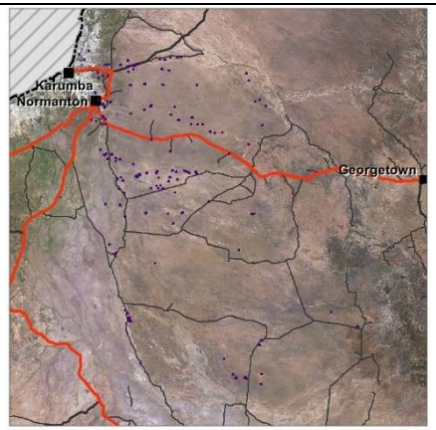
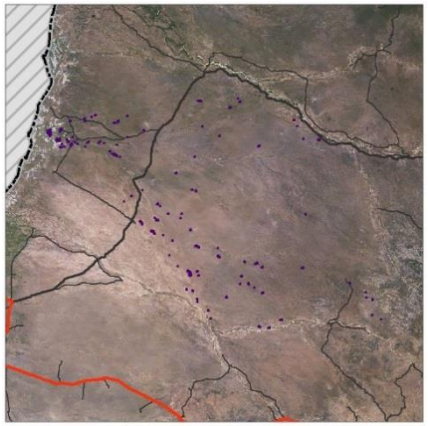
	 					include presence of distinct geomorphic features (6.1.1) such as large swale swamps associated with exceptionally well developed Holocene beach ridge systems and large areas of seasonal lacustrine habitats formed in the numerous prior channels and drainage depressions formed in Quaternary deposits associated with the Mitchell - Gilbert Fans province of the Gulf. Many of these wetlands also function as refugia and provide other critical purposes (6.3.1) including hosting the largest winter population of migratory wader birds in Queensland (5.1.3) including internationally important populations of 16 species providing breeding and post breeding habitat for nationally significant populations of waterbirds (5.1.4) and nursery habitat for commercial fishery species. Areas within the aggregation will provide important transitional habitats for dependent species during predicted sea level rises associated with climate change (6.3.4). Distinct hydrological regimes (6.4.1). associated with the site include significant wet season flooding which creates one of the largest know extents of seasonally inundated grassland and also creates unique transitional communities which result in typically freshwater macrophytes established in brackish areas (6.2.1).			

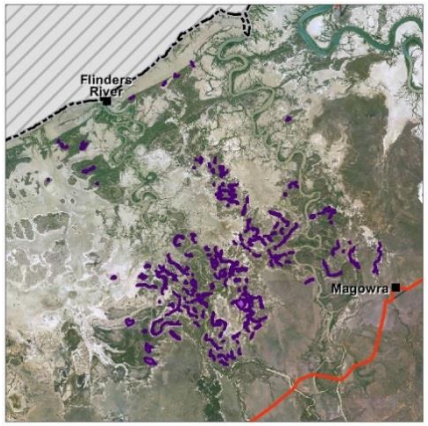
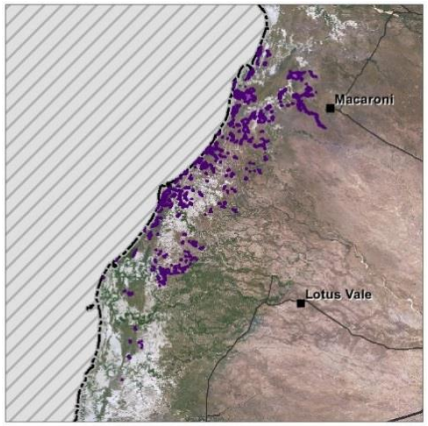
	 Jenny Lind Waterhole Maggieville Karumba Normanton  Inkerman Galbraith								

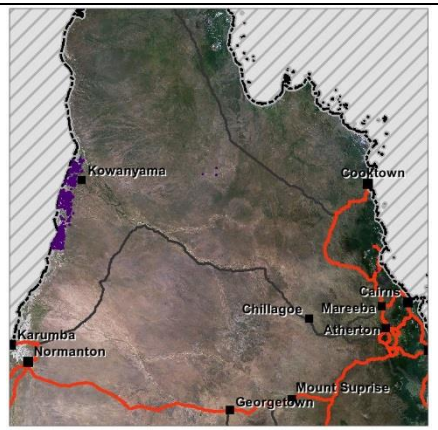
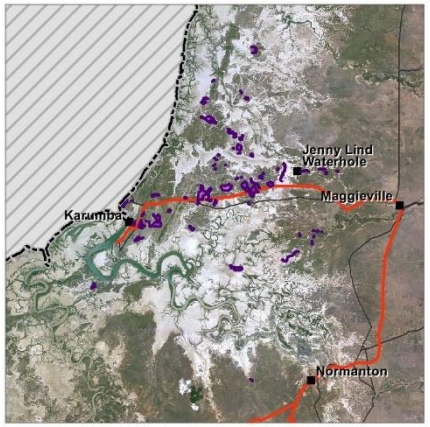
Lower Flinders River floodplain		Flinders	Y		Y	This area was identified as being of Regional significance in the Gulf Plains Biodiversity Planning Assessment (BPA) (gup_l_38): Ib (wildlife refugia): HIGH Ie (high species diversity): HIGH Ii (high density of hollow-bearing habitat trees): HIGH. Concentration of off-stream wetlands on scoured floodplain and extensive water holes associated with lower Flinders River. High fauna diversity particularly of frogs e.g. northern waterfrog *Litoria dahlii* and birds e.g. radjah shelduck *Tadorna radjah* (Queensland Museum data Birdlife Australia Atlas data). Recorded presence of threatened green sawfish *Pristis zijsron* and pictorella mannikin *Heteromunia pectoralis* and the uncommon freshwater whipray *Himantura dalyensis.*	6.3.1	3	fl_nr_ec_20
Perennial off river waterholes		Flinders Norman	Y	Y	Y	Within the seasonally dry climate of the eastern Gulf perennial waterholes are a limited asset and have high values as aquatic refugia (6.3.1) particularly considering the spectre of increasing rainfall variability due to climate change (6.3.4). Perennial off river waterholes have been defined on the basis of Landsat TM satellite that has recorded water within wetland spatial units for greater than 70% of observations. Given limitations affecting satellite observation capacity wetlands in this observational class are likely to have water within them more frequently than their classification indicates. Perennial off river waterholes owe their existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1). These include greater waterhole depth associated with prior channels and/or flood scouring and groundwater supplementation. Groundwater can be supplied from shallow alluvial aquifers associated with interbedded sands in quaternary alluvium or from deeper or adjoining fractured rock aquifers. Water clarity regimes within perennial waterholes are a key driver of their ecology and can also be an indicator of their condition. While	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 3 4 4 3 4 4	fl_nr_ec_21 nn_nr_ec_17

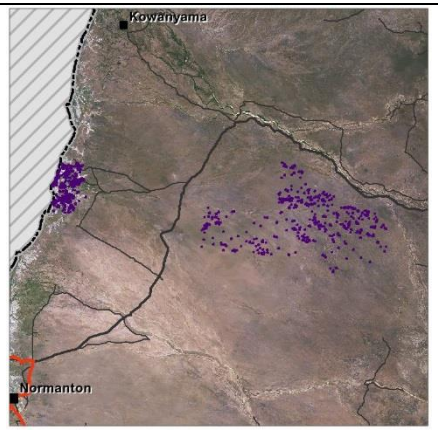
						clear waterholes are often associated with high values e.g. instream productivity aquatic plant and fish diversity some level of water turbidity is commonly a natural water quality feature of Flinders and Norman basin waterholes. In absence of water quality data coverage for the Flinders and Norman basins no distinction in perennial off river waterhole values have been made on the basis of water clarity within these catchments. Regardless of water clarity priority aquatic ecosystems (5.2.1) are commonly associated with perennial waterholes including RE 2.3.16 lagoons on Quaternary alluvial plain. This regional ecosystem is recognised as important breeding and feeding sites (6.3.1) for waterbirds and have an 'of concern' biodiversity status (Sattler & Williams 1999). The ecological significance of perennial waterholes within both the Flinders and Norman Basins has been recognised in a number of documented studies (6.3.3) for the eastern Gulf basins ((Burrows & Perna 2006; Kennard et al. 2011; Hermoso et al. 2011; Hogan & Vallance 2012; Jaensch & Richardson 2013; Petheram et al. 2013a, b).			
Near perennial off river waterholes		Flinders Gilbert Mitchell Norman Staaten	Y		Y	Within the highly variable seasonally dry climate of the eastern Gulf waterhole perenniality can vary between years. Near perennial waterholes have been defined on the basis of Landsat TM satellite that has recorded water within wetland spatial units for between 50 to 70% of observations. Given limitations affecting satellite observation capacity wetlands in this observational class are likely to have water within them more frequently than their classification indicates. Near perennial off river waterholes are more extensive than perennial waterholes and share many of their values for much of the year particularly during periods of full inundation in the wet season. In wetter years they may also function as perennial wetlands including in providing refugia for aquatic organisms (6.3.1). Near perennial off river waterholes usually possess a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1) that promote the	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.4.1	3 3 3 3 3 3	fl_nr_ec_22 gi_nr_ec_24 ml_nr_ec_23 nn_nr_ec_18 sn_nr_ec_12

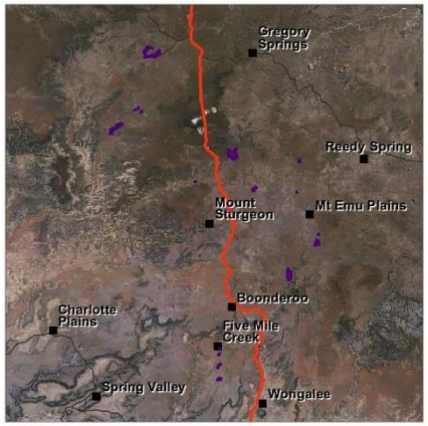
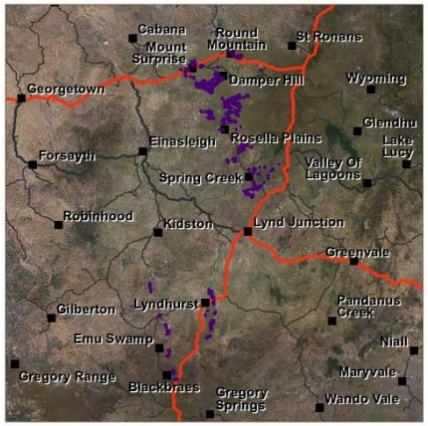
	 					retention of water into the dry season including greater waterhole depth clay or bedrock underpans and potentially some level of seasonal groundwater supplementation. Water clarity regimes within near perennial waterholes can be highly variable and cover all spectrums within eastern Gulf basins. Priority aquatic ecosystems (5.2.1) are commonly associated with near perennial waterholes including RE 2.3.16 lagoons on Quaternary alluvial plain. This regional ecosystem is recognised as important breeding and feeding sites (6.3.1) for waterbirds and have an 'of concern' biodiversity status (Sattler & Williams 1999). Seasonality associated with non-perennial waterholes can drive boom and bust productivity cycles and habitat resetting that make them productive nursery areas for fisheries and nesting and feeding areas for waterbirds including migratory waders (Blackman et al. 1999). The ecological significance of near perennial waterholes has been recognised in National Directory of Important Wetland listings for certain wetlands and in documented studies (6.3.3) for the eastern Gulf basins (Blackman et al. 1999; Kennard et al. 2011; Jaensch & Richardson 2013; Petheram et al. 2013a, b).			

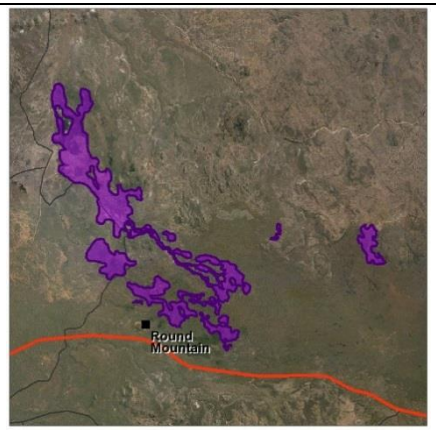
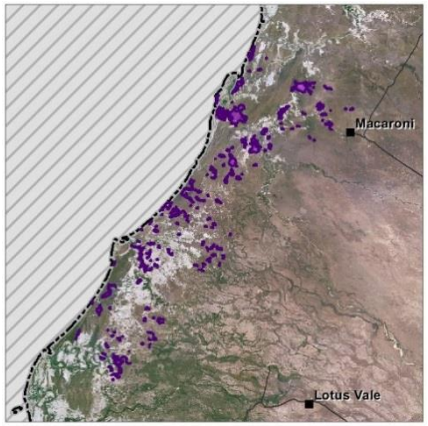
	 								

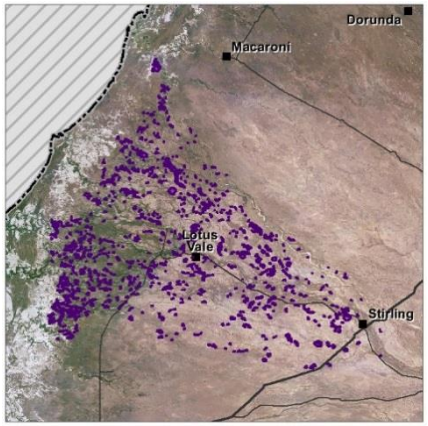
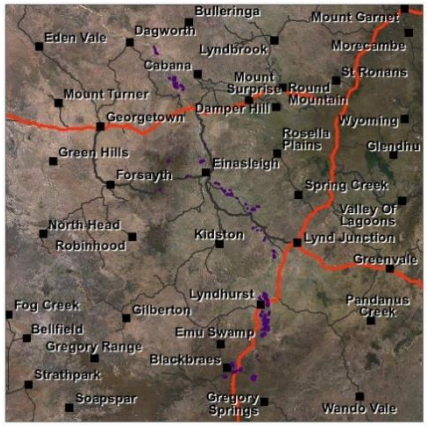
Important Bird Areas (IBA) - Migratory wader and waterbird roosting, feeding and breeding sites	 	Flinders Gilbert Mitchell Norman Staaten	Y			Part of the Gulf Plains BPA Important Bird Area (related to GUP BPA decision(s): cyp_fa_05 cyp_l_07 and gup_l_03). Large breeding population of sarus crane *Grus antigone* and brolga *G. rubicunda* present as well as a diversity of other waterbirds e.g. black-winged stilt *Himantopus himantopus* and black-necked stork *Ephippiorhynchus asiaticus* and supports large numbers of migratory waders e.g. black-tailed godwit *Limosa limosa,* great knot *Calidris tenuirostris,* little curlew *Numenius minutus,* lesser sand plover *Charadrius mongolus* and eastern curlew *N. madagascariensis* (Taplin 1991; Dutson et al. 2009). Large waterbird nesting colonies known from Mitchell especially of intermediate egret *Ardea intermedia* but does include other egrets, herons, cormorants and Australasian darter *Anhinga novaehollandiae* (Garnett 1985; Jaensch & Richardson 2013).	5.1.4 6.3.1	4 4	fl_nr_fa_01 gi_nr_fa_01 ml_nr_fa_01 nn_nr_fa_01 sn_nr_fa_01

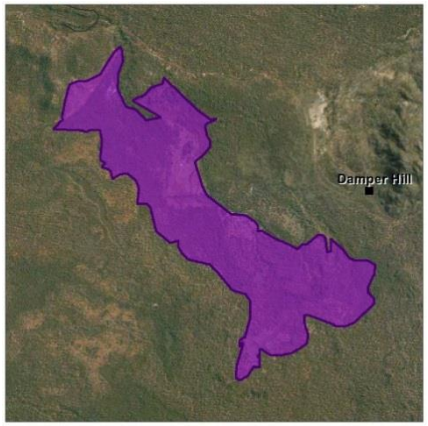
	 Kowanyama Cooktown Cairns Chillagoe Mareeba Atherton Karumba Normanton Mount Suprise Georgetown  Jenny Lind Waterhole Maggieville Karumba Normanton								

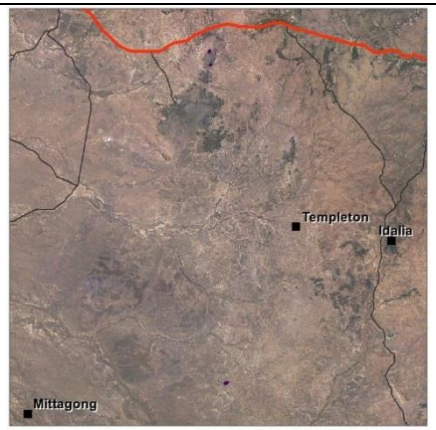
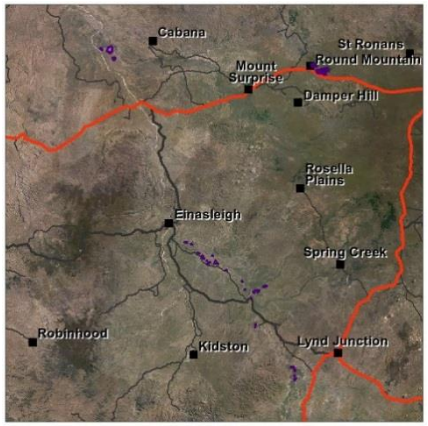
									
Shallow seasonal hypersaline lakes on Mesozoic sandstone plateaus		Flinders		Y		Regional Ecosystem RE 2.3.38 is a lacustrine wetland described as "shallow seasonal hypersaline lakes with a fringe of Eucalyptus camaldulensis on Mesozoic sandstone plateaus with a combination of grasses and sedges including *Eragrostis parviflora, Diplachne fusca* var. *fusca, Pseudoraphis spinescens, Schoenoplectiella lateriflora* and *Eleocharis philippinensis*. Low sandy deposits on the western margins may occur. Open water is common but seasonal. Occurs in large closed depressions on Mesozoic sandstone plateaus It represents a unique rare geomorphic unit (6.1.1). Named examples in the assessment area include Louisa Lake Pelican Lake Agnes Lake and Gum Swamp Bore. Several of these have been the focus of published studies (6.3.3). This rare ecosystem has a limited extent and an 'of concern' biodiversity status (5.2.1). The seasonal inundation and hypersalinity of these lakes is related to their hydrological connections to the host sandstones (6.4.1) and this creates unique habitats (6.3.1) which supports an adapted invertebrate community and also distinctive ecological processes (6.2.1). During periods of inundations they provide habitat and feeding resources for a range of waterbirds.	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.4.1	3 4 4 4 4 4	fl_nr_fl_04

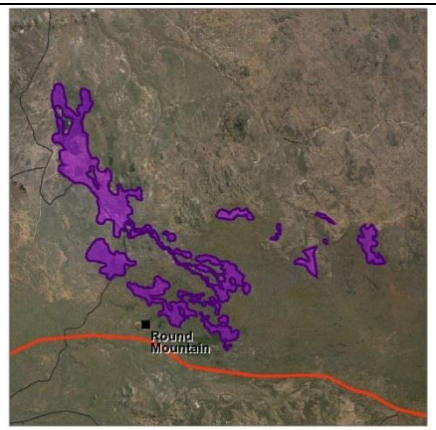
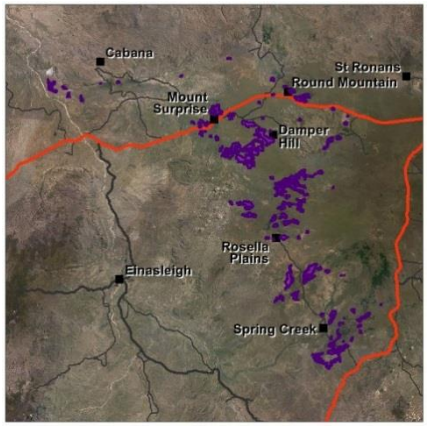
Black tea tree swamps with vine thicket elements especially on basalt	 	Flinders Gilbert Mitchell		Y		Regional ecosystem 9.3.10a is a palustrine wetland comprised of black tea tree *Melaleuca bracteata* low woodland to low open forest swamps +/- *Casuarina cunninghamiana* +/- *Eucalyptus leptophleba* +/- *Eucalyptus spp.* +/- *Corymbia spp.* emergents or vine scrub species on basalt plains wetted by spring discharges (6.1.1). The shrub layer varies from absent to a continuum with *M. bracteata* and dry rainforest species where these are present. This community is floristically rich and very variable in structure and can also occur as small clumps of trees in association with the grassland RE 9.3.27 or as a dense sub-canopy layer of *M. bracteata* under a dominant canopy of *Casuarina cunninghamiana*. Occurs on or fringing swamps and springs on basalt and occasionally along creek lines on basalt geologies. This community occurs in seasonally arid landscapes and the springs associated with it retain moisture well into the dry season and support significant food and habitat resources and provide refugia for local fauna and may support endemic flora (6.3.1).	6.1.1 6.3.1	3 3	fl_nr_fl_05 gi_nr_fl_04 ml_nr_fl_03

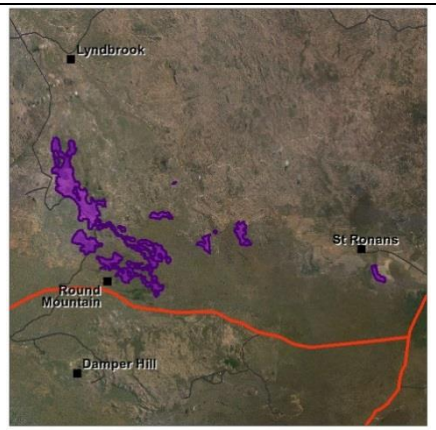
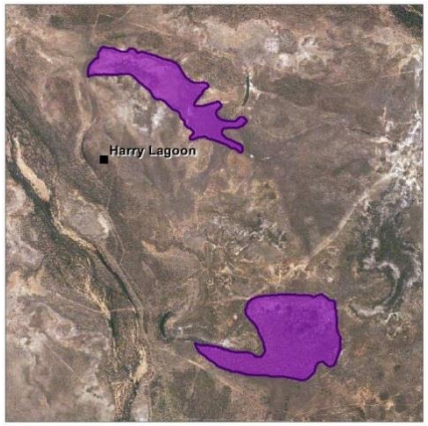
									
Gilbert marine plains		Gilbert	Y		Y	The Gilbert catchment contains extensive freshwater marine plain areas on clay pans. This area is the start of the big well-developed flat marine plains in the region containing good freshwater bird sites. Significant values include being a productive recreational fishing area and providing habitat for crocodiles *Crocodylus* spp. and large barramundi *Lates calcarifer*. Bird habitat values include habitat for birds of prey which nest on dunes. The area includes a lower surface more frequently inundated by tidal waters and an upper surface less frequently inundated but with extensive freshwater wetlands. This area is threatened by total grazing pressure rubber vine encroachment and neem tree encroachment.	5.1.4 6.2.1 6.4.1	4 4 4	gi_nr_ec_01

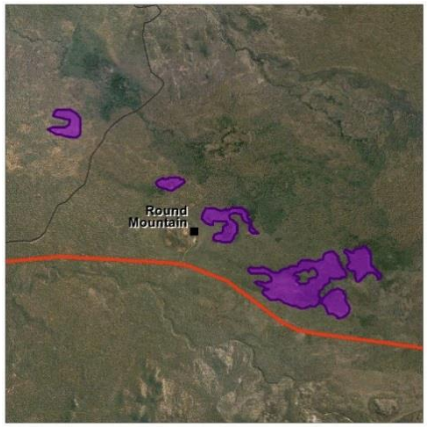
Gilbert-Smithburne delta fan		Gilbert	Y			The Gilbert-Smithburne delta fan is full of waterbird colonies and is a particular stronghold for the sarus crane *Grus antigone*.	5.1.4	4	gi_nr_ec_02
Einasleigh River spring fed system		Gilbert	Y		Y	This part of the Einasleigh River is a ground water dependent system from the Einasleigh headwaters to the gorge. It provides perennial flow wildlife refugia and habitat for freshwater crocodiles *Crocodylus johnstoni*.	6.3.1 6.3.4 7.2.1	4 4 4	gi_nr_ec_03

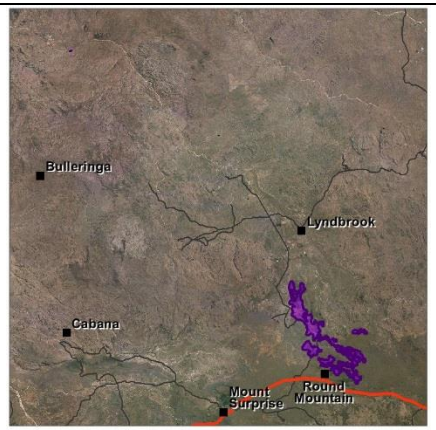
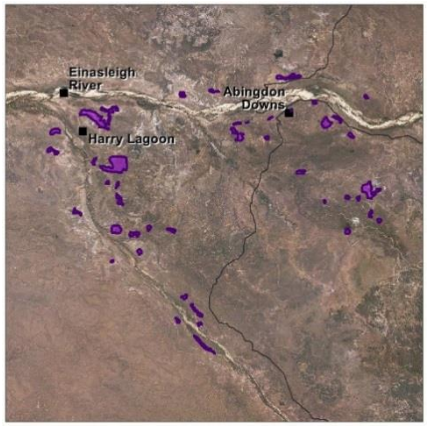
Wetlands fed by Great Artesian Basin springs (Fensham et al. 2006 - Class 3 & 4)	 	Flinders Gilbert Mitchell Norman Staaten			Y	Springs of the Great Artesian Basin feed permanent wetlands that provide oases for unique aquatic life forms in otherwise dry landscapes. For example, an abundance of specialised invertebrates including ostracods, snails, spiders, flatworms and dragonflies are known to occur only in wetlands associated with GAB springs. Likewise, certain grass, herb and sedge species are often restricted to wetlands associated with GAB springs (Fensham 2006). Note: This decision applies to all catchments assessed as part of the EGoC ACA v1.1. In arid environments, a spring with a permanent saturation regime and fixed spatial location may only support surface expression groundwater dependent ecosystems extending less than one hectare from the spring vent. For this reasons a standard distance of 100m was used to identify the location and extent of wetlands dependent upon spring flows. In reality this distance will vary depending on local hydrological characteristics, spring flow rates and extent. There were no intersecting non-riverine spatial units in the Flinders and Staaten catchments.	6.3.1 6.3.4 7.2.1	3 3 3	gi_nr_ec_05 ml_nr_ec_18 nn_nr_ec_07

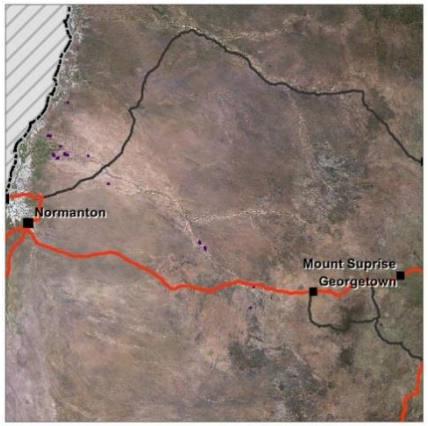
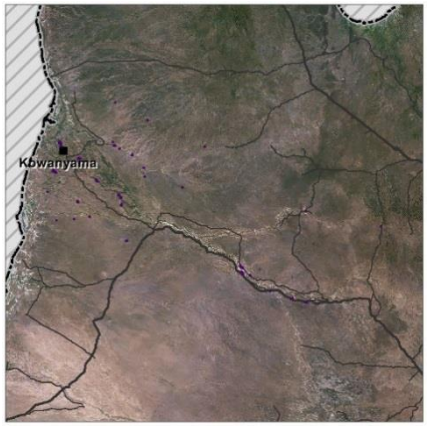
									
Wetland complexes		Gilbert Mitchell	Y	Y	Y	Selected wetland complexes identified as being of State significance in the Einasleigh Uplands BPA (eiu_l_09): Ib (wildlife refugia): VERY HIGH Id (taxa at the limits of their ranges): HIGH Ie (high species richness): VERY HIGH Ig (REs with distinct variation): HIGH Ii (high density of hollow-bearing trees): VERY HIGH Ij (significant breeding or roosting sites): HIGH Values listed in the BPA include: One of the primary concerns for biodiversity assessment and planning in undeveloped regions is that biodiversity conservation and management be pursued at a landscape scale. This is particularly so for wetlands. In undeveloped landscapes the aim is to retain wetlands within their landscape context not to restrict the focus to the wetland body itself. In these landscapes there is the opportunity to ensure that landscape elements that directly relate to wetlands and contribute to their values are identified in association with the wetland itself; 12 wetland complexes in the EIU are so significant that they particularly need to be addressed at the landscape scale. Additional values provided by the Southern Gulf of Carpentaria wetland ecology expert panel include: These wetlands have a much localised	6.1.1 6.3.1 6.3.3	4 4 4	gi_nr_ec_09 ml_nr_ec_19

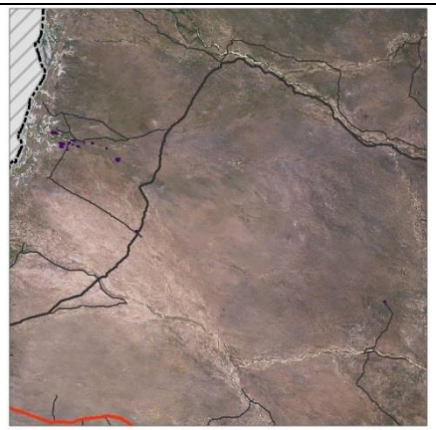
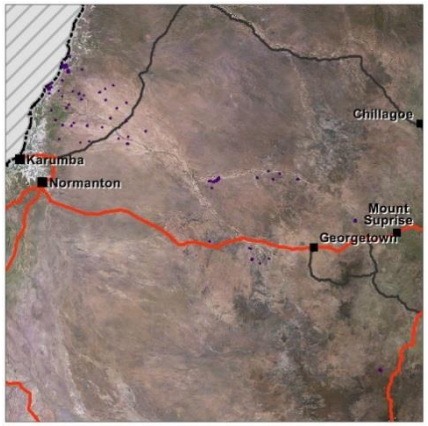
						feed, mostly from southeast although they are modified by drainage. The area has basalt to the south/west and granite/rhyolite to the north east as well as tertiary residuals. The main floodplain complex is upstream of the Einasleigh township. Some of the largest freshwater crocodiles *Crocodylus johnstoni* are known from this area. The area is related to the Blackbraes lava flow and contains combined basalt systems a mosaic of springs and waterholes. These systems are unique in a state wide context. The most southern decision is remnant of old tertiary surface with two wetlands in depressions.			
Basalt swamps McBryde volcanic province		Gilbert Mitchell	Y	Y	Y	This area was identified as being of Regional significance in the Einasleigh Uplands BPA (eiu_l_27): Ia (centre of endemism): HIGH Ib (wildlife refugia): VERY HIGH Ic (disjunct populations): HIGH Id (taxa at the limits of their ranges): HIGH Ie (high species richness): VERY HIGH Values listed in the BPA include: The basalt wetlands associated with the outer margins of the volcanic McBride Province are the most extensive in the state. The relatively high altitude the extent of the basalt surface (which acts as both catchment and recharge area) the broad dome shape that characterizes it and the periodically high monsoonal rainfalls all contribute to their formation and maintenance. The wetlands include permanent and seasonal wetlands including RE 9.3.4 (only those occurrences on basalt derived alluvials) RE 9.3.10 (*Melaleuca bracteata* creeks and swamps) RE 9.3.11 (wetlands on basalts) RE 9.3.25 (basalt grasslands) RE 9.3.27a (basalt grassland with *M. bracteata*) RE 9.8.10 (forest red gum on fresh vesicular basalt) RE 9.8.12 (*Excoecaria parvifolia*) and some RE 9.8.13 (basalt grasslands). The wetlands allow the survival of a great diversity of species in an otherwise inhospitable landscape including	6.3.1 6.3.3	4 4	gi_nr_ec_10 ml_nr_ec_20

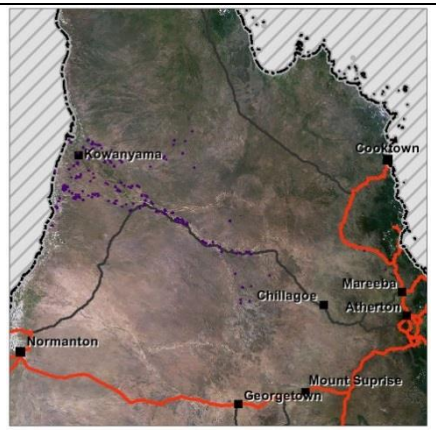
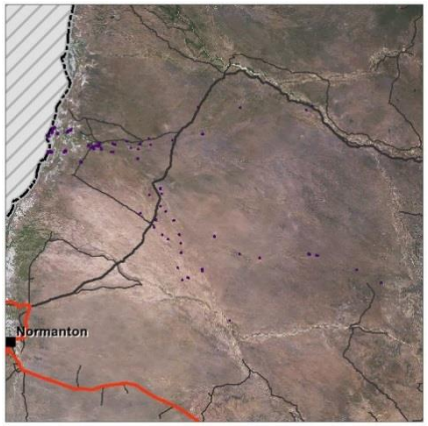
						species at the limits of their ranges disjunct populations and threatened species. Threatened flora includes *Paspalidium udum, Aponogeton queenslandicus, Solanum multiglochidiatum, Lysiana filifolia and Rhamphicarpa australiensis* while threatened fauna include the limbless fine-lined slider *Lerista ameles*. Additional values provided by the Southern Gulf of Carpentaria wetland ecology expert panel include: this river is permanently spring fed.			
Large wrtlands at confluence of Einasleigh and Ethridge rivers		Gilbert		Y	Y	The primary value associated with these two wetlands is that they represent the largest and best examples of two palustrine wetland associated regional ecosystems (8.2.5). The large size of these swamps is a distinct geomorphic feature (6.1.1) associated with their location at the confluence of two larger river systems. These are REs: 2.3.61a: *Eucalyptus microtheca* woodland in seasonal swamps on active Quaternary alluvial plains and RE 2.3.34d: *Eucalyptus camaldulensis* woodland and sedges in circular swamp depressions on podsolic soils. Both are seasonal swamp communities that have a ground layer of emergent macropytes that form important food sources and nesting habitats for waterbirds including spike rush *Eleocharis spp*. spiney mud grass *Pseudoraphis spinescens,* nardoo *Marsilea* spp. and occasionally native rice *Oryza australiensis*. Given the size and productivity of these wetlands and their proximity to adjoining near perennial wetlands they can seasonally host relatively large water bird populations and provide seasonally important feeding and moulting sites for water birds (6.3.1). The size of the spikerush swamps also limits the capacity of local feral pig populations to create extensive disturbance (C. Appleton pers. comm.).	6.1.1 6.3.1 8.2.5	3 3 4	gi_nr_ec_13

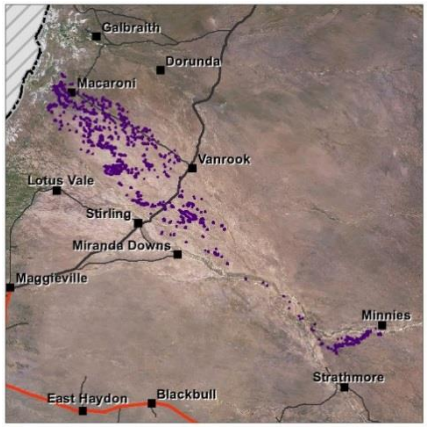
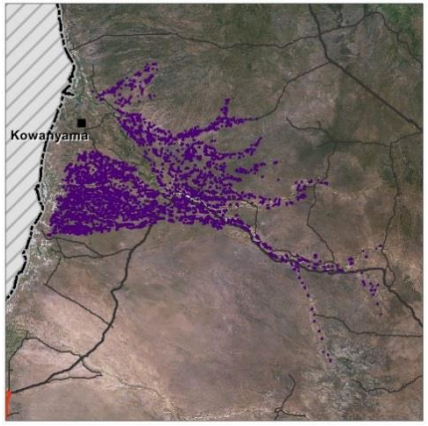
Blackbraes NP artificial wetland		Gilbert	Y		Y	This region was identified as being of Regional significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_fa_11): Ib (wildlife refugia): HIGH Ie (high species richness): HIGH Ih (artificial waterbody or manipulated wetland of ecological significance): HIGH Ij (significant breeding or roosting sites): VERY HIGH. Large artificial wetland in Blackbraes Resources Reserve. Supports a wide variety of wetland birds including more than 1% of the total population of the cotton pygmy *goose Nettapus coromandelianus* and breeding site for cormorants and the white bellied sea eagle *Haliaeetus leucogaster.* Area includes 500m buffer from edge of wetland.	6.3.1 6.3.3 6.3.4	4 4 4	gi_nr_ec_17
Fossil Brook and Lynd area		Gilbert Mitchell	Y		Y	This area was identified as being of State significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_l_31): Ib (wildlife refugia): VERY HIGH Ie (high species richness): VERY HIGH. This area covers the wetlands springfields and spring-fed ecosystems associated with the upper Lynd River and Fossil Brook. The wetlands are fed by northern flows of Undara Basalt and flow in the main river channels is permanent. The area includes key sooty grunter *Hephaestus fuliginosus* habitat including spawning habitat in the rapids, outstanding freshwater crocodile *Crocodylus johnstoni* habitat and very high fish diversity. The area includes an internationally significant reference site for crocodilians. The area also has a very high diversity of macropod species and includes the only known habitat for the skink *Proablepharus barrylyoni*. Enclosed pockets of basalts and granites are included to consolidate the area increase connectivity and diversity of ecosystem and species and to increase the integrity and viability of the area. A	6.3.1 6.3.3 6.3.4 6.4.1 8.2.5	4 4 4 4 4	gi_nr_ec_19 ml_nr_ec_16

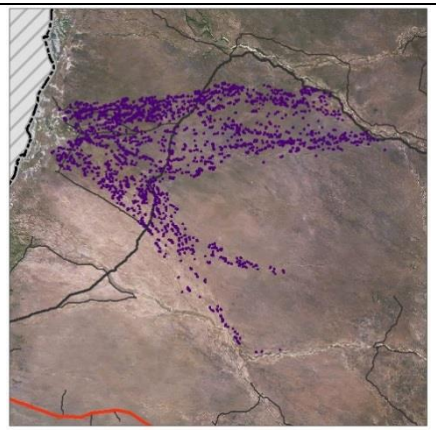
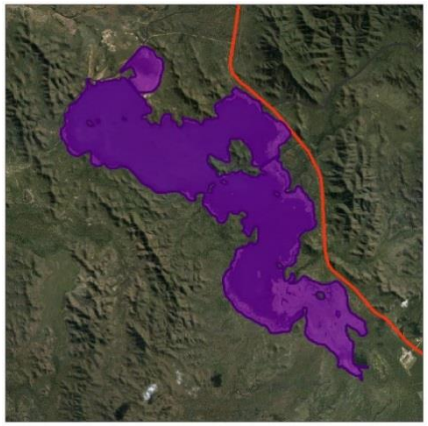
						buffer of 500m was also used to ensure values associated with the ecotone between the wetlands and adjacent habitat were included and to further increase habitat representation.			
Wetlands at the confluence of Etheridge and Einasleigh rivers		Gilbert	Y	Y	Y	This area was identified as being of Regional significance in the Gulf Plains Biodiversity Planning Assessment (BPA) (gup_l_11): Id (species at geographic range limit): HIGH Ie (high species diversity): VERY HIGH Ig (REs show distinct variation in species composition): VERY HIGH. Diverse surface. A few very unusual and very large wetland areas with diverse veg/land types/RE's. Very large and best example of coolabah woodland swamp. Clay soils including black soil section which is rare in this part of the Gulf. Exposed duricrust north of the Einasleigh River. Most southern extent of flying fox scrub type ecosystem. Western limit of *Macropteranthes montana* which is vulnerable. Diverse fauna recorded in area including a range of waterbirds, *Ctenotus zebrilla* and north-eastern range limit of long-haired rat *Rattus villosissimus*.	6.2.1 6.3.1 6.3.3	4 4 4	gi_nr_ec_20

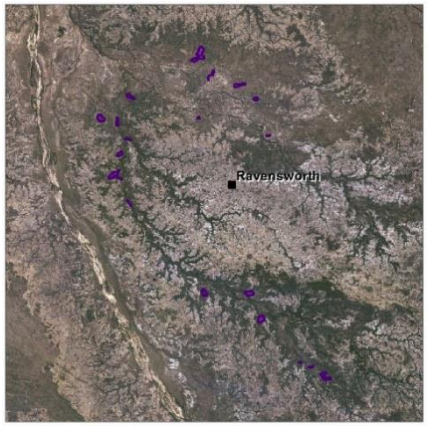
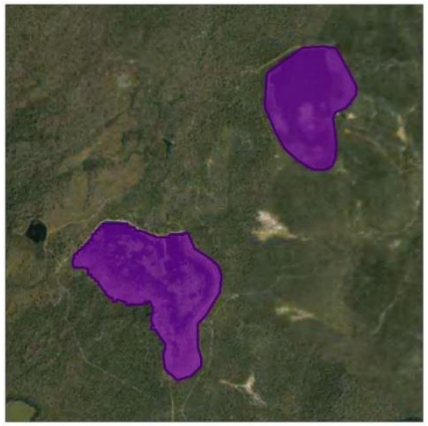
Clear perennial off river waterholes	 	Gilbert Mitchell Staaten	Y	Y	Y	Within the seasonally dry climate of the eastern Gulf perennial waterholes are a limited asset and have high values as aquatic refugia (6.3.1) particularly considering the spectre of increasing rainfall variability due to climate change (6.3.4). A subset of these are clear perennial off river waterholes which are an even more limited wetland asset that owe their existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1) These include greater waterhole depth associated with prior channels and/or flood scouring and groundwater supplementation. Groundwater is often supplied from shallow alluvial aquifers associated with interbedded sands in quaternary alluvium. Such aquifers are recharged by a combination of rainfall overbank flood flows and connectivity to within channel flows in adjoining river channels as occurs in mid reaches of the Mitchell River or via supplementation from fractured rock aquifers as occurs in some upper Gilbert Basin waterholes (Batlle-Aguilar et al. 2014; CSIRO 2009; Petheram et al. 2013a). Direct supplementation of waterholes from fractured rock and deeper groundwater aquifers also occurs in upper catchment areas of the Mitchell Staaten and Gilbert basins (CSIRO 2009; Petheram et al. 2013a). The maintenance of water clarity within these waterholes has been assessed by reference to multiple years of satellite TM imagery and can sometimes also be an indication of less disturbance by land use and other pressures including cattle access soil erosion and pig wallowing (Lymburner & Burrows 2008). TM imagery is not capable of detecting smaller sized or heavily vegetated waterholes which may not be included in this value decision. Such smaller perennial wetlands will share equivalent values to larger sites particularly where they occur in aggregations. The combination of water clarity and perenniality within such waterholes supports the development of rich aquatic macrophyte habitats and high instream productivity and underpins their role as refuges (6.3.1) for relictual fauna such as the lake grunter *Variichthys lacustris*	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 4 4 4 4 4 4	gi_nr_ec_21 ml_nr_ec_21 sn_nr_ec_10

						which has only been recorded in Australia from two off river lagoons (10 Mile and 12 Mile Lagoon) in the mid Mitchell Basin. Many clear perennial off river waterholes are mapped as RE 2.3.16 lagoons on Quaternary alluvial plains which are recognised as important breeding and feeding sites (6.3.1) for waterbirds and have an 'of concern' biodiversity status. They also commonly host 'of concern' RE 3.3.66 permanent lakes and lagoons frequently with fringing woodlands or sedgelands (5.2.1) (Sattler & Williams 1999). The exceptional value of clear perennial waterholes including these specific lagoons has been recognised in a number (6.3.3) of national and regional assessments (Kennard et al. 2011; Hermoso et al. 2013). They also underpin key refugia and nursery habitat values nominated for several National Directory listed (6.3.2) wetlands including the Mitchell River Fan Smithburne-Gilbert Fan and Dorunda Lakes aggregations (Blackman et al. 1999).			
Clear to turbid or turbid perennial off river waterholes		Gilbert Mitchell Staaten	Y		Y	Within the seasonally dry climate of the eastern Gulf perennial waterholes are a limited asset and have high values as aquatic refugia (6.3.1) particularly considering the spectre of increasing rainfall variability due to climate change (6.3.4). Perennial off river waterholes owe their existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1) These include greater waterhole depth associated with prior channels and/or flood scouring and groundwater supplementation. Groundwater is often supplied from shallow alluvial aquifers associated with interbedded sands in quaternary alluvium. Such aquifers are recharged by a combination of rainfall overbank flood flows and connectivity to within channel flows in adjoining river channels as occurs in mid reaches of the Mitchell River or via supplementation from fractured rock aquifers as occurs in some upper Gilbert Basin waterholes (Batlle-Aguilar et al. 2014; CSIRO 2009; Petheram et al. 2013a). Direct supplementation of waterholes from fractured	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 3 4 4 3 4 4	gi_nr_ec_22 ml_nr_ec_22 sn_nr_ec_11

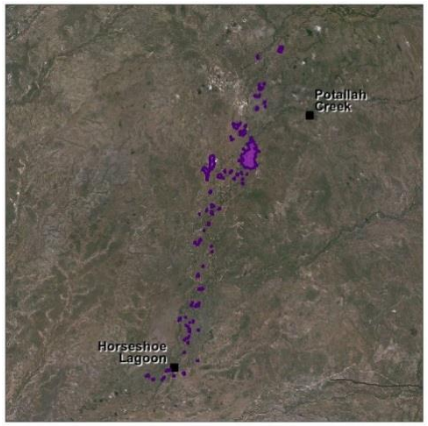
	 					rock and deeper groundwater aquifers also occurs in upper catchment areas of the Mitchell Staaten and Gilbert basins (CSIRO 2009; Petheram et al. 2013a). Water clarity regimes within perennial waterholes are a key driver of their ecology and can also be an indicator of their condition. Mitchell Staaten and Gilbert basin waterhole perenniality and clarity has been assessed by reference to multiple years of satellite TM imagery (Lymburner & Burrows 2008). Such imagery is not capable of detecting smaller sized or heavily vegetated waterholes which may not be included in this value decision. Such smaller perennial wetlands will share equivalent values to larger sites particularly where they occur in aggregations. While clear waterholes are often associated with high values e.g. instream productivity aquatic plant and fish diversity water turbidity is often a natural water quality feature of eastern Gulf drainages. However in some cases it is indicative of land use pressure or other disturbances including cattle access elevated soil erosion and pig wallowing particularly in the Mitchell Staaten and Gilbert Basins where good water clarity is associated with baseline conditions in these typically sand bedded and groundwater supplemented systems. Consequently waterholes that do not exhibit sustained clarity have been valued less than their clear counterparts for these basins. Regardless of water clarity priority aquatic ecosystems are commonly associated with non-clear perennial waterholes including RE 2.3.16 lagoons on Quaternary alluvial plain. This RE is recognised as important breeding and feeding sites (6.3.1) for waterbirds and have an ‘of concern’ biodiversity status (Sattler & Williams 1999). The significant value of non-permanently clear and or turbid perennial waterholes are still recognised in a number (6.3.3) of national and regional assessments (Kennard et al. 2011 Hermoso et al. 2013). They also underpin key refugia and nursery habitat values nominated for several National Directory listed (6.3.2) wetlands including the Mitchell River Fan Smithburne-Gilbert Fan and Dorunda Lakes aggregations			

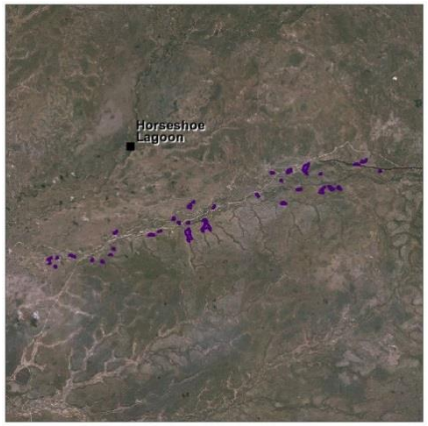
						(Blackman et al. 1999).			
Pleistocene fan	 	Gilbert Mitchell Staaten	Y		Y	A nationally outstanding example of an alluvial plain wetland aggregation occurring within the predominantly Pleistocene aged component of the largest fluvial megafan system (6.1.1) in Australia (Blackman et al. 1999). The site includes extensive areas of seasonal and more scattered semi-permanent palustrine and lacustrine wetlands unique to western Cape York Peninsula and the south east Gulf of Carpentaria and those within the Mitchell are considered the best example (8.2.5) component part of the most extensive and densest occurrence of these wetland types in northern Australia (Cook et al. 2011) (6.3.3). Areas on younger Pleistocene surfaces adjoining the Mitchell Delta are included within the nationally listed Mitchell River fan wetland aggregation (6.3.2). In contrast to the younger Holocene fan which forms the active Mitchell delta the Pleistocene fan defines the broader floodplain of the Mitchell and contiguous and hydrologically linked lower Staaten River Basin (6.4.1). It is comprised of elevated floodplain levees and distributary systems with predominantly finer clayey soils. These soils form a hard underpan for the predominantly shallow and seasonal wetlands which lack groundwater inflows and obtain much of their water supply from local floodplain catchment run in. Overland flood flows; inundation and connectivity (6.2.1) are critical for the form and function of the Pleistocene fan aggregation but are occur less frequently and extensively than for the Holocene fan. Overland flow connectivity from the Mitchell to Staaten basins is essential for the maintenance of these wetlands within the lower Staaten basin (T. Vallance pers. comm.). Areas not inundated by flood inundation provide regional flood refugia for terrestrial fauna (6.3.1). Where distributary watercourses cut through the clayey underpan of the floodplain deeper wetlands forming important aquatic refugia occur (6.3.1). The high density of wooded melaleuca swamps associated with the fan support large	5.1.4 6.1.1 6.2.1 6.3.1 6.4.1 6.3.1 8.2.5	4 3 4 4 3 4 3	gi_nr_ec_23 ml_nr_ec_09 sn_nr_ec_04

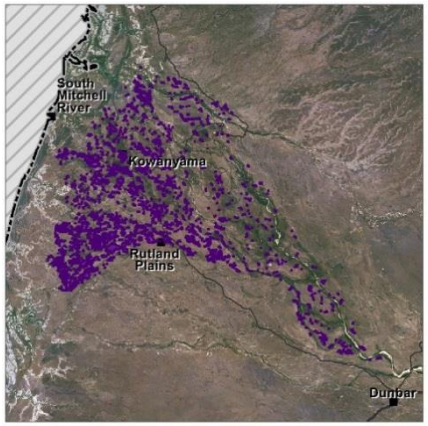
						diverse populations of waterbirds (5.1.4) and other fauna via the provision of critical nesting and breeding roosting feeding and moulting habitats (6.3.1) with the best examples occurring within the Mitchell Basin.			
Lake Mitchell (also known as South Edge Dam)		Mitchell	Y		Y	Lake Mitchell (also known as South Edge Dam) contains a high diversity of water birds and freshwater fishes unique to Mitchell catchment as well as freshwater crocodiles *Crocodylus johnstoni* saltwater crocodiles *C. porosus* and macrophytes. It is an artificial dam and unique to have such a large water body so high in the Mitchell catchment. Connected to adjacent wetlands. Grouped with surrounding non-riverine wetlands upstream. Possibly contains migratory waders.	5.1.4 6.3.1 6.3.4 6.4.1	3 4 4 3	ml_nr_ec_01

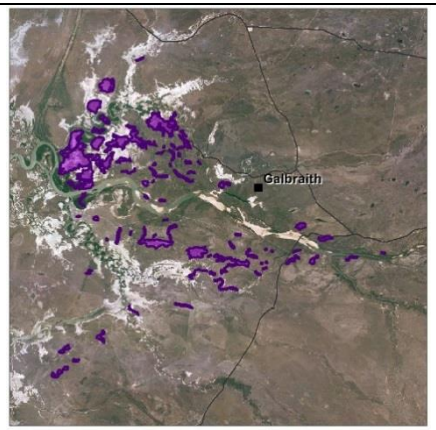
Bulimba station		Mitchell		Y	Y	This aggregation of swamps is considered the best example (8.2.5) of RE 2.5.55 a palustrine /seasonal swamp wetland *Melaleuca clarksonii* low woodland in closed depressions on Tertiary to Quaternary deposits. The ground layer is a combination of tussock grasses sedges and forbs including *Pseudoraphis spinescens, Nymphoides indica and Eleocharis* spp. They also includes small unwooded areas and open water. The swamps are relatively large and are formed in blocked tributary depressions and back plains (6.1.1) of Sugarbag Creek. The expression of the RE at this site is unique in that it only includes pure stands of *Melaleuca clarksonii* with no co-occurring *M. viridiflora* typically associated with the RE. There is also an undescribed Fabaceous vine species in the area. The wetlands have a hard mud stone underpan formed on alluvials and are surrounded by lateritic hills and hard catchments that run off easily. The wetlands fill easily and consequently inundate early in the wet season and retain water into the dry season providing contemporary and future climate change (6.3.4) refugial (6.3.1) values and important feeding and moulting sites for waterbirds.	6.1.1 6.3.1 6.3.4 8.2.5	3 3 3 4	ml_nr_ec_02
Mareeba wetlands		Mitchell	Y		Y	This area was identified as being of Regional significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_fa_12): Ib (wildlife refugia): HIGH Ih (artificial waterbody or manipulated wetland of ecological significance): HIGH Ij (significant breeding or roosting sites): HIGH Complex of artificial wetlands watercourses and woodlands on sand sheets and low metamorphic hills. Fed largely by irrigation runoff. Support a wide range of fauna including brolgas *Grus rubicunda,* sarus crane *G. antigone,* freckled duck *Stictonetta naevosa,* northern tree creeper *Climacteris picumnus melanotus*, buff-breasted button-quail *Turnix olivii,* northern quoll *Dasyurus hallucatus* and Mareeba rock wallaby	6.3.1 6.3.3 6.3.4 6.4.1	3 3 3 3	ml_nr_ec_03

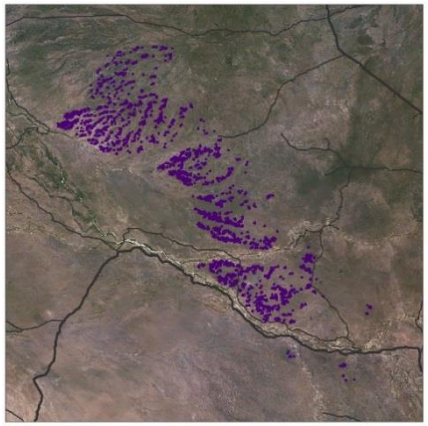
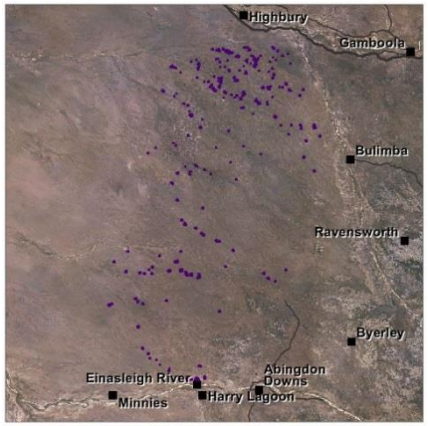
						Petrogale mareeba. Additional values provided by the Eastern Gulf of Carpentaria wetland fauna and ecology expert panel include: A permanent to near permanent water source for important fauna species; provides refugia during dry season; is an important water source for Gouldian finch *Erythrura gouldiae* which needs to drink several times per day. The Mareeba Wetlands are a group of artificial lacustrine wetlands in a natural setting that receive tailwater discharge and overflow from the Dimbulah irrigation area. This artificially enhanced perenniality represents a distinct hydrological regime (6.4.1) within the relatively hydrologically unmodified planning area. The permanence of these relatively shallow lakes has created aquatic refugia (6.3.1) within a seasonally dry landscape that is likely to increase in value under the spectre of increased rainfall variability under climate change (6.3.4). They have also supported the development of a rich aquatic macrophyte community the productivity of which supports a good stable population of birds including listed woodland species e.g. Gouldian finches. Birdlife associated with these wetlands has attracted scientific study and documentation (6.3.3) and the site has become a regional tourism attraction.			
Mt Mulligan plateau wetlands		Mitchell			Y	These wetlands include a small number (e.g. 3) of palustrine and open water bodies the largest of which is approximately 350m long situated at an altitude of approximately 700m atop the Mt Mulligan. The site is data deficient. Springs are known for the site and it is assumed that the wetland which may be semi perennial receives some groundwater supplementation. Mt Mulligan is representative of an ancient Triassic sandstone surface and this plateau is the only remnant of its type remaining. The occurrence of this wetland at this altitude an on this sandstone surface is a distinct geomorphic feature (6.1.1) and the hydrological regime associated with a spring fed high altitude wetland is also distinctive (6.4.1).	6.1.1 6.4.1	4 4	ml_nr_ec_04

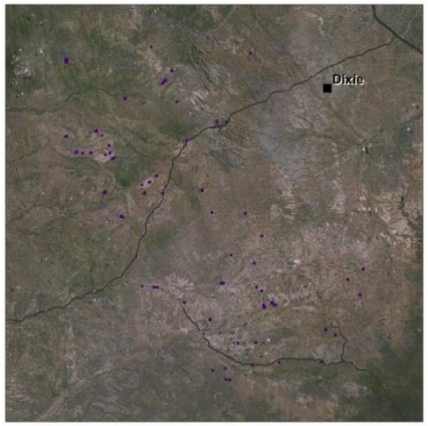
Fisherman Waterhole springs		Mitchell	Y	Y	Y	Hot springs near Fisherman Waterhole. Thermal Soda springs and nearby non-riverine wetlands. Contributing to hydrological regime of the wetlands. Number of significant fauna species specialised soda biota. This small wetland aggregation is comprised of several active hot springs and associated palustrine wetlands located just above the active river channel immediately adjacent and to the east of Fisherman Waterhole on the Walsh River. The geomorphic and associated geologic setting for these thermal springs is unique (6.1.1) as is the hydrological regime (6.4.1) of the associated palustrine wetlands. Their soda geochemistry creates unique water quality characteristics which is also reflected in a specialised soda biota (6.2.1). (S. Choy pers. comm.). Include nearby non-riverine wetlands. The perennial palustrine wetlands contain a well-developed emergent macrophyte community and provide an aquatic refugia (6.3.1) and habitat resources for dependent fauna.	6.1.1 6.2.1 6.3.1 6.4.1	4 4 4 4	ml_nr_ec_05
Wetland aggregation on upper Crosby floodplain		Mitchell	Y	Y	Y	This floodplain wetland aggregation is part of an alluvial valley which hosts the most upstream permanent waterholes in the Crosbie Creek subcatchment of the Alice River. The primary significance of the area is associated with the size and permanence of the riverine and non-riverine wetlands within a highly seasonal sub basin with Horseshoe Lagoon the best example (Jeff Shellberg pers. comm.). The area's values have been identified by a number of recent field investigations (6.3.3) (Shellberg 2014; Shellberg et al. 2014, 2015). It includes a rich array of meandering and anabranching channels off-channel lagoons (billabongs and oxbows) elliptical or elongate swamps tributary creeks and other interconnected complex habitat within inter-bedded alluvial sediments. They are frequently inundated by floodwater each wet season. There is a high diversity of aquatic plants around floodplain wetlands and the areas supports a number of 'Of Concern' wetland associated Regional Ecosystems (5.2.1) including RE 3.3.45: *Eucalyptus chlorophylla* +/-	5.2.1 6.3.1 6.3.3 6.3.4	4 4 4 3	ml_nr_ec_06

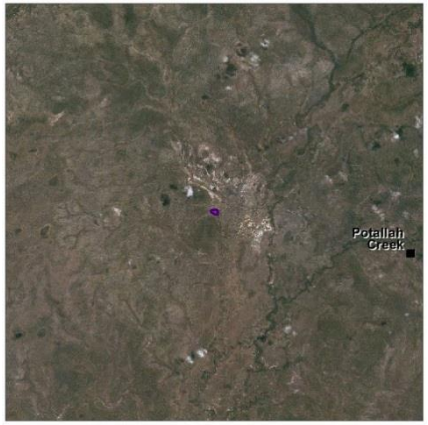
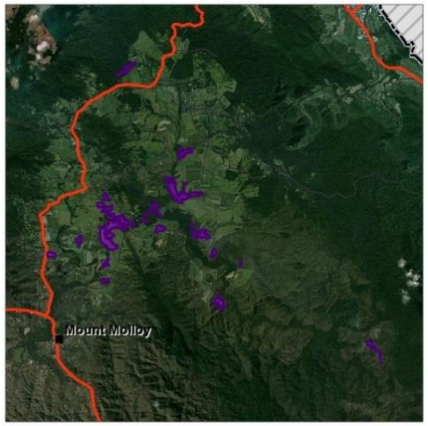
						Melaleuca viridiflora low open woodland on Mitchell River floodplain and RE 3.3.66a: Permanent wetlands vegetated with *Eleocharis spp. Nymphaea* spp. and *Nymphoides* spp. +/- fringing open-forests of *Melaleuca* spp. Lacustrine wetlands are commonly fringed by an open sedge-land dominated by *Lepironia articulata*. Perennial aquatic refugia (6.3.1) (6.3.4) are comprised of off channel lagoons and channel hosted pools and support a high species richness of fish including species at their extralimital range, e.g. delicate blue-eye *Pseudomugil tenellus* and threadfin rainbowfish *Iriatherina werneri* the latter expressing unique phenotypes (Shellberg 2014; Shellberg et al. 2014, 2015). Sixteen species of fish and three crustacean species have been identified including tiger crab *Austrothelphusa tigrina* which represents a range extension for this endemic species. Wildlife fauna associated with the Crosbie floodplains is also diverse and includes eighty-one species of birds five mammal species six reptile species and seven amphibian species. The importance of the wetlands as a focal point for bird fauna and amphibians has also been noted.			
Wetland aggregation on Eight Mile Creek, Crosby floodplain		Mitchell	Y	Y	Y	This floodplain wetland aggregation occurs on the floodplain of Eight Mile Creek immediately upstream of the confluence of Crosbie Creek both of which are subcatchment of Alice River. The aggregation occurs on an alluvial floodplain and abuts adjoining sand sheets derived from a weathered Holroyd Plain surface into which connected wetland depressions extend. The primary significance of the area is associated with the size and permanence of the riverine and non-riverine wetlands within a highly seasonal sub basin (Jeff Shellberg pers. comm.). The wetlands include meandering and anabranching riverine channels off-channel lagoons (billabongs and oxbows) elliptical or elongate swamps tributary creeks large seasonal lakes within sandy depressions and other interconnected complex habitat within inter-bedded alluvial sediments. Most are inundated	5.2.1 6.3.1 6.3.3 6.3.4	4 4 3 3	ml_nr_ec_07

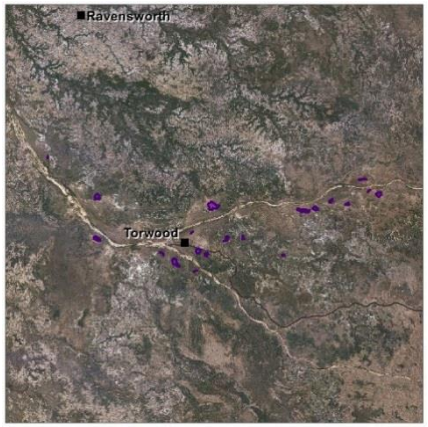
						by floodwater each wet season and elevated flood flows also contribute to the recharge of sand sheet aquifers (6.4.1) supplying large seasonal swamps in connected sandy depressions. There is a high diversity of aquatic plants around floodplain wetlands and the areas supports a number of 'Of Concern' wetland associated Regional Ecosystems (5.2.1) including RE 3.3.41: *Melaleuca clarksonii* low open forest in swamps and RE 3.3.66a: Permanent wetlands vegetated with *Eleocharis* spp., *Nymphaea* spp. and *Nymphoides* spp. +/- fringing open-forests of *Melaleuca* spp. Lacustrine wetlands are commonly fringed by an open sedge-land dominated by *Lepironia articulata*. Perennial aquatic refugia (6.3.1) (6.3.4) are comprised of off channel lagoons and channel hosted pools and support a high species richness of fish. The importance of the wetlands as a focal point for bird fauna and amphibians has also been noted.			
Holocene fan		Mitchell Staaten	Y	Y	Y	This area is identified as being of State significance in the Gulf Plains Biodiversity Planning Assessment (6.3.3) (BPA decision gup_l_05) and is included within the nationally listed Mitchell River fan Aggregation (6.3.2). It provides an outstanding example of a diverse and rich array of alluvial plain wetlands and deep water habitats which characterise the northern portions of the Mitchell-Gilbert Fan province of the Gulf Plains bioregion (8.2.5). The Holocene fan represents the youngest most active component of the largest fluvial megafan system in Australia (Blackman et al. 1999) and includes the active delta of the Mitchell River the largest landform feature of this type in the state (6.1.1). The sites also includes a high diversity of other alluvial landform elements including; closed depressions (lakes oxbows swamps) and open depressions (drainage depression stream channel stream bed swamp) within a flat upland comprising plains fans back plains and floodouts. Flood inundation and flows are integral to site values associated with its dynamic geomorphological hydrological and	5.1.4 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 4 3 4 4 4 4	ml_nr_ec_10 sn_nr_ec_05

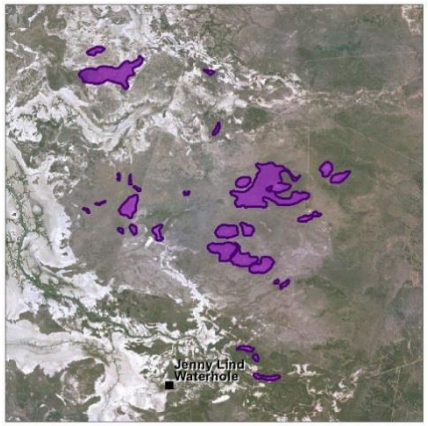
						ecological form and function. Its lower position in the landscape means it is more frequently inundated connected and scoured by channel outbreak flows than older more elevated alluvial fan components (6.4.1). The geomorphic setting forms shallow alluvial aquifers and deeper more permanent off river waterholes which both support ecologically important aquatic refugia with potential importance as climate change refuges (6.3.4). It contains extensive areas of seasonal semi-permanent and permanent palustrine and lacustrine wetland which are unique to western Cape York Peninsula and the south east Gulf of Carpentaria and are a component part of the most extensive and densest occurrence of these wetland types in northern Australia (6.3.3) (Cook et al. 2011). Characteristically high floodplain primary productivity made available during flood inundation across this area provide a 'floodplain subsidy' to aquatic food chains and fishery productivity within adjoining riverine and downstream estuarine systems (6.2.1) (Hunt et al. 2012; Jardine et al. 2012). Anabranching distributary streams of the delta also support the equal (to Fitzroy River in WA) greatest density of ox-bow lakes in northern Australia (Pusey 2011). These wetlands function as important breeding sites for aquatic species and nursery habitat for fishery species including barramundi *Lates calcarifer* (6.3.1). They also support breeding roosting feeding and moulting habitats for a diverse range of waterbirds including nationally significant populations (5.1.4) (>1%) and listed species as well as estuarine crocodiles *Crocodylus porosus* (Taplin 1991; Blackman et al. 1999). Soil and landform diversity supports high plant diversity including higher rainfall species at the southern limit of their distribution given the site lies within the southern margin of the wet tropical savanna climate zone and Cape York Bioregion. Gallery rainforest along delta levees represent some of the best examples of this ecosystem.			

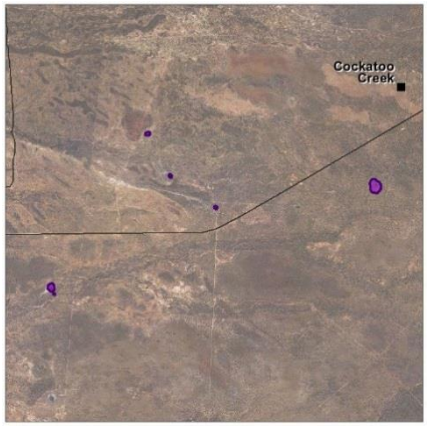
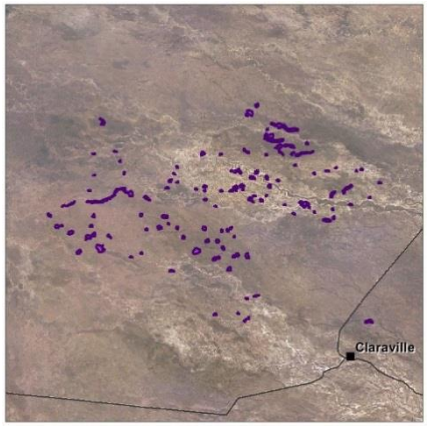
Pliocene fan	 	Mitchell Staaten		Y	Y	This aggregation of wetlands lies on the older northern and eastern margin of the large fluvial megafan systems that characterise the lower Mitchell basin. The Pliocene fan is formed of outwash from the western Great Dividing Range and lies within an extensive Tertiary sand sheet that forms the Holroyd Plain provinces of the Cape York and Gulf Bioregion. Unlike the Holocene and Pleistocene fan that form the currently active delta and floodplain the Pliocene fan is relatively elevated and non-active and has been weathered laterised and subsequently dissected into an intricate system of dendritic drainage depressions (6.1.1). Non-riverine wetlands are associated with closed depressions formed as pans on ridges in areas of more pronounced weathering and as channel-less waterlogged swampy valleys (dambos) filled with leached fine material (sand silt clay solutes) received in drainage from the surrounding sand sheets (Shellberg 2014). This Pliocene surface has the highest concentrations of dambos in Australia with the best developed expression in the higher rainfall areas within the Cape Bioregion and Alice River sub basin (8.2.5). While the majority of wetlands are seasonal and formed as sunken holes on the late tertiary sandstone seepage from the adjoining sand sheets and deep sandy soils (6.4.1) make them last longer into the dry season than those associated with hardpan areas of the active floodplain (6.3.1). The site is considered to have unique as well as transitional floristic values lying within the cross over from Cape York to Gulf bioregions. The waterlogged sandy plains support a community of wetland associated grasses and emergent aquatic macrophytes comprised of sedges and herbs including an undescribed species of *Lindernia* spp. and the rare *Lobelia douglasiana* (Shellberg 2014). The low nutrient status of sandy soils has promoted semi carnivorous genera (6.2.1) within the wetland plants communities including *Stylidium Utricularia and Drosera* spp. This low primary productivity has also limited grazing exploitation of these wetlands and extensive areas remain	6.1.1 6.2.1 6.3.1 6.3.3 6.4.1 8.2.5	4 3 3 3 4 3	ml_nr_ec_11 sn_nr_ec_09

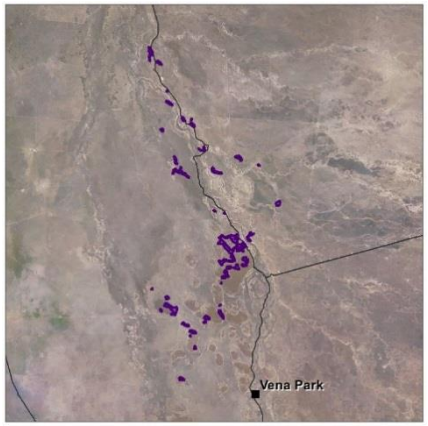
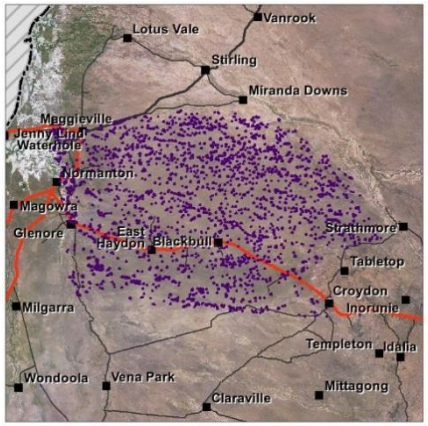
						relatively free of grazing pressure and associated weed infestation. Described in part as the 'the way the Cape used to be' the site is considered to include the biggest weed free area of the Cape (6.3.3) (Shellberg 2014).			
Wetland Pans on basement rock		Mitchell	Y	Y	Y	These closed depression wetland pans are similar to those formed within the Pliocene Fan but instead of being formed on residual sands and weathered material are perched as veneers on top of weathered granite and metamorphic rock (6.1.1). Their values have been described on the basis of relatively recent integrated discipline field studies (6.3.3) (Shellberg 2014). This relatively impermeable base prevents water from seeping out laterally and the aquatic habitats within them although seasonal last longer (6.4.1) into the dry season with some being near perennial in wetter years. The near perennial more open examples of these wetlands host rich aquatic macrophyte communities equivalent to 'of concern' Regional Ecosystem 3.3.66 permanent lakes and lagoons frequently with fringing woodlands or sedgelands (5.2.1). Retaining water longer and being in contact with basement rock they tend to be more fertile than other seasonal wetland pans formed in sand sheets (Jeff Shellberg pers. comm.). These wetlands occur in a seasonally arid area of the upper Alice River catchment where surface water is a limited resource through the dry season. All are key bird and wildlife watering sites into the middle to late dry season (6.3.1) in an area that hosts the nationally endangered golden-shouldered parrot *Psephotus chrysopterygius* (Shellberg 2014). Due to their drainage isolation many lack obligate aquatic biota such as fish though those connected to drainage seasons can host fish populations seasonally which contribute additional food resources to piscivore wildlife. The endemic tiger crab *Austrothelphusa tigrina* occurs in the same catchment as these wetlands (which have not been specifically surveyed for aquatic biota) and could be expected to occur within them given the affinity of freshwater crabs for this type of habitat	5.2.1 6.1.1 6.3.1 6.3.3 6.4.1	3 3 3 3 3	ml_nr_ec_12

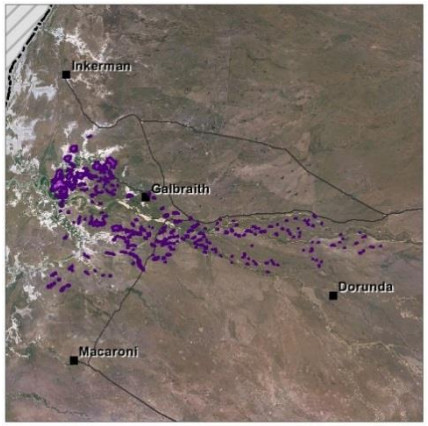
						elsewhere in the eastern Gulf (J. Tait pers. comm.).			
Crosbie Mound Springs		Mitchell		Y	Y	Mound springs (6.1.1, 6.4.1) are a central geomorphic and hydrologic feature of the Crosbie Creek floodplain. The spring water is sourced from the GAB and Mesozoic aquifers. These mound springs are considered the best developed on Cape York (Shellberg et al. 2015). The alkaline chemistry (6.2.1) of the mound springs support surrounding vegetation similar to RE 3.3.51 normally found on marine plains which has a biodiversity status 'of concern' (5.2.1). A rare Asteraceae plant *Pluchea* sp. has been collected from the mound spring area. The normally estuarine tadpole goby *Chlamydogobius ranunculus* has also been collected from a mound spring pool highlighting the potential for unique habitat (6.3.1) and species in the mound spring area.	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.4.1	3 4 4 3 4 4	ml_nr_ec_24
My Molloy - Julatten Aggregation Wet Tropics Priority Wetland REs		Mitchell		Y	Y	The upper Mitchell Basin is unique within Gulf Basins in its extension into the Wet Tropics Bioregion. The Wet Tropics climatic zone creates hydrologic regimes that are unique relative to the rest of the eastern Gulf planning area (6.4.1). Seasonally distributed rainfall and associated sustained moisture and perennial aquatic habitat facilitate ecological process that are distinct (6.2.1) relative to the more seasonal habitats and environments that characterise the broader assessment area. Wetlands located in moist cool uplands are a distinct habitat type restricted to the Wet Tropics Bioregion within the planning area (6.3.1). Wet Tropics regional ecosystems in the upper Mitchell Mt Molloy - Julatten area include aggregations of palustrine and lacustrine wetlands with an 'endangered' or 'of concern' status (5.2.1) including RE 7.3.1, RE 7.3.4, RE 7.3.5, RE 7.3.10, RE 7.3.16, RE 7.3.29, RE 7.3.31, RE 7.8.7, RE 7.11.19, RE 7.12.29 and RE 7.12.37. In many cases the threatened status of these regional ecosystems is due to impacts in more developed eastern river basins elsewhere within the Wet Tropics bioregion. The more limited development	5.2.1 6.1.1 6.2.1 6.3.1 6.4.1	4 3 3 4 3	ml_nr_ec_25

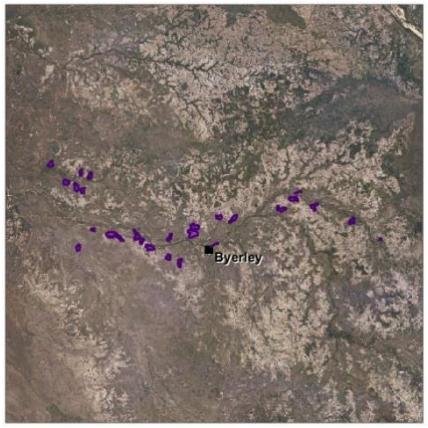
						pressure within the upper Mitchell has thus far retained these wetlands within a variegated landscape. That most of the wetlands do not occur in isolation but hosted within intact alluvial landscape remnants and connected by vegetated riverine corridors increases the conservation value of this aggregation. Alluvial landscapes hosting these wetlands are also comprised of 'endangered' or 'of concern' regional ecosystems associated with floodplains and frequently inundated areas (e.g. RE 7.3.8, RE 7.3.12, RE 7.3.14, RE 7.3.20, RE 7.3.21, RE 7.3.35, RE 7.3.39, RE 7.3.40, RE 7.3.43, RE 7.3.45, RE 7.3.48, RE 7.11.41, RE 7.11.48 and RE 7.12.60). Intact floodplain remnants and alluvial landscapes provide a focus for broader catchment based wetland management initiatives that afford protective measures to both the priority wetland regional ecosystems and their host landscapes. Ongoing emerging development pressure in the uplands of the Mitchell basin underpins the need for recognition of the conservation value of wetland associated priority ecosystems.			
Back Plain Swamps at the confluence of the Lynd and Tate rivers		Mitchell	Y	Y	Y	The confluence of the Lynd and Tate rivers hosts juxtaposed riverine and non-riverine wetland values. During high flows overbank floodplain at the confluence of these rivers generates large back plain swamps a unique geomorphic feature (6.1.1). These support palustrine wetlands RE 2.3.55c which are unusual in terms of their floristic make up which includes unique mixed communities of limited extent representative of several adjoining bioregions that converge on the area. Seasonal swamps on these back plains are dominated by a particularly tall (e.g. 15m) and dense physiognomy *Melaleuca viridiflora* and/or *M. clarksonii* woodland. The ground layer is commonly spike rush *Eleocharis* spp.These seasonal swamps retain moisture into the dry season on account of their size providing a refugial role (6.3.1) for dependent wildlife including waterbirds which use them as important feeding and moulting sites. On	6.1.1 6.3.1 8.2.5	3 3 4	ml_nr_fl_04

						elevated stabilised terraces within the river channels the best example (8.2.5) of another limited extent regional ecosystem RE 2.3.24c occurs. This is a mixed woodland to open forest with rainforest elements and a denser canopy structure afforded by the fire refugia (6.3.1) function of the within channel terraces (6.3.1). This community includes combinations of *Eucalyptus camaldulensis* and the rainforest tree *Celtis paniculata* and several fruit bearing trees including *Terminalia platyphylla, Thryptomene oligandra, Canarium australianum, Parinari nonda, Margaritaria dubium-traceyi, Antidesma parvifolium,* and *Syzygium eucalyptoides.* Some of these species are important to frugivorous birds and other wildlife and the denser physiognomy of the vegetation also provides habitat for cover dependent species (6.3.1).			
Brannigan Creek floodplain		Norman	Y		Y	The Brannigan Creek floodplain is a higher level marine plain not associated with the saline lower area. This area is the start of the big well-developed flat marine plains in the region. Significant values include being a productive recreational fishing area and providing habitat for estuarine crocodiles *Crocodylus porosus* and large barramundi *Lates calcarifer*.	5.1.4 6.3.1	4 4	nn_nr_ec_01

East Creek spring complex		Norman			Y	The East Creek spring complex is the main concentration of high priority springs in the Norman catchment. It covers the main extent of active high priority artesian springs in Claraville plains.	6.4.1 7.2.1	4 4	nn_nr_ec_03
Yappar River wetland aggregation		Norman			Y	During wet season this whole area is under water and access is quite restricted. In this area the harder substrate comes to the surface with large sandsheets. The sandsheets discharge upstream is unique in this area of the system and pooling occurs as a result. The area is thought to continue seeping because of this and the area is seasonally wet. In the recent past (within the last ten years) a big flood event is thought to have scoured this area off. Additionally a large fish and bird kill occurred in 2009 in this area. The area is known to get lightning fires followed by flood events straight after. Whilst there are probably other circumstances like this this one in particular is concentrated.	6.1.1 6.3.1	2 2	nn_nr_ec_05

Lagoons and ponded area on 40 Mile Creek		Norman	Y		Y	The lagoons and ponded parts of the stream at 40 Mile have particular value for waterbirds and fish in this vast dry landscape (Burrows & Perna 2006; Jaensch & Richardson 2013). 40 Mile which contains rock bars forms a big lake in dry season and a river channel in the wet. Significant ecological values include refugia breeding habitat and sites lateral and longitudinal connectivity and feeding areas for wildlife such as turtles and macroinvertebrates.	6.3.1 6.3.4	4 4	nn_nr_ec_09
Carron Forrest country		Norman		Y	Y	The Carron Forrest country contains tiny wetlands along coolabah flats. The area has value as a large interconnected aggregation rather than as individual wetlands. Overflow from the Gilbert is associated with the back swamps however on the sand surfaces the circular wetlands are groundwater recharged. The wetland systems have significant diversity and longevity and contain very thick vegetation including melaleuca swamp box *Lophostemon suaveolens* and spear grass. The area is also subject to flash flooding from the Gilbert River.	6.2.1 6.4.1	3 3	nn_nr_ec_10

Staaten Wyaaba Delta Fan		Staaten	Y	Y	Y	Similar to the Gilbert-Smithburne Delta Fan and the Mitchell Holocene Delta the Staaten-Wyaaba Fan aggregation is a good though less extensive example of a diverse and rich array of alluvial plain wetlands and deep water habitats which characterise the Mitchell-Gilbert Fan province of the Gulf Plains bioregion (8.2.5). The aggregation occurs across the most hydrologically active part of the lower Staaten Basin immediately downstream of the confluences of the basins major sub catchments. Downstream of this point flood flows break out in multiple anastomosing distributary channels across Pleistocene aged floodplain surfaces before splaying and diverging across the active younger Holocene aged delta. Dinah Island formed by delta anabranch channels lies within the active delta and has developed scroll bars and oxbow lagoon habitats formed from past channel meanders. Floodplain overflow from the Mitchell basin are also a critical water supply to the aggregation (6.2.1). The sites includes a high diversity of alluvial landform elements including: closed depressions (lakes oxbows swamps) and open depressions (drainage depression stream channel stream bed swamp) within a flat upland comprising plains fans back plains and floodouts. Flood inundation and flows are integral to site values associated with its dynamic geomorphological hydrological and ecological form and function. Its lower position in the landscape means it is more frequently inundated connected and scoured by channel outbreak flows than less active more elevated floodplain areas (6.4.1). The geomorphic setting forms shallow alluvial aquifers and deeper channels and off river waterholes which both support ecologically important aquatic refugia (6.3.1) with potential importance as climate change refuges (6.3.4). As described for the Mitchell flood inundation across this area would provide a ‘floodplain subsidy’ to aquatic food chains and fishery productivity within adjoining riverine and downstream estuarine systems (6.2.1) (Jardine et al. 2012; Hunt et al. 2012). Wetlands within the aggregation function as	5.2.1 6.1.1 6.2.1 6.3.1 6.3.4 6.4.1	3 4 3 4 4 3	sn_nr_ec_01

						important breeding sites for aquatic species and provide nursery habitat for fishery species including barramundi *Lates calcarifer* (6.3.1). Deep waterholes such as Old Dorunda Crossing Elvis Lagoon Mentana and Lake Condor have high fish species diversity (Hogan et al. 2009). They also support breeding roosting feeding and moulting habitats for a diverse range of waterbirds. The friable silty alluvium of the delta has a greater nutrient status and moisture retaining capacity that older finer floodplain soils and supports a host of fringing wetland associated regional ecosystems on fertile levees including some with 'of concern' biodiversity status e.g. many good examples of RE 2.3.16: billabongs (abandoned channels) on active Quaternary alluvial plains fringed with *Eucalyptus* spp*. Corymbia* spp. *and Melaleuca* spp. (5.2.1).			
Block valley lakes and back plain swampy wetlands on well developed sandy alluvials		Staaten		Y	Y	This is a disjunct aggregation of back plain swampy wetlands occurring on well-developed sandy alluvials which occurs within a distinct geomorphic feature (6.1.1) partially formed by the blocking of tributary valleys by active main channel alluvial deposits. Seepage from adjoining alluvial sands and older adjoining sand sheet uplands contribute to the retention of water within some wetlands into the dry season providing a contemporary (6.3.1) and potential future (6.3.4) aquatic refugia role. The aggregation is comprised of three palustrine regional ecosystems RE 2.3.55b and RE 2.3.55c: Seasonal tree swamps *Melaleuca viridiflora* and/or *M. clarksonii* low woodland in closed depressions on Tertiary to Quaternary deposits, and RE 2.3.34d: Seasonal swamps. *Eucalyptus camaldulensis* woodland and sedges in circular depressions on podsolic soils. All three include a ground layer that is a combination of tussock grasses sedges and forbs. These include many aquatic macrophytes that are important feeding nesting and moulting habitat for waterbirds (6.3.1) including *Pseudoraphis spinescens, Nymphoides indica Eleocharis* spp. *Marsilea* spp. and *Oryza*	6.1.1 6.3.1 6.3.4 6.4.1	4 3 3 3	sn_nr_ec_02

						australiensis. They also include small unwooded areas and open water. Small lacustrine habitats within the back plains are also associated with cut-off meander or prior channel riverine wetlands defined as RE 2.3.24: *Melaleuca* spp. woodland-open forest on sands in channels and on levees. These wetlands are hosted within two floodplain REs including RE 2.3.11: *Eucalyptus microtheca, Excoecaria parvifolia* open woodland and *Dichanthium* spp. on grey clay plains and RE 2.3.28: *Melaleuca* spp. woodland in depressions and shallow valleys on solodised soils and pale earths.			
Subterranean aquatic cave habitats associated with Limestone karsts		Mitchell Gilbert	Y		Y	This area was identified as being of State significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_fa_22): Ia (centre of endemism): HIGH Ib (wildlife refugia): VERY HIGH Ic (disjunct populations): VERY HIGH Id (taxa at the limits of their ranges): HIGH Ie (high species richness): VERY HIGH Ij (significant breeding or roosting sites): VERY HIGH This covers limestone outcrops across the bioregion. The outcrops and the associated caves are an important refugia or breeding site for many species. The specialised habitats associated with the limestone outcrops and caves support endemic fauna including obligate cave-dwellers such as relictual stygofauna and other troglomorphic species as well as other invertebrate species. Numerous bat species roost and breed in the caves including the eastern bent-wing bat *Miniopterus schreibersii,* the little bent-wing bat *M. australis,* the eastern cave bat *Vespadelus troughtoni,* the common sheathtail bat *Taphozous troughtoni,* the eastern horseshoe-bat *Rhinolophus megaphyllus,* the eastern dusky leaf-nosed bat *Hipposideros ater aruensis,* and the diadem leaf-nosed bat *Hipposideros diadema*. Area includes 500m buffer from the limestone outcrop. Note: this decision comes from the Einasleigh	6.1.1 6.3.1	4 4	Not Implemented

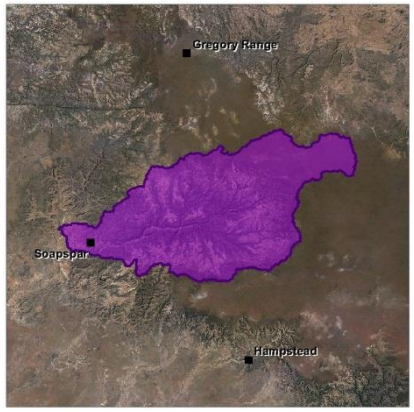
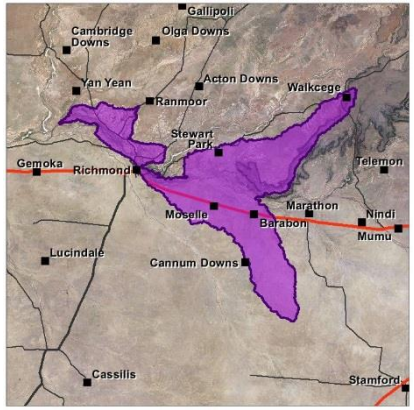
						Uplands Biodiversity Planning Assessment. The wetland component relates to subterranean aquatic cave habitats associated with Limestone karst (subterranean systems with a large void size). This decision could not be implemented because subterranean aquatic cave wetlands are not represented in the non-riverine and riverine spatial units used for the assessments.			
Wetland aggregation near Ridley and Warrigal Creek		Norman			Y	This wetland aggregation contains circular isolated wetlands kept alive for a long time by ground water discharge. It is a typical wetland aggregation because of hard pan underlay and the depressions contained within are ground water fed. This whole sandsheet area is poorly known. Note: this decision could not be implemented due to uncertainty in spatial implementation.	6.4.1 7.2.1	3 3	Not Implemented
Melaleuca dealbata swales and dunes		Mitchell	Y	Y	Y	*Melaleuca dealbata* swales and dunes. Does not occur anywhere else in the Gulf Plains. Rare in the Gulf catchments. Dominated by an unusual flora and fauna values. Isolated southern species such as the southern extent of swamp fish fauna. Note: this decision could not be implemented due to uncertainty in spatial implementation.	5.2.1	3	Not Implemented

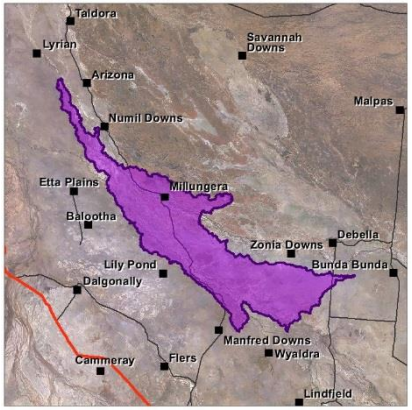
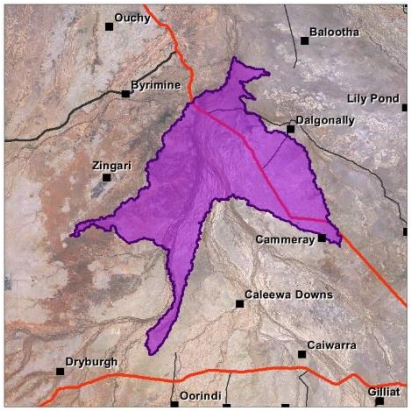
[1] R — Riverine, NR — Non-riverine.

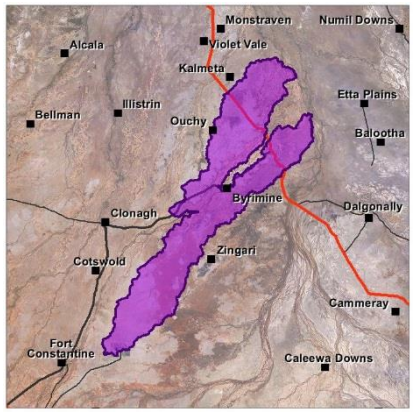
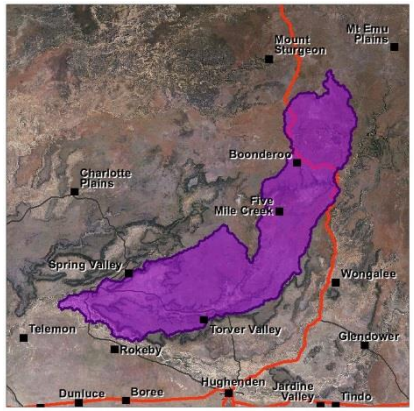
[2] Criteria, indicators and measures (used in AquaBAMM).

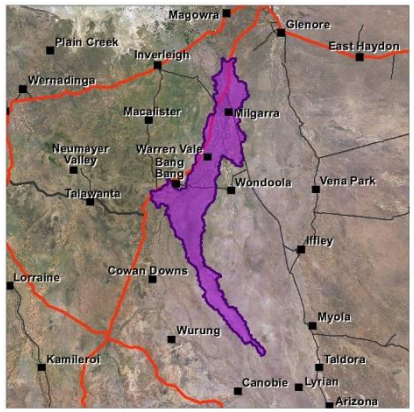
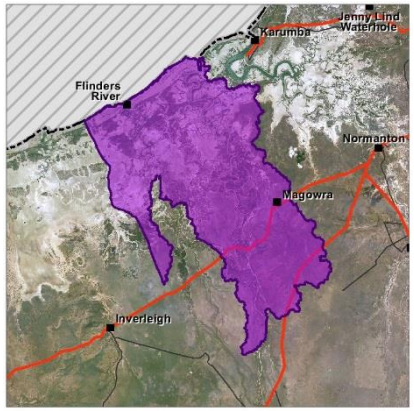
[3] Conservation rating between 1 (Low) and 4 (Very High).

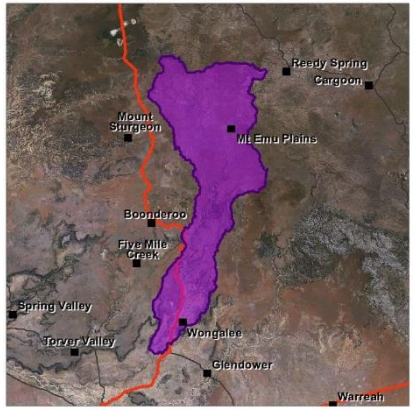
Table 16. Riverine special features and their values

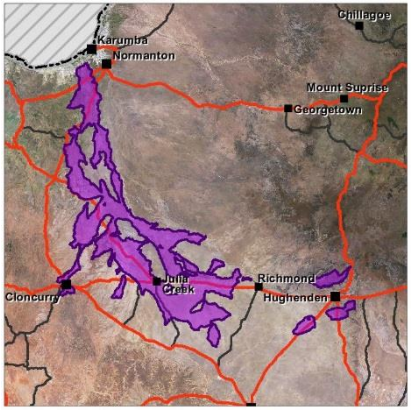
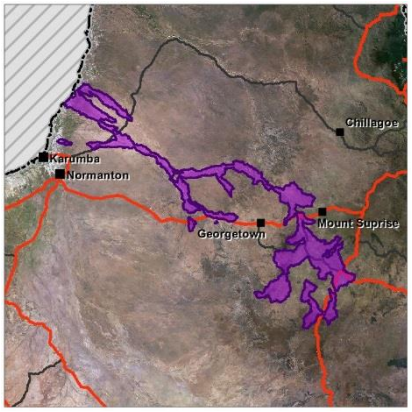
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Upper Woolgar River		Flinders			Y	The upper Woolgar River is a spring fed system fed purely by groundwater. The springs in this area contain a metamorphic basement which is unlike other areas of springs in the region which have a sand basement. The system has deep running water and is thought to support water gums. Although the flora & fauna values are largely unknown, the area is likely to have value as refugia.	6.1.1 6.4.1 7.2.1	4 4 4	fl_r_ec_01
Flinders River near Marathon		Flinders			Y	This section of the Flinders River contains first time braided systems that appear deeply incised. The area experiences lateral connectivity and provides refugia in and around the semi-permanent/permanent waterbodies.	6.1.1 6.3.1 6.3.4	3 3 3	fl_r_ec_02

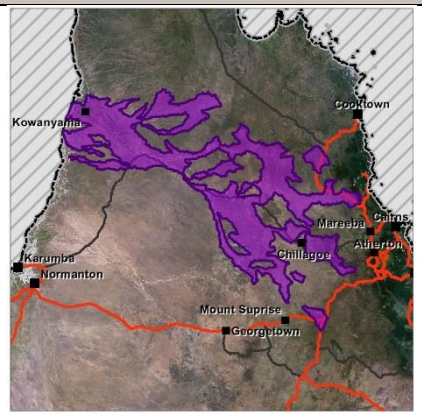
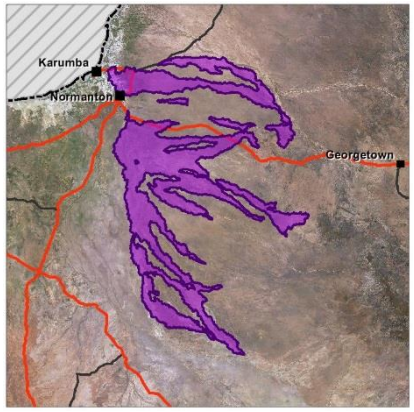
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Washpool Lagoon complex		Flinders	Y		Y	The washpool lagoon complex is formed by a constriction from the shale hills and sand sheets. The complex is the best development of deep pools and braiding on the Flinders River. With good lateral connectivity, persistent waterholes and a large concentration of palustrine systems, the area contains significant ecological values.	6.2.1	4	fl_r_ec_03
Williams River		Flinders	Y	Y	Y	This section of the Williams River is always a very wet blue grass grassland; blue grass occurs in this area whilst most other areas have Mitchell grass. The riparian area functions as a wetland holding water for a long time after it fills. The area therefore has good fertility and productivity and provides refuge for a long time. Areas such as these are quite restricted.	6.2.1 6.3.1 6.3.4	3 3 3	fl_r_ec_04

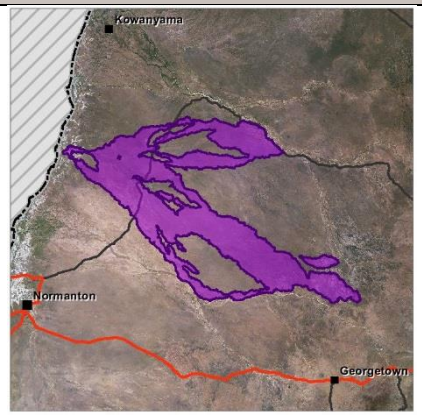
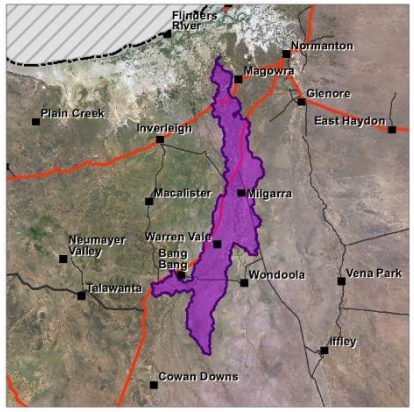
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Cat Creek swamp		Flinders			Y	The Cat Creek Swamp is a seasonal wetland/persistent waterbody that experiences a lot of water cycling. It is covered by regional ecosystem 2.3.3b. Note: This decision was implemented as a riverine decision as no non-riverine spatial units occurred at the nominated location.	6.2.1	3	fl_r_ec_05
Soda valley area		Flinders		Y	Y	The Soda valley area contains a significant local cluster of unique sodic springs in upper tributaries. Currently, there are no springs mapped in the wetlands mapping for this area. The palustrine wetlands covered by this special area contain regional ecosystem 9.3.10. Additionally, the springs in this region discharge on shale not basalt which is unlike other basalt springs in the area.	6.1.1 6.4.1	3 3	fl_r_ec_06

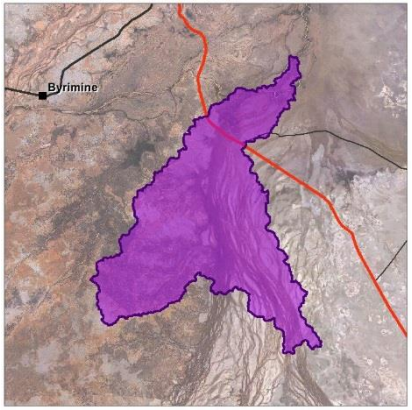
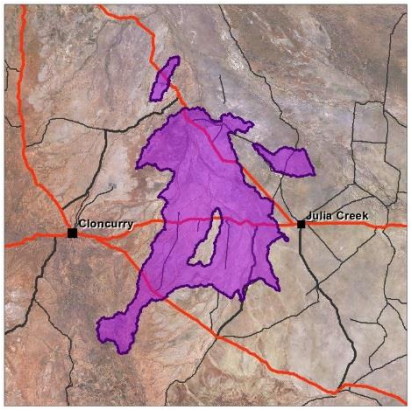
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Intersection of Flinders & Saxby rivers		Flinders	Y		Y	The intersection of the Flinders and Saxby rivers has a good diversity and concentration of deep waterholes within the drainage channel. These waterholes provide refugia and habitat that are connected to the estuarine systems, making them important for fish migration and spawning. There is also high potential for waterbird colonies of sarus crane *Grus antigone*, pelican *Pelecanus conspicillatus*, black-necked stork - *Ephippiorhynchus asiaticus* and brolga *Grus rubicunda.*	6.3.1 6.3.4 7.1.2	4 4 4	fl_r_ec_07
Deep water holes just above estuarine extent		Flinders	Y		Y	These deep waterholes occur in the hard pan systems just before the river enters the estuarine area. They provide valuable nursery habitat and are riverine just above the estuarine extent. Such waterholes include Walker's Bend on the Flinders and the Burke & Wills Crossing waterhole on the Bynoe, both supporting high fish species diversity (Hogan & Vallance 2005).	6.3.1 7.5.1	4 4	fl_r_ec_08

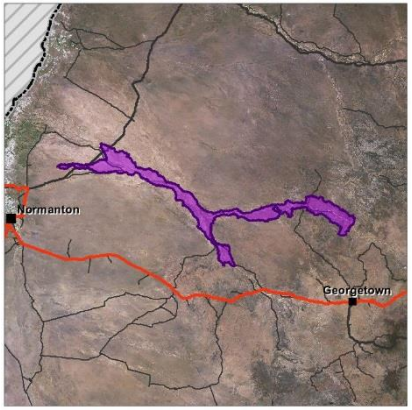
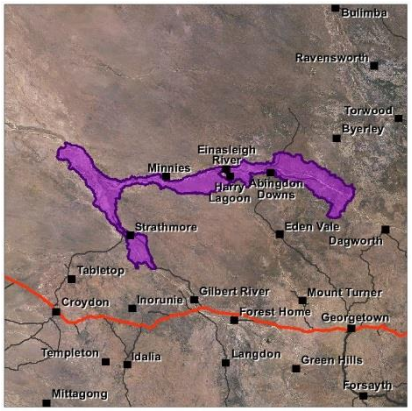
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Porcupine and Prairie Gorge		Flinders	Y	Y	Y	This area was identified as being of State significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_fa_01): Ib (wildlife refugia): VERY HIGH Ic (disjunct populations): VERY HIGH Ie (high species richness): HIGH Values listed in the BPA include: the area contains spring-fed refuge for northern purplespotted gudgeon *Mogurnda mogurnda*, spangled perch *Leiopotherapon unicolor* and eastern rainbowfish *Melanotaenia splendida.* The only permanent clear water in the Flinders River system. The area identified includes a 500m buffer from the scarp edge. Additional values provided by the Southern Gulf of Carpentaria wetland ecology expert panel include: The springs feeding the gorge provides a clear water stable perennial flow that occurs nowhere else in the catchment. The gorge, which is downstream of the springs, contains a series of pools. Northern purplespotted gudgeons *Mogurnda mogurnda* are the most significant fish fauna in this area, only occurring in this region). Invertebrate species present are also quite unique (despite the families being quite common). Additionally, there is a diversity of aquatic flora with the presence of about six primitive species found here.	6.3.1 6.3.3 7.2.1	4 4 4	fl_r_ec_09

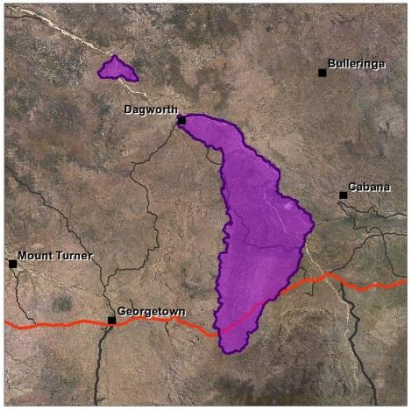
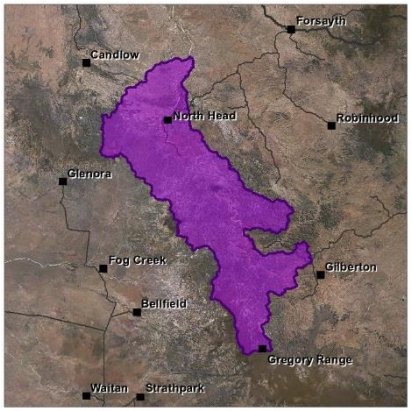
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Perennial waterholes in active streams	 	Mitchell Staaten Gilbert Norman Flinders	Y		Y	In the seasonally dry tropics of the Eastern Gulf, perennial waterholes in active streams provide critical refugial (6.3.1) dry season habitat for obligate freshwater species including conservation dependent and listed species such as juvenile freshwater sawfish *Pristis pristis* and snapping turtles and represent a priority aquatic ecosystems (5.2.1). They are also important for migratory fish species (7.1.2) in particular sooty grunter *Hephaestus fuliginosus* and adult phase eel tailed catfish. Permanent waterholes in active streams support a range of ecological processes that are distinct relative to the more extensive seasonal aquatic habitats that characterise the eastern Gulf (6.2.1). Within the seasonally dry climate of the eastern Gulf the presence of permanent freshwater usually owes its existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1). Within the suite of exiting perennial waterholes are subset will also have an increasingly important role as refugia within the increasingly variable rainfall and elevated temperature regimes predicted under climate change (6.4.1). Note: This decision was implemented as riverine special features.	5.2.1 6.1.1 6.2.1 6.3.1 6.3.4 6.4.1 7.1.2	3 3 3 4 3 3 3	fl_r_ec_10 gi_r_ec_12 ml_r_ec_06 nn_r_ec_04 sn_r_ec_06

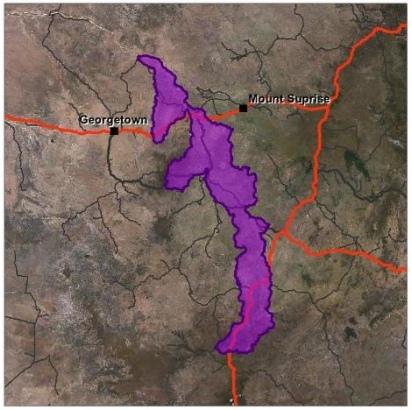
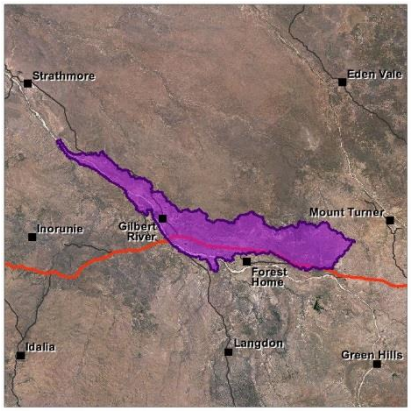
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
	 								

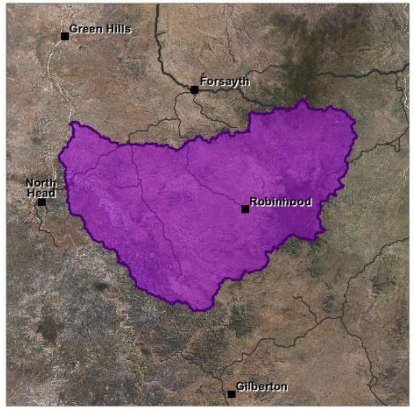
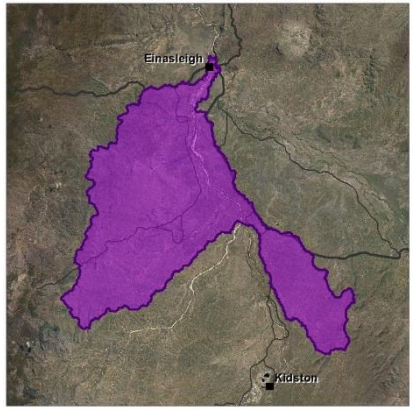
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
									
Lower Flinders River floodplain			Y		Y	This area was identified as being of Regional significance in the Gulf Plains Biodiversity Planning Assessment (BPA) (gup_l_38): Ib (wildlife refugia): HIGH Ie (high species diversity): HIGH Ii (high density of hollow-bearing habitat trees): HIGH. Concentration of off-stream wetlands on scoured floodplain and extensive water holes associated with lower Flinders River. High fauna diversity, particularly of frogs, e.g. northern waterfrog *Litoria dahlii*, and birds, e.g. *radjah shelduck Tadorna radjah* (Queensland Museum data, Birdlife Australia Atlas data). Recorded presence of threatened green sawfish *Pristis zijsron* and pictorella mannikin *Heteromunia pectoralis*, and uncommon freshwater whipray *Himantura dalyensis*.	6.3.1	3	fl_r_ec_11

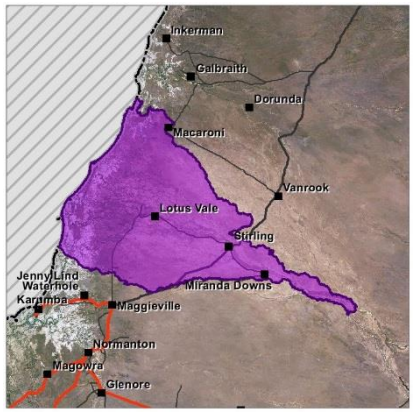
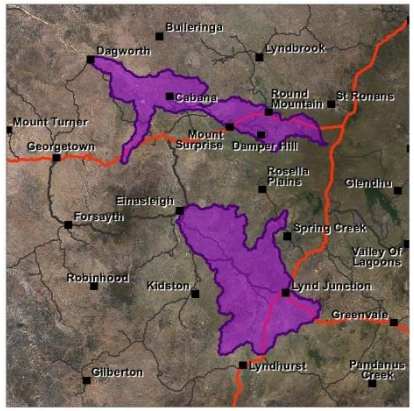
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Dalgonally Swamps		Flinders	Y		Y	This area was identified as being of Regional significance in the Gulf Plains Biodiversity Planning Assessment (BPA) (gup_l_06): Ib (wildlife refugia): HIGH Ig (REs show distinct variation in species composition): VERY HIGH Ih (artificial waterbody or managed/manipulated wetland of ecological significance): HIGH Very wet grassland which is atypical for the system. Confined floodplain. The lowest part in the area and the water pools here is a refuge and stays wet for a long period. Most of the other wetlands in this area dry out quickly. Not so much standing water as just staying damp for extended periods. Used by a variety of waterbirds including black-necked stork *Ephippiorhynchus asiaticus*, as well as threatened grey falcon *Falco hypoleucos* (Birdlife Australia Atlas data). Significant pig populations.	6.3.1	3	fl_r_ec_12
Seasonally inundated channels of the Gilliat River		Flinders		Y		Seasonally inundated channels of the Gilliat river are characterised by RE 2.3.43: *Sporobolus mitchellii, Elytrophorus spicatus, Oryza sp., Juncus sp. and Ipomoea diamantinensis* in mixed tussock grasslands on seasonally inundated alluvial plains and Regional Ecosystem 2.3.21: *Eucalyptus leptophleba* and *Corymbia spp*. woodland on low rises and plains on fine sands and red earths. These floodplains are a unique ecosystem (5.2.1) dominated by rare plant species not represented elsewhere. Following wet season inundation which delivers nutrients to the floodplain their fine sandy soils retain moisture well into the dry season creating a refugial area (6.3.1) of floodplain productivity that in combination with near-perennial and less common perennial channel hosted waterholes sustains local fauna populations.	5.2.1 6.3.1	4 4	fl_r_fl_01

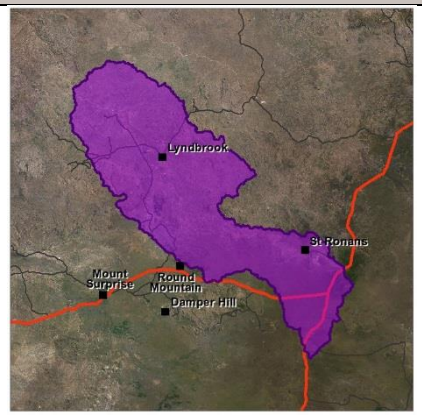
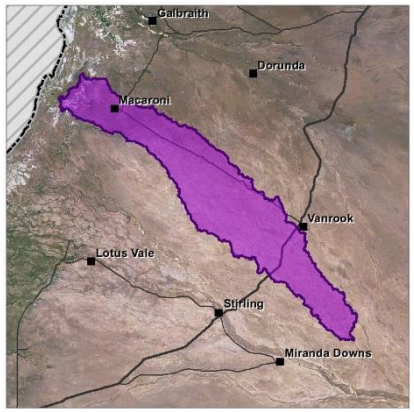
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Gilbert catchment bottleneck (Gilbert and Einasleigh junction)		Gilbert	Y		Y	These waterholes in the Gilbert catchment bottleneck are very dynamic, very confined, long standing waterholes. The waterholes are also very sandy and very deep with permanent water and numerous off stream lagoons. This section of the Gilbert catchment experiences the Venturi effect, i.e. a reduction in water pressure that results when a water flows through a constricted area), which can result in scaring. The area is geomorphologically significant, contains good refugial values, high diversity of species, including threatened species and sawfish, and provides good habitat for fresh *Crocodylus johnstoni* and estuarine crocodiles - *C. porosus*. High fish species diversity recorded in Chillagoe Crossing and Bobby Towns waterholes (Ecowise Environmental 2007).	6.1.1 6.3.1 6.4.1 6.3.4	4 4 4 4	gi_r_ec_01
Lower Einasleigh waterholes		Gilbert	Y		Y	The lower Einasleigh waterholes have had permanent flows through this system in the last two years. They receive localised soaks and are likely to contain sawfish species. Currently knowledge of this area is lacking however it has been identified as a special feature because of its importance as a waterbody in a dry environment.	6.2.1	4	gi_r_ec_02

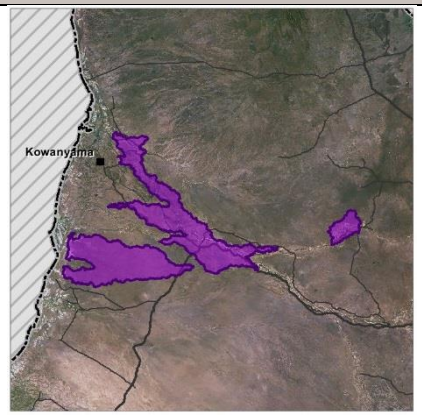
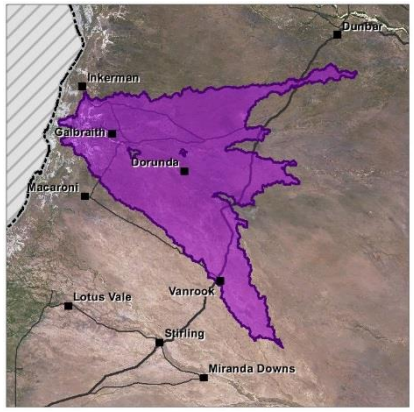
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Einasleigh River gorges		Gilbert	Y		Y	This area of the Einasleigh River is called The Race. It is characterised by basalt flows, which form a gorge up to Junction Creek. The area has unique geomorphology, a rock basement and contains permanent water. Northern quolls *Dasyurus hallucatus* and water rats *Hydromys chrysogaster* are also known to be present.	6.1.1 6.3.1	4 4	gi_r_ec_03
Aquatic habitats associated with the sandstone headwaters of the Gilbert River		Gilbert	Y	Y	Y	The Langdon area is located within the sandstone headwaters of the Gilbert River. The area provides refugia for flora and fauna and has similar values to the sandstone gorges identified in the top of the Norman catchment.	6.1.1 6.3.1 6.3.4	4 4 4	gi_r_ec_04

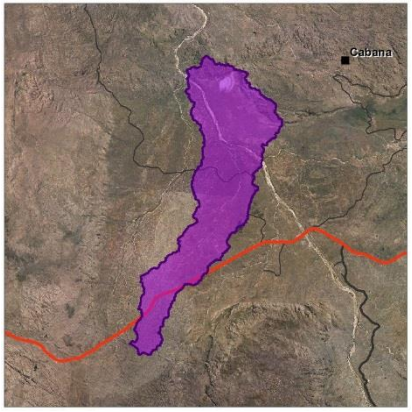
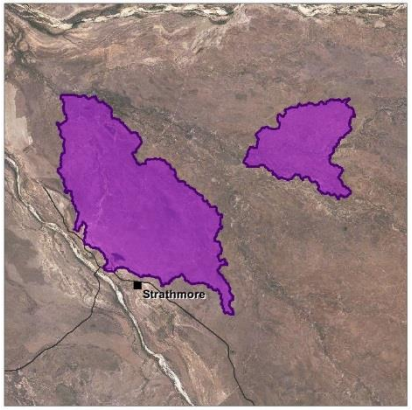
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Einasleigh River spring fed system		Gilbert	Y		Y	This part of the Einasleigh River is a ground water dependent system from the Einasleigh headwaters to the gorge. It provides perennial flow, wildlife refugia and habitat for freshwater crocodiles *Crocodylus johnstoni.*	6.3.1 6.3.4 7.2.1	4 4 4	gi_r_ec_05
Aquifer near the Rockfields gauging station		Gilbert	Y		Y	This aquifer near Rockfields gauging station contains a lot of distinct and special habitat for unique groundwater fauna, including stygofauna. This area provides some of the most significant water resources in the Gilbert River. This area highlights hyporheic fauna and ecology in this catchment that continue a long way up and down the stream. The rocky creek is thought to be the ancient channel of the Gilbert. The area is under significant threat from a proposed dam site upstream of this site at Mt Sircom.	6.2.1 6.3.1	3 3	gi_r_ec_06

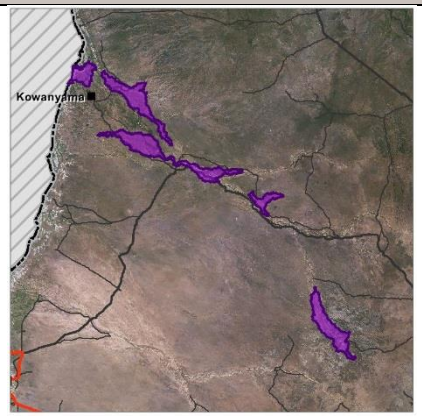
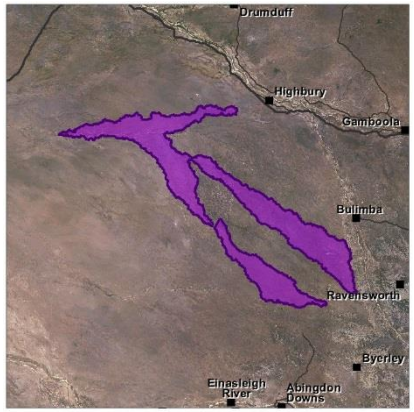
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Cobbold Gorge		Gilbert	Y	Y	Y	The Cobbold Gorge is located close to the junction with the Robertson river. There is a unique spring located in this gorge. It is recognised that the damming effect associated with organic matter build up that occurs in this area is one that is unique and should be protected. In addition, the area has interesting springs, sandstone faces, and unusual terrestrial ecology. The gorge is also unusual in that it is deep and it is well documented that this gorge is the only significant waterbody in the entire sandstone block (although other waterholes in the region remain unexplored). The gorge contains areas of refugia for fish and freshwater crocodiles *Crocodylus johnstoni*, as well as refugial rainforest flora species in riparian communities. Deep waterholes such as Fish Hole and Cobbold Gorge are recognised for their high freshwater fish diversity (Ecowise Environmental 2007).	6.1.1 6.2.1 6.3.1 6.3.4 6.4.1 7.2.1	3 3 3 3 3 3	gi_r_ec_07
Copperfield Gorge		Gilbert	Y		Y	Copperfield Gorge is interesting geologically and very different to Cobbold Gorge. The gorge has a column of basalt through it and sandy waterholes at the bottom. There are only two or three of these types of waterholes in the Gilbert catchment. These areas contain significant refugial values. The gorge has also recently undergone a change in management, with timed releases of water that is leading to an improvement in health. As a result of these releases, the system keeps flowing slightly longer than others in the region.	6.1.1 6.3.1 6.3.4	2 2 2	gi_r_ec_08

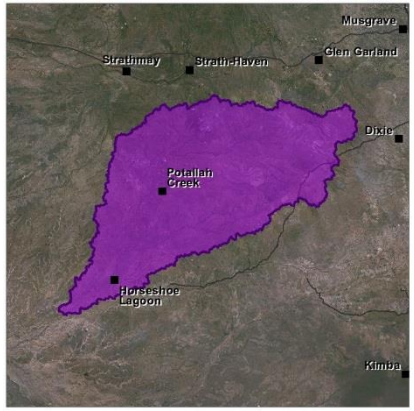
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Gilbert-Smithburne delta fan		Gilbert	Y			The Gilbert-Smithburne delta fan is full of waterbird colonies and is a particular stronghold for the sarus crane Grus antigone.	5.1.4	4	gi_r_ec_09
Wetland complexes		Gilbert Mitchell	Y	Y	Y	Selected wetland complexes identified as being of State significance in the Einasleigh Uplands BPA (eiu_l_09): Ib (wildlife refugia): VERY HIGH Id (taxa at the limits of their ranges): HIGH Ie (high species richness): VERY HIGH Ig (REs with distinct variation): HIGH Ii (high density of hollow-bearing trees): VERY HIGH Ij (significant breeding or roosting sites): HIGH Values listed in the BPA include: One of the primary concerns for biodiversity assessment and planning in undeveloped regions is that biodiversity conservation and management be pursued at a landscape scale. This is particularly so for wetlands. In undeveloped landscapes the aim is to retain wetlands within their landscape context, not to restrict the focus to the wetland body itself. In these landscapes there is the opportunity to ensure that landscape elements that directly relate to wetlands and contribute to their values are identified in association with the wetland itself; 12 wetland complexes in the EIU are so significant that they particularly need to be addressed at the	6.1.1 6.3.1 6.3.3	4 4 4	gi_r_ec_10 ml_r_ec_17

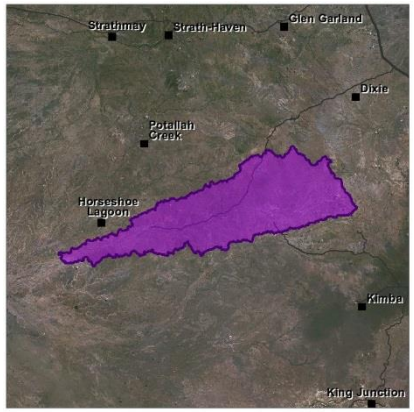
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						landscape scale. Additional values provided by the Southern Gulf of Carpentaria wetland ecology expert panel include: These wetlands have a very localised feed, mostly from southeast although they are modified by drainage. The area has basalt to the south/west and granite/rhyolite to the north east as well as tertiary residuals. The main floodplain complex is upstream of the Einasleigh township. Some of the largest freshwater crocodiles Crocodylus johnstoni are known from this area. The area is related to the Blackbraes lava flow and contains combined basalt systems, a mosaic of springs and waterholes. These systems are unique in a state wide context. The most southern decision is remnant of old tertiary surface with two wetlands in depressions.			
Mixed woodland on levees in active Quaternary alluvial systems		Gilbert Mitchell Staaten	Y	Y	Y	Regional Ecosystem 2.3.21c is a mixed floodplain woodland, which represents a limited unique form (5.2.1) of a broader regional ecosystem comprised of unique combinations of species that do not occur together or within the broader regional ecosystem at all including *Eucalyptus microtheca, Corymbia polycarpa. C. bella and C. confertiflora.* Occasional canopy species include *Terminalia platyphylla* and *Cathormion umbellatum*. A secondary tree layer commonly occurs, including the palm *Corypha utan* and guttapercha *Excoecaria parvifolia*. This RE occurs only on elevated levees (6.1.1) in active Quaternary alluvial systems where it functions as a flood refuge (6.3.1) for fauna. It is also known to provide nesting habitat for estuarine crocodiles *Crocodylus porosus.*	5.2.1 6.1.1 6.2.1 6.3.1	3 3 3 3	gi_r_ec_11 ml_r_ec_04 sn_r_ec_02

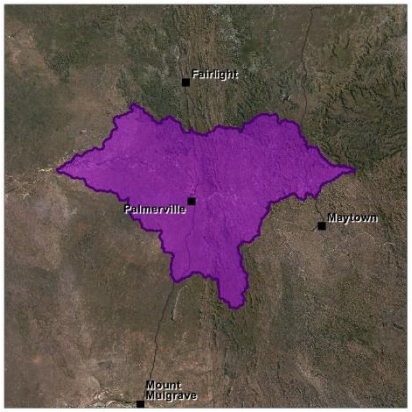
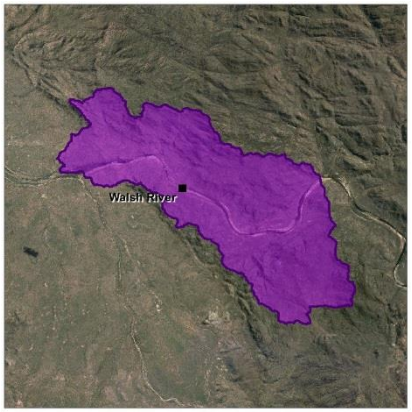
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
	 								

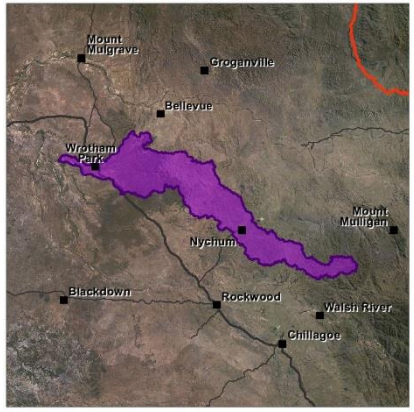
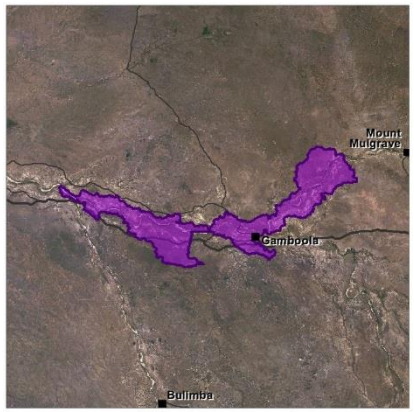
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Creeks associated with the Talaroo springs complex		Gilbert	Y		Y	The Talaroo springs complex consists of a 5 to 10m high mound composed of travertine (a form of limestone). The spring complex covers approximately 6 ha and flow at an extremely slow rate forming terraces and ridges (termed barrages). Water pools and then flows over barrages to the next terrace and so on. Historically, the spring complex drained into three streams connected with the Einasleigh River. Presently, Dunny creek and Pool creek are connected to the Einasleigh River. The ecosystems associated with Talaroo Springs include rare and endemic species. For example, a species of snail identified as *Gabbia affinis* was found in Wallaby and Goodaba creeks. This species is only found in north-western Queensland and may also be a new species. A dragonfly from two of the drainage streams is also unusual and may be undescribed. See Negus et al. (2013) for more detail.	5.2.1 6.3.1 6.4.1	4 4 4	gi_r_ec_13
Mixed woodland to open forest on elevated, stabilised terraces in channels of larger watercourses		Mitchell Staaten Gilbert	Y	Y		Regional Ecosystem 2.3.24c is a Melaleuca spp. woodland-open forest containing significant rainforest elements in a riverine or fringing riverine wetland which occurs on elevated, stabilised terraces in channels of larger watercourses. Regional Ecosystem 2.3.53 is an evergreen notophyll vine forest is a rare (within Gulf catchments) remnant rainforest fringing riverine wetland (5.2.1) which occurs on fringes and levees of the Mitchell River. The geomorphic setting of these regional ecosystems ecosystems provides a fire refugia (6.2.1) which supports the formation of a very rare rainforest ecosystem (5.2.1) which has a range of habitat resources not evident in the rest of the landscape and an 'of concern' biodiversity status. It supports locally uncommon and unique combinations of species within its plant community including Celtis paniculata, Terminalia platyphylla, Eucalyptus camaldulensis, Thryptomene oligandra, Canarium australianum, Parinari nonda and	5.2.1 6.2.1 6.3.1	3 4 4	gi_r_fl_01 ml_r_fl_02 sn_r_fl_01

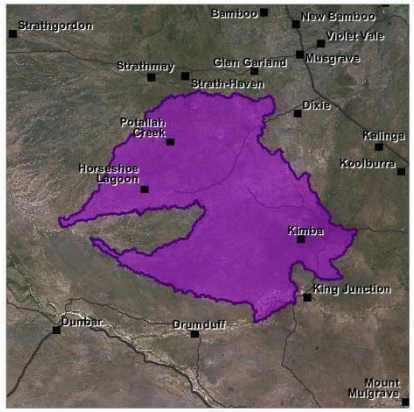
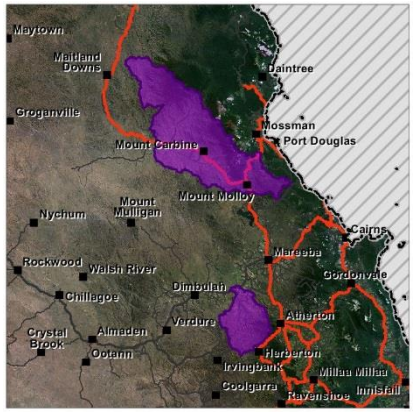
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
	 					Acacia spp. A variable shrub layer commonly occurs, including Margaritaria dubium-traceyi, Antidesma parvifolium and Syzygium eucalyptoides. Many of the rainforest species are fruit bearing and support frugivorous birds. The dense physiognomy and closed canopy vegetation provides important sites for feeding and movement of birds, fish and reptiles and a provincial refuge (6.3.1) for flora and fauna, particularly dense cover dependent species.			

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Wetland aggregation on upper Crosby floodplain		Mitchell	Y	Y	Y	This floodplain wetland aggregation is part of an alluvial valley which hosts the most upstream permanent waterholes in the Crosbie Creek subcatchment of the Alice River. The primary significance of the area is associated with the size and permanence of the riverine and non-riverine wetlands within a highly seasonal sub basin with Horseshoe Lagoon the best example (Jeff Shellberg pers. comm.). The area's values have been identified by a number of recent field investigations (6.3.3) (Shellberg 2014; Shellberg et al. 2014, 2015). It includes a rich array of meandering and anabranching channels, off-channel lagoons (billabongs and oxbows), elliptical or elongate swamps, tributary creeks, and other interconnected complex habitat within inter-bedded alluvial sediments. They are frequently inundated by floodwater each wet season. There is a high diversity of aquatic plants around floodplain wetlands and the areas supports a number of 'Of Concern' wetland associated Regional Ecosystems (5.2.1) including RE 3.3.45: *Eucalyptus chlorophylla +/- Melaleuca viridiflora* low open woodland on Mitchell River floodplain and RE 3.3.66a: Permanent wetlands vegetated with *Eleocharis spp. Nymphaea spp. and Nymphoides spp*. +/- fringing open-forests of *Melaleuca spp*. Lacustrine wetlands are commonly fringed by an open sedgeland dominated by *Lepironia articulata*. Perennial aquatic refugia (6.3.1) (6.3.4) are comprised of off channel lagoons and channel hosted pools and support a high species richness of fish including species at their extralimital range, e.g. delicate blue-eye *Pseudomugil tenellus* and threadfin rainbowfish *Iriatherina werneri* the latter expressing unique phenotypes (Shellberg 2014; Shellberg et al. 2014, 2015). Sixteen species of fish and three crustacean species have been identified including tiger crab *Austrothelphusa tigrina* which represents a range extension for this endemic species. Wildlife fauna associated with	5.2.1 6.3.1 6.3.3 6.3.4	4 4 4 3	ml_r_ec_02

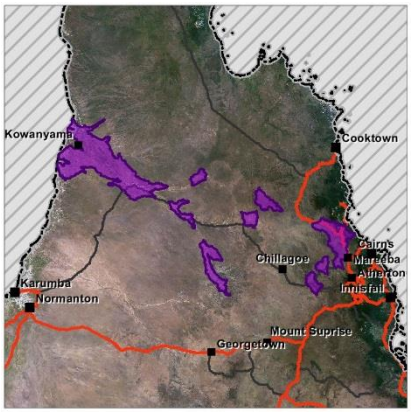
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						the Crosbie floodplains is also diverse and includes eighty-one species of birds, five mammal species, six reptile species and seven amphibian species. The importance of the wetlands as a focal point for bird fauna and amphibians has also been noted.			
Wetland aggregation on Eight Mile Creek, Crosby floodplain		Mitchell	Y	Y	Y	This floodplain wetland aggregation occurs on the floodplain of Eight Mile Creek immediately upstream of the confluence of Crosbie Creek both of which are subcatchments of Alice River. The aggregation occurs on an alluvial floodplain and abuts sand sheets derived from a weathered Holroyd Plain surface into which connected wetland depressions extend. The primary significance of the area is associated with the size and permanence of the riverine and non-riverine wetlands within a highly seasonal sub basin (Jeff Shellberg pers. comm.). The wetlands include meandering and anabranching riverine channels, off-channel lagoons (billabongs and oxbows), elliptical or elongate swamps, tributary creeks, large seasonal lakes within sandy depressions and other interconnected complex habitat within inter-bedded alluvial sediments. Most are inundated by floodwater each wet season and elevated flood flows also contribute to the recharge of sand sheet aquifers (6.4.1) supplying large seasonal swamps in connected sandy depressions. There is a high diversity of aquatic plants around floodplain wetlands and the areas supports a number of 'Of Concern' wetland associated Regional Ecosystems (5.2.1) including RE 3.3.41: *Melaleuca clarksonii* low open forest in swamps and RE 3.3.66a: Permanent wetlands vegetated with *Eleocharis spp. Nymphaea spp. and Nymphoides spp.* +/- fringing open-forests of Melaleuca spp. Lacustrine wetlands are commonly fringed by an open sedgeland dominated by *Lepironia articulata*. Perennial aquatic refugia (6.3.1) (6.3.4) are comprised of off channel lagoons and	5.2.1 6.3.1 6.3.3 6.3.4	4 4 3 3	ml_r_ec_03

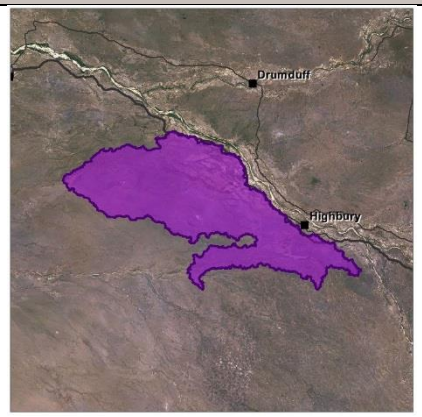
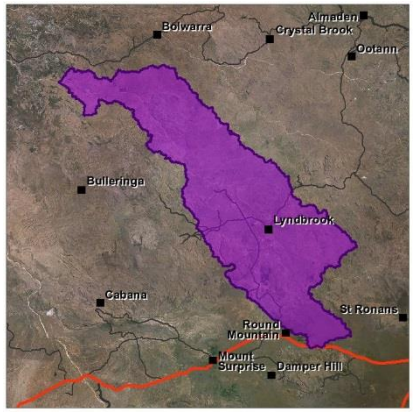
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						channel hosted pools and support a high species richness of fish. The importance of the wetlands as a focal point for bird fauna and amphibians has also been noted.			
Spring fed base flows on Western Yalanji sandstones		Mitchell	Y	Y	Y	Spring fed base flows, Western Yalanji sandstones. Bioregional boundary confluence of values.	6.1.1 6.2.1 6.3.1 6.3.4	4 4 4 3	ml_r_ec_05
Walsh Gorge deep waterholes		Mitchell	Y		Y	Deep waterholes in the Walsh gorge. The unique geomorphic feature of the gorge reach of the Walsh River (6.1.1) constrains high flows within the river channel and has created deep scour holes. These deep gorge holes are perennial and act as contemporary aquatic refugia (6.3.1) for obligate freshwater biota and will also potentially gain importance in the future under the spectre of increased rainfall variability due to climate (6.3.4). The gorge reach of the Walsh River has also been recognised for broader biodiversity conservation values in regional bioregional planning studies (6.3.3).	6.1.1 6.3.1 6.3.3 6.3.4	4 4 4 4	ml_r_ec_11

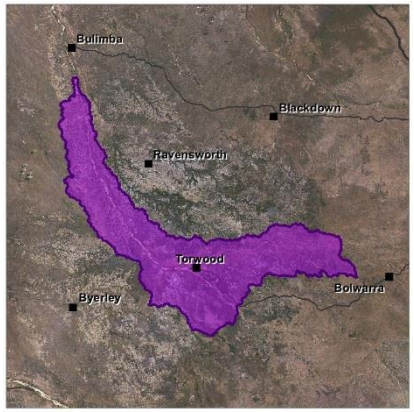
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Elizabeth Creek		Mitchell	Y	Y	Y	Deep waterholes, refugia, contains dry rainforest partly protected by fire and supported by water. Good catchment integrity. Sandstones have series of spring fed non riverine wetlands. Elizabeth Creek is a tributary of the lower Walsh River. Its mid catchment runs through incised sandstone uplands (6.1.1).which have good catchment integrity and a series of springs which support nonriverine wetlands and other groundwater dependent vegetation and riverine ecosystem features (6.4.1). Main channel reaches also support deep refugial (6.3.1) waterholes and provide fire refugia which contains dry rainforest also supported by water availability. A specific spring flora suite of species occurs. Perennial water within sandy channel reaches has also supported the development of an unusually tall (e.g. 25m) community of *Melaleuca leucodendron* forest (6.2.1). The springs have not been mapped but are concentrated in the west of the riverine spatial unit. The refugia roles of this riverine wetland system are likely to increase in importance under future more variable rainfall patters driven by climate change (6.3.4).	6.1.1 6.2.1 6.3.1 6.3.4 6.4.1	4 4 4 4 4	ml_r_ec_12
Major Groundwater Baseflow Reach Mitchell Falls to Walsh and Lynd confluence		Mitchell	Y		Y	Although the Mitchell River's perenniality can be attributed to high rainfall in the headwaters during the wet season and year round discharge from both local and regional aquifers (CSIRO 2009), studies tracing groundwater geochemistry have indicated that reaches within the central basin receive up to 40% of total groundwater discharges (Battle-Aguilar et al. 2014). Groundwater is supplied primarily from the Gilbert River formation and enters the river from the Mitchell River falls downstream to the Walsh and then Lynd confluences (CSIRO 2009). This groundwater connectivity with the Gilbert River formation is a distinct geomorphic feature (6.1.1) and hydrologic regime (6.4.1). It supports perennial aquatic habitats that are important contemporary aquatic refugia (6.3.1)	6.1.1 6.3.1 6.3.4 6.4.1	4 4 4 4	ml_r_ec_13

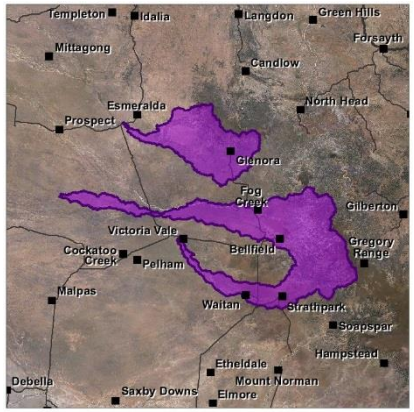
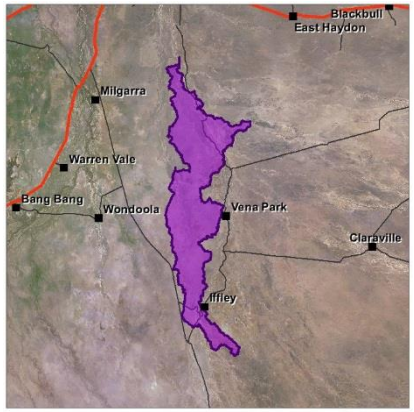
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						for obligate aquatic biota including species of conservation interest such as freshwater sawfish *Pristis pristis*. Permanent water and associated riparian communities are also important habitat resources for terrestrial wildlife. The refugia supported by these groundwater supplemented reaches will also have increasing importance during periods of extreme low rainfall predicted under climate change (6.3.4).			
Spring-fed riverine wetlands and recharge areas at Kimba		Mitchell	Y	Y	Y	Spring-fed riverine wetlands, some of which are on the edges of Tertiary surfaces, support plant species of conservation significance, regional ecosystems of conservation significance and ecological function. Ecological functions include refugial areas, critical habitat for plants and key resources for birds, frogs and reptiles (Lyon & Franklin 2009; Shellberg et al. 2015).	6.1.1 6.3.1 6.4.1	4 3 3	ml_r_ec_14
Wet Tropics rainforests and associated riverine habitats across the upper Mitchell basin		Mitchell	Y	Y	Y	The Mitchell is the most bioregionally diverse basin in the eastern Gulf and is unique within all Gulf River basins in having areas of its upper catchment fall within the Wet Tropics Bioregion. Each of the sub basins of the upper Mitchel drain three different Wet Tropics Provinces including the Palmer which drains the Daintree Bloomfield Province, the Upper Mitchel which drains both the Daintree-Bloomfield and the Macalister Provinces and the Walsh which drains the Atherton Province. These areas are fully representative of the Wet Tropics and include extremely high and seasonally distributed rainfall, cool high (6.1.1) altitude mountains and tropical rainforest vegetation. This combination of biophysical features within a Gulf drainage basin generates unique	5.2.1 6.1.1 6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	4 4 4 4 4 4 4	ml_r_ec_16

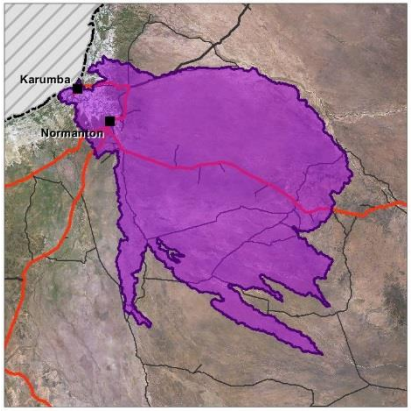
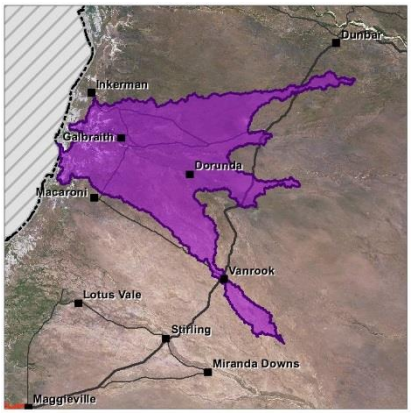
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						hydrological conditions (6.2.1) and associated riverine (and some unmapped non riverine) wetland habitats, communities and values. High elevation areas receive regular rainfall often via cloud capture, which sustains perennial riverine habitats often via direct rainfall run off (6.4.1) rather than groundwater contributions alone which is associated with perennial streams elsewhere in the eastern Gulf. Cool water temperatures associated with high altitude (>700m) areas support habitats rich in bryophytes and mosses and endemic fauna including a large spiny crayfish Euastacus fleckeri restricted within the Mitchell Basin to areas draining Mt Windsor and the Hann Tableland in the adjoining Einasleigh Uplands Bioregion (Ryan et al. 2002). An area also vegetated by Wet Tropics rainforest regional ecosystem. The potential for additional Euastacus species to be discovered elsewhere in these upland rainforest catchments is high. Numerous frog species including at least nine that are listed as threatened (6.3.1) also characterise the fauna of the Wet Tropics upper catchments of the Mitchell (Tait et al. 2015). These high altitude areas also include flat tablelands likely to host a number of unmapped non-riverine wetland types including springs and soaks associated with past alluvial deposits. Another restricted crayfish species red tipped yabby *Cherax wassellii* occupies mid altitude uplands ranging from 500m adjoining Black Mountain to 350m in the lower Rifle Creek system adjoining Mt Carbine. This species occurs more widely throughout adjoining eastern drainages and is believed to be a natural translocation (Ryan et al. 2002). Perennial flows from these upland rainforest catchments sustain perennial riverine habitat into lower altitude reaches and contribute to downstream shallow aquifer recharge (6.4.1) beyond the McLeod River - Rifle Creek confluence in the upper Mitchell (Hydrobiology 2005). These perennial			

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						habitats act as refugia for aquatic species (6.3.1) including fish and crustaceans more typically associated with lower western reaches. When hosted in Wet Tropics upper catchments unique community types of Gulf basins species juxtaposed within Wet Tropics habitats are formed (Vallance & Hogan 2001, Ryan et al. 2002). Some of these perennial riverine reaches are likely to provide important climate change refugia in future years (6.3.4). Frontage communities associated with these Wet Tropics riverine reaches also include a large number of 'endangered' or 'of concern' regional ecosystems (5.2.1), e.g. RE 7.3.23, RE 7.3.25, RE 7.3.26, RE 7.3.28, RE 7.3.49, RE 7.11.42. In many cases the threatened status of these regional ecosystems is due to impacts elsewhere within the Wet Tropics and the more limited development pressure within the upper Mitchell has thus far retained good examples of them. Ongoing emerging development pressure in these uplands of the Mitchell basin underpins the need for recognition of the conservation value of these wetland associated priority ecosystems.			
Priority refugia freshwater fish		Mitchell Staaten	Y		Y	These 'Priority Refugia for Freshwater Fish' (6.3.1) are based on those defined by Hermoso et al. (2013) (6.3.3) for the Mitchell river basin on the basis of water residency (6.4.1) assessed by satellite imagery over multiple years and considerations of fish community distribution across the basin. Fish distribution was used to prioritise candidate refugia by seeking to maximise individual species representation across the set of prioritised refugia. Individual species vagility was also assessed and incorporated in refugia selection by seeking to maximise the length of stream area accessible for colonisation (6.2.1) from refugia following their isolation by extreme droughts including those predicted to occur under future climate change scenarios (6.3.4). Two sets of priority	6.2.1 6.3.1 6.3.3 6.3.4 6.4.1	3 4 4 4 3	ml_r_ec_18 sn_r_ec_05

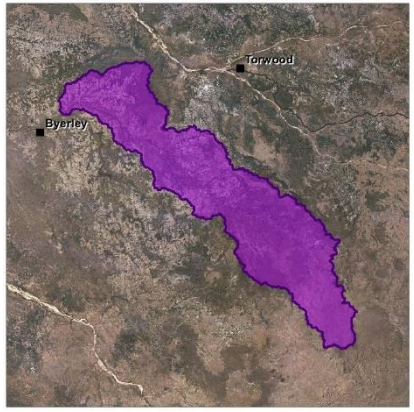
Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						refugia were nominated one using a baseline catchment condition and another using current conditions and projections of ecological pressure that reduce the viability of some candidate refugia. Both sets of prioritised refugia intersected with riverine spatial units have been conservatively used for this decision recognising that not all projected condition pressures have been realised and also that management intervention may have the capacity to mitigate them where they have been realised. Given the use of remote sensing in the identification of potential refugia some caution is needed in the application of identified refugia values recognising that artificial waterbodies including dams may have contributed to satellite based indications of water perenniality in the landscape.			
Fossil Brook and Lynd area		Mitchell Gilbert	Y		Y	This area was identified as being of State significance in the Einasleigh Uplands Biodiversity Planning Assessment (BPA) (eiu_l_31): Ib (wildlife refugia): VERY HIGH Ie (high species richness): VERY HIGH This area covers the wetlands, springfields and spring-fed ecosystems associated with the upper Lynd River and Fossil Brook. The wetlands are fed by northern flows of Undara Basalt, and flow in the main river channels is permanent. The area includes key sooty grunter *Hephaestus fuliginosus* habitat, including spawning habitat in the rapids, outstanding freshwater crocodile *Crocodylus johnstoni* habitat and very high fish diversity. The area includes an internationally significant reference site for crocodilians. The area also has a very high diversity of macropod species, and includes the only known habitat for the skink *Proablepharus barrylyoni*. Enclosed pockets of basalts and granites are included to consolidate the area, increase connectivity and diversity of	6.3.1 6.3.3 6.3.4 6.4.1 8.2.5	4 4 4 4 4	ml_r_ec_19

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						ecosystem and species, and to increase the integrity and viability of the area. A buffer of 500m was also used to ensure values associated with the ecotone between the wetlands and adjacent habitat were included, and to further increase habitat representation.			
Riverine wetlands at the confluence of the Lynd and Tate rivers		Mitchell	Y	Y	Y	The confluence of the Lynd and Tate rivers hosts juxtaposed riverine and non-riverine wetland values. During high flows overbank floodplain at the confluence of these rivers generates large back plain swamps a unique geomorphic feature (6.1.1). These support palustrine wetlands RE 2.3.55c which are unusual in terms of their floristic make up which includes unique mixed communities of limited extent representative of several adjoining bioregions that converge on the area. Seasonal swamps on these back plains are dominated by a particularly tall (e.g.15m) and dense physiognomy of Melaleuca viridiflora and/or *M. clarksonii* woodland. The ground layer is commonly spike rush Eleocharis spp. These seasonal swamps retain moisture into the dry season on account of their size providing a refugial role (6.3.1) for dependent wildlife including water birds which use them as important feeding and moulting sites. On elevated, stabilised terraces within the river channels the best example of another limited extent regional ecosystem RE 2.3.24c occurs. This is a mixed woodland to open forest, with rainforest elements and a denser canopy structure afforded by the fire refugia (6.3.1) function of the within channel terraces (6.3.1). This community includes combinations of *Eucalyptus camaldulensis* and the rainforest tree *Celtis paniculata* and several fruit bearing trees including *Terminalia platyphylla*, *Thryptomene oligandra, Canarium australianum, Parinari nonda, Margaritaria dubium-traceyi, Antidesma parvifolium and Syzygium eucalyptoides*. Some of these species are	6.1.1 6.3.1 8.2.5	3 3 4	ml_r_fl_01

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						important to frugivorous birds and other wildlife and the denser physiognomy of the vegetation also provides habitat for cover dependent species (6.3.1).			
Sandstone gorges		Norman	Y	Y	Y	This special feature is a high gorge section in the upper reaches of the Norman catchment that uncharacteristically flow out of sandstone springs. The area is thought to have similar physical characteristics to the Cobbold Gorge decision. The area is characterised by highly dissected sandstone that supports unique unstable wetlands. The area also has good connectivity, contains permanent waterholes with refugial values and refugial rainforest flora species in riparian communities.	6.1.1 6.3.1	4 4	nn_r_ec_01
Lagoons and ponded area on 40 Mile Creek		Norman	Y		Y	The lagoons and ponded parts of the stream at 40 Mile have particular value for waterbirds and fish in this vast dry landscape (Burrows & Perna 2006; Jaensch & Richardson 2013). 40 Mile, which contains rock bars, forms a big lake in dry season and a river channel in the wet. Significant ecological values include refugia, breeding habitat and sites, lateral and longitudinal connectivity and feeding areas for wildlife such as turtles and macroinvertebrates.	6.3.1 6.3.4	4 4	nn_r_ec_02

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Carron Forrest country		Norman		Y	Y	The Carron Forrest country contains tiny wetlands along coolibah flats. The area has value as a large interconnected aggregation rather than as individual wetlands. Overflow from the Gilbert is associated with the back swamps however on the sand surfaces, the circular wetlands are groundwater recharged. The wetland systems have significant diversity and longevity and contain very thick vegetation including melaleuca, swamp box (*Lophostemon suaveolens*) and spear grass. The area is also subject to flash flooding from the Gilbert River.	6.2.1 6.4.1	3 3	nn_r_ec_03
Staaten Wyaaba Delta Fan		Staaten	Y	Y	Y	Similar to the Gilbert-Smithburne Delta Fan and the Mitchell Holocene Delta, the Staaten-Wyaaba Fan aggregation is a good though less extensive example of a diverse and rich array of alluvial plain wetlands and deep water habitats which characterise the Mitchell-Gilbert Fan province of the Gulf Plains bioregion (8.2.5). The aggregation occurs across the most hydrologically active part of the lower Staaten Basin immediately downstream of the confluences of the basins major sub catchments. Downstream of this point flood flows break out in multiple anastomosing distributary channels across Pleistocene aged floodplain surfaces before splaying and diverging across the active younger Holocene aged delta. Dinah Island formed by delta anabranch channels lies within the active delta and has developed scroll bars and oxbow lagoon habitats formed from past channel meanders. Floodplain overflow from the Mitchell basin are also a critical water supply to the aggregation (6.2.1). The sites includes a high diversity of alluvial landform elements including; closed depressions (lakes, oxbows, swamps), and open depressions (drainage depression, stream channel, stream bed, swamp) within a	5.2.1 6.1.1 6.2.1 6.3.1 6.3.4 6.4.1	3 4 3 4 4 3	sn_r_ec_01

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
						flat upland comprising plains, fans, back plains and floodouts. Flood inundation and flows are integral to site values associated with its dynamic geomorphological, hydrological and ecological form and function. Its lower position in the landscape means it is more frequently inundated, connected and scoured by channel outbreak flows than less active more elevated floodplain areas (6.4.1). The geomorphic setting forms shallow alluvial aquifers and deeper channels and off river waterholes which both support ecologically important aquatic refugia (6.3.1) with potential importance as climate change refuges (6.3.4). As described for the Mitchell, flood inundation across this area would provide a 'floodplain subsidy' to aquatic food chains and fishery productivity within adjoining riverine and downstream estuarine systems (6.2.1) (Hunt et al. 2012; Jardine et al. 2012). Wetlands within the aggregation function as important breeding sites for aquatic species and provide nursery habitat for fishery species including barramundi *Lates calcarifer* (6.3.1). Deep waterholes such as Old Dorunda Crossing, Elvis Lagoon, Mentana and Lake Condor have high fish species diversity (Hogan et al. 2009). They also support breeding, roosting, feeding and moulting habitats for a diverse range of waterbirds. The friable silty alluvium of the delta has a greater nutrient status and moisture retaining capacity that older finer floodplain soils and supports a host of fringing wetland associated regional ecosystems on fertile levees including some with 'of concern' biodiversity status, e.g. many good examples of RE 2.3.16 billabongs (abandoned channels) on active Quaternary alluvial plains, fringed with *Eucalyptus* spp., *Corymbia* spp. and *Melaleuca* spp. (5.2.1).			

Special Feature Name		Study Area	fa	fl	ec	Values	CIM	Cons. Rating	Special Feature ID
Spring fed riverine systems at top of catchment in Bulleringa National Park		Staaten	Y		Y	Springs at top of catchment in Bulleringa National Park. Spring fed riverine systems. Refugia, perennial habitat, powerful springs with a lot of water coming out. Important as a resource to the local fauna, in good condition. Dissected landscape. Hydrological values as a discharge but also as a recharge. Bulleringa National Park straddles the upper catchments of both the Staaten and Mitchell (Lynd subcatchment) basins. Within the upper Staaten basin it includes at least five mapped active spring heads that discharge strongly into the uppermost catchment of the Red River within a seasonally arid landscape. These springs contribute to the maintenance of perennial pool habitats within a riverine ecosystem that acts as contemporary (6.3.1) and potential future (6.3.4) aquatic refugia for obligate freshwater biota including a resident freshwater fish community (T. Vallance pers. comm.). They also provide important habitat resources and watering points for terrestrial fauna. Dissected landscape. Although the principal hydrological values ae associated with spring discharge the surrounding dissected landscape also acts as a groundwater recharge area (6.4.1).	6.3.1 6.3.4 6.4.1	4 4 4	sn_r_ec_03

[1] R — Riverine, NR — Non-riverine.

[2] Criteria, indicators and measures (used in AquaBAMM).

[3] Conservation rating between 1 (Low) and 4 (Very high).

6 Connectivity

Aquatic ecosystem connectivity refers to the connections between and within aquatic ecosystems. An appreciation of the connection of the wetland to other wetlands and to the broader catchment and landscape is important for effective management decisions (DEHP 2017).

The panel members were asked to develop and/or identify a set of principles that could be applied to determine relative connectivity scores for riverine and non-riverine wetlands within the Eastern Gulf of Carpentaria.

6.1.1 Importance of connectivity

There was agreement by the panel that the concept of connectivity is important in the Gulf due to its direct or indirect link to most facets of aquatic ecology, geomorphology and water quality. The scientific literature reviewed for the AquaBAMM program reflects this view.

The ecological value of a particular river reach is directly linked, in quantity and quality, to the movement both up and downstream (and between adjoining terrestrial lands) of resources such as water, sediment and debris and recruitment and distribution of species (Cullen 2003).

An inherent connectivity (or lack of connectivity in drier periods) is a significant feature of riverine and non-riverine wetlands. For example, in arid-zone systems and floodplains, the irregular flow regime and sporadic connectivity underpins the conservation of the instream and floodplain wetland biota such as the invertebrate assemblages (Sheldon et al. 2002). Similarly, this relationship is evident for maintaining the health and productivity of end-of-river estuarine systems (Cullen 2003).

A largely unknown and unseen linkage occurs within the hyporheic zone between surface waters and groundwater ecosystems sustaining many endemic or relictual invertebrate fauna (Boulton et al. 2003).

6.1.2 Applying principles for measuring connectivity

The practicalities of measuring connectivity for aquatic environments are complex making general principles 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.

The expert panel made the following comments regarding wetland connectivity across the study areas:

a. In general, appropriate/pre-European connectivity remains high especial for the Mitchell and Staaten catchments.
b. Connectivity varies between lowland, midland and upland regions. Lowlands a lot more connected than uplands, and connectivity likely to be more important there.
c. Connectivity can occur at different temporal and spatial scales. To assess connectivity appropriately, the components of an ecosystem, and the processes affecting them, must be considered. Connective may vary between catchments resulting in the need for different connectivity rules for different catchments.
d. The nature of overland flow is important (i.e. instream channel flow (in-channel longitudinal; in-channel lateral (overbank flow)).

6.1.3 Fish passage — Measure 7.1.2

The principles for the fish passage connectivity rating (measure 7.1.2) developed by the riverine ecology expert panel from the Burnett River Aquatic Conservation Assessment (Clayton et al. 2006) were tabled at the wetland ecology expert panel workshop.

Under this methodology, the assumption is that barriers lower in the catchment have more impact on fish passage then those in upper reaches of the catchment. There is also recognition that each barrier can be rated according to its relative level of fish passage. For more information on the fish passage connectivity implemented in the Burnett River Aquatic Conservation Assessment see the Burnett River Aquatic Conservation Assessment Report (Clayton et al. 2006).

After consideration of the aforementioned methodology, the wetland ecology panel determined that this method was not sufficient enough for implementation within the Eastern Gulf of Carpentaria. It was identified at the panel that the Eastern Gulf of Carpentaria region is subject to significantly high levels of connectivity — laterally, longitudinally and cross-catchment — on a regular basis and that there are few barriers to fish passage present in

the study area.

The panel discussed alternative methods for determining riverine connectivity (and hence fish passage) in the Eastern Gulf of Carpentaria. The panel suggested that all special features identified by the panel as supporting fish passage be assigned a conservation rating of 3 or 4 for measure 7.1.2.

6.1.4 Connectivity between freshwater wetlands and groundwater - Measure 7.2.1

Connectivity between freshwater wetlands (riverine and non-riverine) and groundwater (measure 7.2.1) was recognised by the panel as being particularly important in the Eastern Gulf of Carpentaria with much of the region being under the influence of groundwater. The panel members discussed several methods for assessing the connectivity of freshwater and groundwater systems and agreed that anything that is connected hydrologically and/or biologically to groundwater areas should be given a higher connectivity rating.

The panel discussed alternative methods for determining connectivity between freshwater wetlands and groundwater systems in the Eastern Gulf of Carpentaria. The panel suggested that all special features identified by the panel as being connected to groundwater (e.g. discharge areas and spring fed systems) be assigned to a conservation rating of 3 or 4 for measure 7.2.1.

6.1.5 Contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values - Measure 7.5.1

Connectivity between freshwater wetlands (riverine and non-riverine) and estuarine ecosystems was also recognised by the panel as being important (measures 7.5.1 and 7.5.2). The panel members discussed several methods for assessing the lateral connectivity of freshwater and estuarine wetlands and agreed that anything that is connected hydrologically and/or biologically to estuarine areas could be given a high connectivity rating.

The panel discussed alternative methods for determining the contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values. The panel suggested that all special features identified by the panel as contributing to the maintenance of estuarine and marine ecosystems with significant biodiversity values being connected to groundwater (e.g. discharge areas and spring fed systems) be assigned a conservation rating of 3 or 4 for measure 7.5.1.

7 Stratification

Study area stratification attempts to mitigate the effect of data averaging across large study areas. Stratification is particularly useful when ecological diversity and complexity is high. For example, an example where stratification may be appropriate is when fewer native fish species (i.e. AquaBAMM measure 3.1.2 (Richness of native fish)) inhabit upland zones compared to lowland floodplains. Stratification is unwarranted for measures where there is an equal probability of species throughout the study area.

Study area stratification is a user decision and is not mandatory for a successful assessment. AquaBAMM makes provision for one or more measures to be stratified in any manner determined to be ecologically appropriate. Decisions concerning which measures to stratify are typically considered by the 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.

The Eastern Gulf of Carpentaria expert panel recommended stratification based on elevation resulting in the segmentation of the study areas into upland and lowland regions. A delineation somehwere between 150 - 200m ASL was recommended; the 175m ALS contour was used. Subsections were assigned to each stratum based on a 'majority' rule (i.e. subsections were assigned the stratum containing the majority of the subsection).

8 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 these result in numerous spring systems displaying unique geomorphic appearances and specialised habitats of high intrinsic conservation value (Fensham & Fairfax 2003; Fensham et al. 2007).

Springs wetlands were not assessed as part of the Eastern Gulf of Carpentaria assessments. The expert panel expressed concern with this highlighting the critical need for information on the conservation values of springs for water and land use planning.

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 (https://data.qld.gov.au/dataset/queensland-spring-database). 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:

a. Category 1a: These spring wetlands provide habitat for biota endemic to one spring complex.
b. Category 1b: These spring wetlands provide habitat for biota endemic to more than one spring complex.
c. 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*).
d. Category 2: These spring wetlands provide habitat for some isolated populations of plant species, or are outstanding examples of their type.
e. Category 3: Any spring of lower value than above that is relatively intact.
f. Category 4: Severely degraded by any threatening processes.

The EGoC assessments assigned value to non-riverine spatial units containing springs under Criterion 6 (Special and Unique Values). Conservation value ratings were assigned to measures 6.3.1, 6.3.4 and 7.2.1 based on based on the conservation rating developed by Fensham and Fairfax (2005) and Fensham et al. (2006). For example, non-riverine spatial units intersection springs with a Fensham et al. (2006) conservation rating of 1a, 1b, 1c or 2 were given a conservation value rating of 4 for measures 6.3.1, 6.3.4 and 7.2.1. Non-riverine spatial units intersection springs with a Fensham et al. (2006) conservation rating of 1a, 1b, 1c or 2 were given a conservation value rating of 4 for measures 6.3.1, 6.3.4 and 7.2.1.

The EGoC assessments used the conservation priority ratings from the Queensland spring database to assign value to any non-riverine spatial units containing springs. This was implemented utilising criterion 6 (special features). See the accompanying expert panel report for more details.

9 Discussion

9.1 Ecology

9.1.1 Pattern

The Eastern Gulf of Carpentaria region can be broadly split into upland and lowland areas, each with a distinct array of freshwater wetlands. Across the middle and lower reaches, anastomosing channels are interspersed with floodplain waterholes while in the upper sections include more well-defined watercourses, springs or spring-fed wetlands and subterranean systems. Spring waters may come from the Great Artesian Basin or from deeper more local aquifers and the cave waterways may form in either extinct basaltic lava flows or limestone karsts.

The physical appearance of the wetlands can vary between study areas. Surface waters in the Flinders and the Norman that drain extensive cracking clay plains are typically turbid and ephemeral (Burrows & Perna 2006; Waltham et al. 2013). Those of the more northern catchments (Gilbert, Staaten and Mitchell) flow through largely sandy soils and are clear with perennial or seasonally intermittent flows (Waltham et al. 2013).

While all the surface wetlands across the region experience a similar seasonality with flows during the wet season followed by a gradual drying out until the next wet, the character of this pattern varies from catchment to catchment. In the south (Flinders) with its lower rainfall and limited connectivity to groundwater sources, the drying results in a series of unconnected deep waterholes both instream and offstream. Generally the number of no flow days in the Flinders is highest of all the catchments. The more northern study areas, particularly the Gilbert and Mitchell, have a combination of intermittent and perennial watercourses with a high diversity of lowland permanent deepwater channels and lagoons (Tait et al. 2015). Permanent flows and persistent waterholes are maintained through groundwater intrusions, e.g. from the Palmer recharge zone and Gilbert River Formation aquifer (Hogan & Vallance 2011; Tait et al. 2015). Even in what appear to be stretches of dry sands separating waterholes then can be flows through saturated sediments below and beyond the banks (the hyporheic zone) (Ecowise Environmental 2007).

While all study areas have similar within year predictability they can vary considerably between years in terms of number of no flow days, duration and extent of flow days and overall discharge volume. Seasonal inundation can last from several days to weeks and occur in one or more episodes during the wet.

Overall wetlands in the study areas are in a good state with the Staaten ranked most undisturbed while the remaining study areas exhibit medium levels of river disturbance (Stein et al. 2002). Recent work in the Staaten (Hogan et al. 2009) revealed a catchment in very good condition that supports earlier assessments (e.g. Stein et al. 2002) that underpinned the past declaration of the Staaten as a wild river (Queensland Government 2007). The ecology panel recognised the catchment as being a good example of an undisturbed area, retaining refugial values in an otherwise disturbed landscape. In all study areas, water quality and general habitat condition is considered good/healthy (Vallance et al. 2000; Ryan et al. 2002; Hogan & Vallance 2005, 2012; Burrows & Perna 2006; Ecowise Environmental 2007; Hogan et al. 2009; Kerezsy & Ebner 2016).

9.1.2 Process

Wetlands in the study areas are exceptionally dynamic with the size, shape and flows changing dramatically, but with a certain degree of predictability, over the course of a year. The seasonal changes in the distribution of water across the landscape is accompanied by changes in the water quality. Within the intermittent wetlands, as they shrink during the dry there is a decline in dissolved oxygen levels and an increase in conductivity (indicator of salinity). These harsher conditions result in changes in both plant and animal community composition. Even in perennial wetlands there can be similar changes in water chemistry due to an increasing contribution of groundwater that can be low in oxygen and higher in salinity values that may contribute to occasional fish kills in the region (Hogan & Vallance 2011). Reduced oxygen may also result from the decay of dead terrestrial and aquatic vegetation washed into waterways during floods (Ecowise Environmental 2009).

Despite some deterioration of conditions during the dry season, the remaining waterholes are critical refugia (Waltham et al. 2013; McJannet et al. 2014) providing a source of aquatic plants and animals. Barring any other disturbance, wet season floods can effectively reset the system, flushing out nutrients, reducing turbidity and enabling the dispersal and regrowth of plants such as floating macrophytes (Pettit et al. 2012) and animals, e.g. larval fish across the landscape from these source refuges.

Wet season flooding also impacts on terrestrial environment. Prolonged inundation of up to eight weeks (Ecowise Environmental 2009) can result in a die off of ground and shrub layers which has significant consequences on the non-aquatic flora and fauna of the region (e.g. Preece & Franklin 2013). Such wet droughts with a loss of forage for an extended period of time can severely affect cattle properties. In other cases, inundation reinvigorates the grasslands and occasionally the algal mats lefts after the waters recede provide valuable nutrients for the soil

(Hogan & Vallance 2012). Discharges associated with flooding are critical in sustaining the productivity of various marine fisheries in the Gulf of Carpentaria (Halliday et al. 2012).

The ecology panel highlighted the fact that connectivity is a prominent feature of the EGoC region. Within catchments there are not only the continuous links from sea to source and channel to floodplain that can occur in the wet, but also that between sub-surface and surface waters either via aquifers or as saturated sediment flows in channels during the wet and dry. Between catchment connectivity can also happen. In fact a north to south relationship is possible starting from the Barron River (east of Great Dividing Range) that provides water through irrigation canals to the upper Mitchell, flood overflows from the Mitchell/Lynd can move in the Staaten as does excess from the Gilbert. Waters from the Gilbert can also enter the Norman via Walker Creek and Six Mile Creek, while the Norman and Flinders are occasionally linked through flooding of Spear Creek.

9.2 Flora

Apart from broad descriptions of wetland vegetation composition and structure very few studies undertaken in the EGoC region have detailed wetland plant inventories. Riparian vegetation in the study region consists primarily of woodlands or open forests of coolibah *Eucalyptus microtheca* or river red gum *E. camaldulensis* and occasionally blue gum *E. tereticornis*, or *Melaleuca* spp. (*M. viridiflora, M. dealbata, M. leucadendra, M. argentea*) (Tait et al. 2015). In terms of aquatic plants details are even less specific with references made to water lilies (e.g. *Nymphaea* spp., *Nymphoides* spp.) or sedges (e.g. *Eleocharis* spp., *Cyperus* spp.). Pettit et al. (2012) lists macrophyte taxa for various individual waterholes but the assessment was restricted to the lower Mitchell. Some inter-study area differences in aquatic vegetation are evident with an absence of submerged macrophytes in many Flinders waterholes due to their persistently turbid nature (Waltham et al. 2013).

During the panel several issues were raised relating to flora and wetlands in general. One is the challenge in determining the boundary between estuarine and freshwater systems. Another is the fact that floodplains in the region are ecologically wetland areas but are not mapped as such. Consequently, should those species that grow on floodplains being considered "wetland" taxa? The panel also considered climate change a small issue for most EGoC plants which are already adapted to climate extremes and major shifts in climatic conditions throughout the year.

9.3 Fauna

The vertebrate fauna of wetlands within the study areas is relatively well known. Waterbirds aggregate in large numbers, feeding and/or breeding in both flooded areas (wet season) and waterholes (dry season) across the lowland floodplains (Blackman et al. 1999; Dutson et al. 2009). As part of the East Asian-Australasian Flyway, the gulf is a gateway to Australia for thousands of migratory waders (Bamford et al. 2008; Jaensch and Richardson 2014). The wetlands, including the freshwater ones on the extensive floodplains are of major importance providing feeding habitat, either over-wintering or replenishment before heading further south. Recent surveys have focussed on the freshwater fish communities and diversity in the study areas is high (41 - 57 taxa; Hogan & Vallance 2011; Tait et al. 2015) compared to elsewhere in northern Australia (Kennard 2011), and is likely to increase as new taxa are found, e.g. *Porochilus* spp. in Flinders and Gilbert (Hogan & Vallance 2011). Within individual waterholes Hogan & Vallance (2005) found that fish diversity increased with the size of the waterbody and the abundance of food, e.g. freshwater prawns. Generally fish diversity decreases with distance upstream. Burrows (2004) described the fish fauna as being biogeographically and evolutionary distinct and this is borne out by the richness and the unique composition with a mixture of widespread, endemic, edge of range (particularly of CYP) fish and taxa with highly disjunct populations being represented within the study region.

Macroinvertebrates of instream and floodplain wetlands have also received recent attention (e.g. Leigh 2013; Waltham et al. 2013), but our knowledge is still minor compared to the region's vertebrates. For the invertebrates in springs, subterranean caves (stygofauna) and sub-surface saturation zone (hyporheic fauna) data is minimal to non-existent. The hyporheic zone is considered critical for the dry season survival of instream macroinvertebrates (Ecowise Environmental 2007). This is a major gap considering that such unique environments often contain endemic or undescribed taxa (Fensham & Fairfax 2005; Negus et al. 2013), and these wetland systems play a significant role in the aquatic dynamics of the region, e.g. maintaining base flows during dry season in upper catchments.

The fauna communities of the study region are generally considered to be in good condition. This is in part due to their current exposure to natural flows and the retention of high levels of connectivity within channels and between channels and floodplain wetlands. Apart from the Glenore Weir on the Norman, water infrastructure that acts as fish barriers are absent from most of the river systems and so have minimal impact on the movement of adults (e.g. taxa that migrate either between fresh and salt water or up and downstream to complete their breeding cycle) and offspring (dispersal from breeding areas into preferred habitats) (B. Ebner - EP). Tagged barramundi *Lates calcarifer* have been recorded traversing 360km of Flinders River in less than a year (Hogan & Vallance 2005).

Similarly the natural variability in flow is important, favouring low-flow spawners at some times of the year and high-flow spawners during floods.

9.4 Threats

9.4.1 Current

The major threats common to wetlands in all the study areas are pigs, weeds and grazing (Tait et al. 2015). Pig activity includes rooting that disturbs riparian habitat, fouling of waterholes and predation on native animals, especially nests of turtles (Fordham et al. 2006). Degradation increases over the course of the dry season as herbivores feral and domestic concentrate around waterholes (Pettit et al. 2012).

Degradation of riparian vegetation can enable the establishment of weed species such as rubbervine *Cryptostegia grandiflora*, parkinsonia *Parkinsonia aculeata* and prickly acacia *Vachellia nilotica*. Rubbervine not only results in a destabilisation of the riparian zone it can also directly affect the fauna in lagoons and low flow sections due to the water soluble poisons that can leach from any plant material that falls into the water (Ryan et al. 2002). At present aquatic weed infestations are low with water hyacinth *Eichhornia crassipes* in the lower Mitchell and Smithburne part of the Gilbert (Ryan et al. 2002; Hogan & Vallance 2011), and hymenachne *Hymenachne amplexicaulis*, salvinia *Salvinia caroliniana* and water lettuce *Pistia stratiotes* in the upper Mitchell in the MDIA (Walsh River) and upstream of Mount Carbine (Mitchell River) (Ryan et al. 2002; Tait et al. 2015).

Cattle grazing is the dominant and widespread landuse of the region (Tait et al. 2015). A consequence of this activity is the decline in water quality and biota of waterholes and the degradation of the riparian zone leading to alluvial gully erosion. Such erosion can result in increased sediment/turbidity and nutrients, infilling of riverine waterholes and channels and exposing more terrestrial areas to possible weed invasion (Shellberg & Brooks 2012).

EGoC is largely free of exotic fish. Established feral fish populations of guppy *Poecilia reticulata* are confined to the upper reaches of the Walsh in the MDIA (Vallance et al. 2000, Ryan et al. 2002) while disturbingly there have been occasional captures of tilapia *Oreochromis mossambicus* in the same area (Pearce et al. 2009). The latter are major predators with established populations in Lake Tinaroo which is a water source for the MDIA. Cane toads *Rhinella marina* are ubiquitous in the region but their impact on native predators is uneven, e.g. healthy populations of freshwater crocodiles *Crocodylus johnstonii* are present in the Staaten (Hogan et al. 2009) but elsewhere there has been a significant decline in Merten's water monitor *Varanus mertensi*.

9.4.2 Potential

Future threats to the wetlands in study region are water extraction, climate change and exotic plants and animals.

As most rivers in northern Australia have very little water infrastructure, the impacts of any development have not been observed. Consequently, any assessment of the likely outcomes is based on southern examples and an understanding of the relationships between the water dynamics of the region and its biota. Potential adverse effects of water extraction (surface and/or groundwater) include:

Reduced flow (volume and duration) resulting in downstream impacts:

a. Decreased size and persistence of waterholes, especially by late dry, and associated decline in water quality (lower oxygen level and raised conductivity through evaporation and proportional increase in groundwater input); increased sedimentation of waterholes; shift from perennial to intermittent streams; cessation of spring flow (localised extinction of spring-dependent flora and fauna); lowered inputs into gulf marine waters (reduced fisheries productivity); insufficient flows to enable successful fish reproduction; increased salinity in certain soils (rise in groundwater level).
b. Changed timing of any flows that would: disadvantage both freshwater and marine fish and invertebrates if releases do not match breeding requirements (impeded movement of adults and larval dispersal, and loss of spawning and nursery habitat, e.g. riffles and estuarine wetlands); pulses of nutrient/pesticide agricultural run-off (reduce water quality); changes in species composition.
c. The likelihood that water extraction in the region will have a major impact has been assessed as medium to high (King et al. 2015).
d. Climate change predictions for the region include a rise in temperature, increased evaporation, greater cyclone intensity and a rise in sea levels. Likely consequences are:
e. Reduced waterhole persistence.
f. Increased run-off (greater sediment loads) and aggravated gully erosion.
g. Loss of species diversity as conditions surpass physiological tolerances.
h. Saltwater incursion into lowland wetlands.

Given the region already experiences high intra- and inter-year variation in rainfall and temperature, these

suspected changes under current climate change scenarios may not be as significant a threat compared to other regions. While the aquatic biota appears able to cope with the current extreme wet and dry conditions, their capacity to deal with an amplification of those extremes is unknown. Potential effects of development and climate change on the aquatic systems in northern Australia has been thoroughly addressed in Leigh & Sheldon (2008), Morrongiello et al. (2011), Close et al. (2012) and King et al. (2015).

Overall, the most significant impact of water extraction and/or climate change would be the reduced capacity of waterholes to act as effective dry season refugia for the aquatic flora and fauna of the affected catchments. Even in its current near-natural state, the biota of some wetlands had not fully recovered three years after a major flood event (Hogan & Vallance 2012).

The concerns over exotic biota relate to the potential invasion of exotic and non-indigenous taxa via inter-basin transfer of water and the stocking of impounded waters. Pests such as tilapia could severely impact on populations of smaller native fish and introduction of non-local stocks of native fish, e.g. sooty grunter *Hephaestus fuliginosus* and sleepy cod *Oxyeleotris lineolata,* could result have a similar effect. There is also the possible introduction of disease with such animals and genetic dilution. Within any developed agricultural area there is considerable risk with the introduction and spread of aquatic plants especially ponded pasture grasses such as hymenachne. The impact of any aquatic pest species in EGoC is multiplied by the high degree of inter-catchment connectivity that occurs during floods which provides an avenue for the infestation of large areas of instream and floodplain wetlands.

For a more detailed review of the aquatic systems in the Norman, Gilbert, Staaten and Mitchell study areas - their status and threats, see Tait et al. (2015).

10 Constraints

The expert panel highlighted several deficiencies or constraints which should be considered when interpreting assessment results. These constraints are typical across most Aquatic Conservation Assessments and relate largely to the availability and completeness of input data:

a. A general lack of survey data for the region in part due to accessibility and funding limitations
g. A general lack of ecological knowledge for wetlands across the region
b. Geographical biases in species location databases
c. The ecological relevance of the riverine subsection – measures results calculated at the riverine subsection level (i.e. measures of species diversity and richness) will be driven in part by the size of the riverine subsections
h. Missing non riverine wetlands –wetland systems below minimum threshold size of the Queensland Wetlands Mapping will not have bene assessed

11 Recommendations

11.1 General

The following general recommendations came out of the expert panel workshops:

a. There is a need for increased knowledge on invertebrate fauna, especially of springs and sub-surface environments.
b. The knowledge of freshwater turtles for the region is very poor. There is a high likelihood of either endemic *Elseya* taxon in the catchments or that the range or *E. lavarackorum* extends into the Eastern Gulf of Carpentaria (C. Limpus EP). More survey work is required by expert in turtle sampling.
c. The interaction of groundwater with above surface wetlands and the ecology of groundwater-dependent ecosystems in region need serious investigation, especially when considering any water extraction proposals.

11.2 Methodology

The following methodological recommendations came out of the expert panel workshops:

a. Consider the use of new measure(s) to reflect migratory behaviour of fish (B. Ebner).
b. In poorly sampled study areas consider using habitat models or some type of data smoothing/extrapolation instead of point record counts for diversity and richness measures.
c. Consider using data on the abundance and intensity of pest infestation when determining the impact of exotic species on wetland ecosystems.

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13 Appendix I. Expert Panel Terms of Reference

The terms of reference presented below are to be read in conjunction with the AquaBAMM report that requires expert panel workshops to be run to inform a number of AquaBAMM criteria and their associated indicators and measures (Clayton et al. 2006).

Members of the expert panel were experts in scientific disciplines relevant to freshwater ecosystems, processes and species. Panel members were required to have professional or semi-professional standing in their fields of expertise and have direct knowledge and experience of the EGoC. Experience in the identification and assessment of riverine and non-riverine values including natural processes, species and places of significance was an important factor in the selection process; the panel included members with experience in these areas, as well as in their areas of specialist technical expertise. Panel members were appointed on the basis of their individual standing rather than as representatives of a particular interest group or organisation.

13.1 Aquatic flora expert panel

The Aquatic Flora Expert Panel is established to provide expert advice on the aquatic floristic values of the riverine and non-riverine wetlands in the Eastern Gulf of Carpentaria. The panel membership will consist of professionals with expertise relating to aquatic flora and riparian flora and floristic communities.

The advice provided by the expert panel at the workshop will be compiled into written and electronic form, which the Department of Environment and Science will use in the Aquatic Conservation Assessment (ACA). The ACA will assist in assigning aquatic ecological and conservation values to the riverine and non-riverine wetlands of the Eastern Gulf of Carpentaria.

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 endangered, vulnerable or near-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 floral communities or species;
- Provide advice on aquatic dependent exotic flora species localities and abundance;

13.2 Aquatic fauna expert panel

The Aquatic Fauna Expert Panel is established to provide expert advice on the aquatic fauna values of the riverine and non-riverine wetlands in the Eastern Gulf of Carpentaria. The panel membership will consist of professionals with expertise relating to aquatic fauna values.

The advice provided by the expert panel at the workshop will be compiled into written and electronic form, which the Department of Environment and Science will use in the Aquatic Conservation Assessment (ACA). The ACA will assist in assigning aquatic ecological and conservation values to the riverine and non-riverine wetlands in the Eastern Gulf of Carpentaria.

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 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;

13.3 Aquatic ecology expert panel

The Aquatic Ecology Expert Panel is established to provide expert advice based on experience and demonstrated scientific theory on natural geological or geo-morphological and hydrological processes, and issues of connectivity between aquatic systems within the waterways in Eastern Gulf of Carpentaria. The panel membership will consist of professionals in fields of expertise relating to water quality, wetland health assessment, geomorphology, fish passage and hydrological processes.

The advice provided by the expert panel at the workshop will be compiled into written and electronic form, which the Department of Environment and Science will use in the Aquatic Conservation Assessment (ACA). The ACA will assist in assigning aquatic ecological and conservation values to the riverine and non-riverine wetlands of the Eastern Gulf of Carpentaria.

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

- Identify areas of significant geomorphological, ecological or hydrological processes (Special Features);
- Provide advice on biodiversity 'hot-spots' or areas of particular significance for aquatic species or communities;
- Establish principles for applying the connectivity criterion in the study area;
- Weight measures relative to their importance for an indicator, and
- Rank indicators relative to their importance for a criterion.

14 Appendix II - Expert Panel Definitions

14.1 Expert Panel Definitions (Fauna)

14.1.1 Wetland indicator species

Wetland indicator species are species that are adapted to and dependent on living in wetland conditions for all, or at least part of, their life.

WIS have adapted to living in wetlands and are dependent on them for:

a. all of their life; or
b. a major part of their life; or
c. for critical stages of their lifecycle, such as breeding and larval development.

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 WISL includes mainly 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 wetland indicator species for a certain locality given expert recommendation and reliable site specific data.

Most marine species are also not included in the WISL as the wetland definition excludes marine water more than 6m below low tide.

14.1.2 Waterbirds

Bird species that are dependent on wetland environments.

14.1.3 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 point.

14.1.4 Priority Species

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

a. It is endemic to the study area (>75% of its distribution is in the study area/catchment).
b. It has experienced, or is suspected of experiencing, a serious population decline.
c. It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
d. It is currently a small population and threatened by loss of habitat.
e. It is a significant disjunct population.
f. Migratory species (other than birds).
g. A significant proportion of the breeding population (>1% for waterbirds, >75% other species) occurs in the waterbody (see Ramsar Criterion 6 for waterbirds).
h. 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.

14.2 Expert Panel Definitions (Flora)

14.2.1 Wetland indicator Species

Wetland indicator species are those 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.

This definition of a wetland indicator species extends beyond the more traditional definition of submerged and floating aquatic plants to include plants inhabiting the littoral zone (waters 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 indicator and measure of Species Richness: "Richness of wetland dependent plants" (3.1.5). The indicator is a measure of floristic richness of a particular spatial unit's aquatic environment, and hence, a broad definition will better depict the flora richness value at a given location.

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

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

14.2.2 Aquatic Species (QLD Herbarium definition)

Species adapted to growing in or on permanent water (obligate)

14.2.3 Semi-aquatic Species (QLD Herbarium definition)

Species that can withstand near-permanent shallow water and require only periodic temporary inundation - bordering permanent water, in bogs and shallow swamps.

14.2.4 Exotic Flora

Only exotic plants that cause, or have the potential to cause, significant detrimental impact on natural systems within a riverine or non-riverine systems.

14.2.5 Priority Species

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

i. It forms significant macrophyte beds (in shallow or deep water).
j. It is an important/critical food source.
k. It is important/critical habitat.
l. It is implicated in spawning or reproduction for other fauna and/or flora species.
m. It is at its distributional limit or is a disjunct population.
n. It provides stream bank or bed stabilisation or has soil-binding properties.
o. It is a small population and subject to threatening processes.
p. 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.

14.3 Expert Panel Derived Measures

The expert panel process was used to derive poygons for the following measures:

- 5.1.4. – Habitat for significant numbers of waterbirds.
- 5.2.1. – Presence of 'priority' aquatic ecosystem.
- 6.1.1 – 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.
- 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, boggomoss).
- 7.1.2 – Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit
- 7.2.1 – The contribution (upstream or downstream) of the spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6 (e.g., karsts, cave streams, artesian springs)
- 7.5.1 –The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6
- 8.2.5. Wetland type representative of the study area (non-riverine only).

15 Appendix III - Criteria, indicators and measures for the Eastern Gulf of Carpentaria assessments

Criteria and Indicators	Measures		Riverine	Non-riverine
1 Naturalness aquatic				
1.1 Exotic flora/fauna	1.1.1	Presence of 'alien' fish species within the wetland	Y	Y
	1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	Y	Y
	1.1.3	Presence of exotic invertebrate fauna within the wetland	Y	Y
	1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	Y	Y
1.3 Habitat features modification	1.3.4	Presence/absence of dams/weirs within the wetland	Y	
	1.3.5	Inundation by dams/weirs (% of waterway length within the wetland)	Y	
	1.3.7	% area of remnant wetland relative to preclear extent for each spatial unit	Y	Y
1.4 Hydrological modification	1.4.5	Hydrological disturbance/modification of the wetland (e.g. as determined through EHP wetland mapping and classification)		Y
2 Naturalness catchment				
2.1 Exotic flora/fauna	2.1.1	Presence of exotic terrestrial plants in the assessment unit	Y	Y
2.2 Riparian disturbance	2.2.1	% area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	Y	
	2.2.2	Total number of REs relative to preclear number of REs within buffered riverine wetland or watercourses	Y	
	2.2.5	% area of remnant vegetation relative to pre-clear extent within buffered non-riverine wetland: 500m buffer for wetlands >= 8Ha, 200m buffer for smaller wetlands		Y
2.3 Catchment disturbance	2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	Y	Y
	2.3.2	% "grazing" land-use area	Y	Y
	2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	Y	Y
	2.3.4	% "settlement" land-use area (i.e. towns, cities, etc)	Y	Y
2.4 Flow	2.4.1	Farm storage (overland flow harvesting, floodplain	Y	

Criteria and Indicators	Measures		Riverine	Non-riverine
Modifications		ring tanks, gully dams) calculated by surface area		
3 Diversity and richness				
3.1 Species	3.1.1	Richness of native amphibians (riverine wetland breeders)	Y	
	3.1.2	Richness of native fish	Y	Y
	3.1.3	Richness of native aquatic dependent reptiles	Y	Y
	3.1.4	Richness of native waterbirds	Y	Y
	3.1.5	Richness of native aquatic plants	Y	Y
	3.1.6	Richness of native amphibians (non-riverine wetland breeders)		Y
	3.1.7	Richness of native aquatic dependent mammals	Y	Y
3.2 Communities/ assemblages	3.2.1	Richness of macroinvertebrate taxa	Y	
	3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance	Y	
3.3 Habitat	3.3.2	Richness of wetland types within the local catchment (e.g. SOR sub-section)	Y	Y
	3.3.3	Richness of wetland types within the sub-catchment	Y	Y
4 Threatened species and ecosystems				
4.1 Species	4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species – NCAct, EPBCAct	Y	Y
	4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCAct, EPBCAct	Y	Y
4.2 Communities/ assemblages	4.2.1	Conservation status of wetland Regional Ecosystems – Herbarium biodiversity status, NCAct, EPBCAct	Y	Y
5 Priority species and ecosystems				
5.1 Species	5.1.1	Presence of aquatic ecosystem dependent 'priority' fauna species (expert panel list/discussion or other lists such as ASFB, WWF, etc)	Y	Y
	5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	Y	Y
	5.1.3	Habitat for, or presence of, migratory species (expert panel list/discussion and/or JAMBA / CAMBA agreement lists and/or Bonn Convention)	Y	Y
	5.1.4	Habitat for significant numbers of waterbirds	Y	Y

Criteria and Indicators	Measures		Riverine	Non-riverine
5.2 Ecosystems	5.2.1	Presence of 'priority' aquatic ecosystem	Y	Y
6 Special features				
6.1 Geomorphic features	6.1.1	Presence of distinct, unique or special geomorphic features	Y	Y
6.2 Ecological processes	6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	Y	Y
6.3 Habitat	6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	Y	Y
	6.3.2	Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Areas, etc.	Y	Y
	6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	Y	Y
	6.3.4	Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)	Y	Y
6.4 Hydrological	6.4.1	Presence of distinct, unique or special hydrological regimes (eg. Spring fed stream, ephemeral stream, boggomoss)	Y	Y
7 Connectivity				
7.1 Significant species or populations	7.1.2	Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit	Y	Y
7.2 Groundwater dependent ecosystems	7.2.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values, including those features identified through criteria 5 and/or 6 (e.g. karsts, cave streams, artesian springs)	Y	Y
7.5 Estuarine and marine ecosystems	7.5.1	The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values, including those features identified through criteria 5 and/or 6	Y	Y
8 Representativeness				
8.1 Wetland protection	8.1.1	The percent area of each wetland type within Protected Areas.		Y
8.2 Wetland uniqueness	8.2.1	The relative abundance of the wetland management group to which the wetland type belongs within the catchment or study area (management groups ranked least common to most common)		Y

Criteria and Indicators	Measures		Riverine	Non-riverine
	8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the sub-catchment or estuarine/marine zone (management groups ranked least common to most common)		Y
	8.2.3	The size of each wetland type relative to others of its management group within the catchment or study area		Y
	8.2.4	The size of each wetland type relative to others of its type within a sub-catchment (or estuarine zone)		Y
	8.2.5	Wetland type representative of the study area – identified by expert opinion		Y
	8.2.6	The size of each wetland type relative to others of its type within the catchment or study area		Y