Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Southern Gulf Catchments

Summary Report

Version 1.1

Queensland Government

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NB. This report should be read in conjunction with the accompanying Expert Panel Report – Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Southern Gulf Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 1.1. Department of Environment and Science, Queensland Government.

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)
DAF	Department of Agriculture and Forestry
DIWA	Directory of Important Wetlands in Australia
DERM	Department of Environment and Heritage Protection
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation for Australia
JAMBA	Japan–Australia Migratory Bird Agreement
NCA	*Nature Conservation Act 1992*
NP	National Park
QHFD	Queensland Historical Fauna Database
QLUMP	Queensland Landuse Mapping Program
Ramsar	Ramsar Convention on Wetlands
REDD	Regional Ecosystem Description Database
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
SGC	Southern Gulf Catchments
SOR	State of the Rivers

1 Introduction

Australia's tropical north has a long and chequered history of initiatives aimed at intensifying agricultural and pastoral production. While broad analyses have identified areas with land and water resources capable of supporting enhanced production (Petheram et al. 2013), variable rainfall patterns, high potential evapotranspiration, and seasonally dynamic hydrological regimes linked to critical ecological processes combine to create complex ecological settings which need to be considered for resource allocation to occur in a sustainable way (CSIRO 2009). Careful planning and adaptive management regimes supported by accurate and up-to-date information is key to dealing with this complexity.

The Aquatic Biodiversity Assessment and Mapping Methodology (AquaBAMM) was developed in 2006 to provide a robust and repeatable method for assessing the biodiversity values of Queensland's wetlands (Clayton et al. 2006). The method uses a comprehensive set of criteria founded upon a large body of national and international literature. Criteria are combined to assign an overall biodiversity value (AquaScore) to each wetland or spatial unit assessed. The criteria, each of which have a variable number of indicators and measures, include Naturalness Aquatic, Naturalness Catchment, Diversity and Richness, Threatened Species and Ecosystems, Priority Species and Ecosystems, Special and Unique Features, Connectivity and Representativeness. The product of applying the AquaBAMM is an Aquatic Conservation Assessment (ACA) for a particular study area (usually a catchment).

Aquatic conservation assessments are non-social, non-economic and tenure neutral. In addition to the AquaScore, assessment results include a comprehensive set of baseline ecological information at the individual wetland scale. Assessment measures are populated with data from a range of sources including expert opinion elicited during structured expert panel workshops. Aquatic conservation assessments provide a powerful decision support tool that can be easily interrogated through a geographic information system (GIS) to support natural resource management decisions, policy or regulatory development and implementation. For example, Aquatic Conservation Assessment results can have application in:

- Determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems.
- On-ground investment in wetlands and other aquatic ecosystems.
- Contributing to impact assessment of large-scale development (e.g. dams).
- Water resource and strategic regional planning processes.
- Providing input to broader social and economic evaluation and prioritisation processes.

This report summarises the methods and results for the Aquatic Conservation Assessments completed for the Settlement Creek, Nicholson River, Leichhardt River, Mornington Inlet and Wellesley Islands hydrological basins (Table 1). Freshwater riverine and non-riverine systems have been assessed. An assessment of estuarine systems was not undertaken due to difficulties with habitat differentiation that inhibited development of suitable spatial units that would be appropriate for the implementation of AquaBAMM measures.

This report should be read in conjunction with the accompanying expert panel report – An Aquatic Conservation Assessment for the riverine and non-riverine wetlands of the Southern Gulf of Carpentaria: Flora, fauna and Ecology Expert Panel Report, Version 1.1 (DES 2020a).

Table 1. Study areas of the Southern Gulf Catchments Aquatic Conservation Assessment project

ACA study areas or catchments	Study area code	Catchment area (ha)	Number of riverine spatial units	Number of non-riverine wetlands	Area of non-riverine wetlands (ha)
Settlement Creek	sc	1,173,325	48	1,223	17,932
Nicholson River	nr	3,544,046	116	1,171	31,110
Leichhardt River	lr	3,354,050	113	1,671	40,598
Mornington Inlet	mi	351,418	11	227	4,027
Mornington Island (Wellesley Island Group)	md	123,956	34	133	1,461
	TOTAL	8,546,795	322	4,425	95,127

1.1 Southern Gulf Catchments study region

1.1.1 General region

The Southern Gulf Catchments of the Gulf of Carpentaria region is comprised of five study areas – Settlement Creek, Nicholson River, Leichhardt River, Mornington Inlet and Mornington Island (Wellesley Islands group) (

Figure 1). Combined, they cover the western third of the Gulf Plains Bioregion, the northern two thirds of the Northwest Highlands Bioregion and the northern tip of the Mitchell Grass Down Bioregion (Sattler & Williams 1999). While extending over a significant latitudinal range, the various study areas exhibit many similarities.

The region experiences a semi-arid/wet-dry monsoonal climate characterised by a long, hot, dry spring preceding a hot, humid summer. Winters are short but cooler and dry (DERM 2010). Inter-year variation in rainfall is high but seasonally predictable with most falling during the wet season (December-March) and a spatial pattern of highest precipitation on Mornington Island and along the coast then declining as one moves south and inland (Tait et al. 2015).

All the region’s major rivers enter the Gulf of Carpentaria after passing through the Karumba Plains subregion. This coastal belt contains mudflats and saline plains, mangrove-lined estuaries, and dune systems. Blackman et al. (1999) recognised the significance of these extensive saltwater and freshwater wetlands with all of the area being listed as important wetlands (Wentworth Aggregation, Southern Gulf Aggregation). Much of the region’s shoreline and immediate hinterland covered by these wetland aggregations are recognised as a significant location for migratory waders and waterbirds – the Gulf Plains Important Bird Area (Bamford et al. 2008; Dutson et al. 2009; Jaensch & Richardson 2013).

While the vegetation of the region has been comprehensively mapped (see study area descriptions below), the fauna is relatively unknown. Historically, most activities have focussed on migratory waders and waterbirds (Garnett & Taplin 1990, Blackman et al. 1999; Driscoll 2001). In the last decade there has been a more concerted effort to survey the terrestrial and freshwater fauna of the Gulf region, however most of these studies have focussed on catchments to the east and north.

The dominant terrestrial land use across the region is pastoralism with cattle over most of the area. Agriculture at present is confined to several small areas in the Leichhardt River. Commercial fishing, e.g. barramundi, mud crab and prawns, occurs in the estuarine sections of the rivers and offshore in the Gulf of Carpentaria. Concern has been raised about the potential decline in fisheries productivity, e.g. changes in nutrient and sediment loads, due to changes in water flows following any expanded irrigation development (Halliday et al. 2012; Bayliss et al. 2014).

Natural resource management activities in the region are supported by the Southern Gulf Resource Management Group (Flinders). They are involved in assessing the natural values of the study areas and developing strategies and actions that promote sustainable land use practices. Landscape environmental outcomes are also provided through the Queensland Indigenous Land and Sea Ranger program that delivers care for the biological and cultural values of the country.

1.1.2 Settlement Creek study area

The Settlement Creek basin straddles the Queensland - Northern Territory border and is comprised of several adjoining northward draining sub-catchments that have separate mouths to the Gulf. From the west to the east the major drainages include the Settlement and Branch Creeks, Lagoon Creek, Eight Mile Creek, Cliffdale Creek and Moonlight Creek. Collectively these systems drain two bioregions with the main extent of the upper basin extending westward into the Northern Territory. The headwaters of the basin lie in its south and west and are comprised of the McArthur Bioregional subregion of the Gulf Fall and Uplands Bioregion composed of low hills, plateaus and escarpments. Sandstone areas contain springs and areas of permanent or near permanent water hosted within narrow incised or large spectacular gorges. Sandy alluvium is common along the larger water courses.

The lowlands of the Settlement Creek basin are dominated by flat alluvial plains comprised of two bioregional subregions of the Gulf plains Bioregion including the extensive Doomadgee Plains Subregion and the coastal Karumba Plains Subregion. The Doomadgee Plains Subregion is characterised by laterised Tertiary surfaces overlain by sandy outwash from the upper catchment. The Karumba Plains Subregion is comprised of landforms subject to coastal influences including beaches, dunes, swale swamps, saline mudflats and mangrove lined estuaries.

The Settlement Creek basin has a seasonally arid grassland (upland) and tropical savanna (lowland) climate with rainfall concentrated in the summer wet season. While seasonal wetland habitats are extensive following wet season rains, in the extended dry season the extent of freshwater habitat within each sub-catchment reduces to a small set of perennial waterholes that act as important refugia for obligate aquatic biota.

The extent of perennial habitat within the Settlement Creek basin is related to the contributing area of spring bearing sandstone uplands within each sub-catchment. The western sub-catchments of Settlement, Branch and Redbank Creek drain the greatest extent of such uplands located mostly in the Northern Territory. These systems retain flowing habitats well into the dry season resulting in the greatest extent of high value channel hosted perennial riverine habitat within the basin. The greater overall contributing upper sub-catchment area of these western systems also results in a more active floodplain in their coastal lowlands with broad disjunct extents of alluvial landform hosted palustrine and lacustrine wetlands. These systems abut a continuous coastal wetland complex comprised of transitional fresh to brackish areas on marine plains and adjoining beach ridge swale and mangrove estuary channel complexes. Collectively this complex forms the nationally listed Wentworth Aggregation which is considered one of the best examples of the full range of wetland types characteristic of hydrologically related alluvial and estuarine systems occurring in the far northwest of Queensland.

Lagoon Creek also has a significant area of sandstone uplands. These sandstone areas host springs and associated perennial pool habitats within spectacular gorges and rock holes and include subterranean systems with restricted biota. In contrast to the Settlement and Branch creeks flows in Lagoon Creek are also more seasonal As Lagoon Creek moves into the coastal lowlands high conservation value areas are primarily associated with perennial refugial waterholes. In the mid catchment this includes both main and distributary channel hosted waterholes supplemented by rock springs and shallow alluvial aquifer contributions. In the lowlands of the Settlement Creek basin groundwater supplementation is lacking and perennial pools are much rarer occurring as larger isolated named waterholes in deeper scours in impermeable clay substrates within main and distributary channels. Catchments further to the east i.e. Eight Mile and Cliffdale creeks reflect a similar pattern of wetland values to Lagoon Creek albeit with more limited contributions from the sandstone upper catchment, greater ephemerality of flow, and rarer more isolated perennial refugial waterholes in the lower part of the Settlement Creek basin.

Moonlight Creek, the eastern most sub-catchment, is distinct from other basins as it lacks sandstone uplands and is hosted primarily within an elevated tertiary lateritic surface. This surface acts as the catchment area for a variety of circular depressions and streamlines with impeded drainage that collectively form part of the nationally listed complex, disjunct Marless Lagoon Aggregation which extends into the adjoining Nicholson River basin. Sandy alluvium deposited on the laterised surface acts as a seasonal aquifer and a conduit for groundwater seeps extending the seasonal duration of rich palustrine and lacustrine wetland habitats which are productive for waterfowl. This same laterised surface also contributes to the formation of lateritic barrier pools, another high aquatic conservation value of the Settlement Creek basin. These lateritic barriers exclude tidal incursion in the near coastal zone extending the reach of productive freshwater and brackish habitats into the coastal zone. While this wetland formation is mostly developed in the east of the basin, isolated examples also occur around its coastal margin where residual expressions of the tertiary surface occur.

The coastal margin of the Settlement Creek basin hosts a range of aquatic conservation values some of which are shared with adjoining basins, while others, like lateritic barrier pools, are more unique to the Settlement Creek basin. With the exception of the easternmost portion, the coastal margin of the Settlement Creek basin has a beach dominated coastline dissected only by isolated estuary mouths and their associated intertidal mud flats. These extensive beach-dominated systems are unique to Settlement Creek basin across the southern Gulf region. This beachline is backed by the most developed beach ridge swale systems in the Southern Gulf, most of which host high value freshwater to brackish swale wetlands. A relatively narrow band of marine plains backs the swale systems and host fresh to brackish transition zone wetlands. A high value feature of these systems are shallow aquifer seeps that emanate from the sand sheet associated with the Doomadgee Plains Subregion providing extended freshwater inputs to these wetlands.

The easternmost coastal margin of the Settlement Creek basin is similar to the southern Gulf basins further to the east which have a coastline comprised of extensive mangrove lined intertidal mud flats backed by extensive low-lying marine plains and transitional wetlands. This latter setting hosts the nationally listed and continuous Southern Gulf Aggregation which extends from the eastern Settlement Creek basin east to Karumba. This wetland complex is the largest continuous estuarine wetland aggregation of its type in northern Australia and one of the three most important areas for shorebirds in Australia.

Summary of the conservation values of the Settlement Creek basin

The aquatic conservation values of the Settlement Creek basin are associated with the main coastal plain aggregations of seasonal palustrine and lacustrine wetlands, three of which are nationally listed, perennial aquatic refugia which include rocky waterholes of the upper catchment, spectacular gorges and large isolated riverine waterholes within Gulf Plains lowlands, unique wetland geomorphic settings including subterranean upper catchment streams, laterised Tertiary surface depression plains, regionally well-developed examples of particular wetland types (e.g. coastal swale complexes) and supported fauna populations which include endangered fish species and significant populations of waterfowl and migratory waterbirds.

1.1.3 Nicholson River study area

The Nicholson basin drains four bioregions with approximately a quarter of the basin draining western upland regions within the Northern Territory. The Nicholson River is the major river system of the basin and has two mouths to the Gulf including the Gin Arm distributary. The Albert River, connected by inland distributaries from the Nicholson River, also has a separate mouth to the Gulf. Several other named river systems comprise sub-catchments of the Nicholson River basin including Lawn Hill Creek, Gregory River, O' Shannassy River and Thornton River.

The upper regions of the Nicholson River basin is comprised of one bioregional subregion (McArthur-South Nicholson River basins) of the Gulf Fall and Uplands Bioregion, two bioregional subregions (Thorntonia, Mount Isa Inlier) of the North West Highlands Bioregion and a small area comprised of a single bioregional subregion (Barkly Tableland) of the Mitchell Grass Downs Bioregion. These upland areas are characterised by low hills of sedimentary rock and limestone, escarpments and sand sheet plateaus. Some plateaus are comprised of remnants of Mitchell Grass Downs grasslands. Sandstone and limestone areas contain springs with the latter associated with permanent flowing watercourses. These are sometimes hosted within narrow valleys amongst limestone hills or large spectacular sandstone gorges such as the Lawn Hill Gorge which is a nationally listed wetland within the Thorntonia Aggregation. Sandy alluvium is common along the larger water courses.

The lowland regions of the Nicholson River basin are comprised of three provinces of the Gulf plains Bioregion including the extensive Doomadgee Plains Province characterised by laterised Tertiary surfaces overlain by sandy outwash from the upper catchment in the west, and the Armraynald Plains Province comprised of clay plains channelised by braided watercourses and overlain by areas of alluvium in the east. The coastal margin of the basin is comprised of the Karumba Plains Province which in the Nicholson River basin is dominated by marine plains hosting shallow transitional (fresh-saline) wetland basins, extensive saline mudflats and mangrove lined estuaries.

The Nicholson River basin has a seasonally arid predominantly hot grassland, winter drought (south eastern) and tropical savanna (north western) climate with rainfall concentrated in the summer wet season. While seasonal palustrine and lacustrine wetland habitats are extensive across the basin following wet season rains, in the extended dry season most wetlands dry out and freshwater habitat within each sub-catchment is restricted predominantly to perennial riverine wetlands which, unique to the Nicholson River basin within the Southern Gulf region, includes an extensive network of perennially flowing streams fed by the southern limestone aquifers of the upper Gregory River and Lawnhill Creek sub-catchments.

The extent of perennial freshwater habitats including flowing riverine systems within the Nicholson River basin distinguishes it from other Southern Gulf basins, and much of the seasonally arid tropics of Queensland, and underpins many of its exceptionally high aquatic conservation values. This perenniality can be largely attributed to groundwater contributions from upper catchment areas which include predominantly sandstone surfaces in the western basin and limestone surfaces in the southern basin.

The most significant groundwater discharges emanate from limestone associated with the Thorntonia limestone and Camooweal Dolomite formations which form an extensive karst landscape within the upper catchment of the Gregory River, including the O'Shannassy and Thornton River sub-catchments to the south, and within the upper catchment of the Lawn Hill Creek system to the west. Within these limestone upper catchment areas high aquatic conservation values are associated with flowing clearwater streams, riffle reaches, deep channel hosted pools and diverse riparian and macrophyte communities. Dendritic streamlines within these catchment areas are included in the nationally listed Thorntonia Aggregation. This aggregation is a good example of a pristine riverine wetland system with permanent deep water in a semi-arid environment and represents probably the only perennial streams in arid Queensland. Where these southern basin streams descend from low hills to the Gulf Plain lowlands they collectively form the Gregory River a nationally listed riverine wetland system which is fringed by rich riparian communities on alluvial levees and is the largest perennial river in arid and semi-arid Queensland. Similarly, the Lawn Hill Creek system draining from the west also creates a ribbon of perennial stream habitat on the lowland alluvial plains.

Discharge from limestone upper catchments promulgating across the Gulf plain lowlands creates a unique juxtaposition of perennial stream channel habitat and associated riparian communities threading across seasonally dry black soil plain grasslands. On flat low-lying areas these channel networks become braided and anastomosing and intersect to form blocked distributary backswamps that receive flow seepage and/or capture overland flows and host large palustrine wetlands including the nationally listed Bluebush (tree) Swamp and Musselbrook Creek Aggregations.

Sandstone and other sedimentary rock dominated upper catchments of the western basin including the named main stem of the Nicholson River also contribute significant groundwater volumes to the system. This creates extensive reaches of perennial pool habitat albeit without the sustained surface flows associated with limestone catchments. In upper catchment bedrock-controlled reaches, pools are often hosted within spectacular gorges. Transitional areas toward the Gulf Plains lowlands include large, long, deep pools fringed by melaleuca and eucalypt riparian forests hosted within narrow alluvial valleys.

The Nicholson River basin's northern lowlands are formed by the Doomadgee Plains Province of the Gulf Plains Bioregion which has a laterised Tertiary surface overlain by sandy outwash derived from the upper catchment. While no contemporary upper catchment runoff reaching this area of lowlands, the laterised surface acts as a local catchment area for circular depressions and streamlines with impeded drainage that collectively form part of the nationally listed, complex and disjunct Marless Aggregation. This aggregation extends into the adjoining Settlement Creek basin to the north. Sandy alluvium deposited on the laterised surface acts as a seasonal aquifer and conduit for groundwater seeps extending the seasonal duration of the rich palustrine and lacustrine wetland habitats that form the aggregation and provide productive waterfowl habitat. This same laterised surface also contributes to the formation of lateritic barrier pools another high aquatic conservation value of the basin. These lateritic barriers exclude tidal incursion in the near coastal zone extending the reach of productive freshwater and brackish habitats into the coastal zone.

Large channel hosted pools of the Nicholson River main channel extend across the Gulf Plains coastal lowlands where connecting riverbed sands convey subsurface hyporheic flows that maintain their dry season perenniality. Below the confluence of the Nicholson River with the limestone aquifer supplied Gregory and Lawnhill systems the perenniality of channel hosted waterholes is also maintained by connected surface flows. These productive systems support large fish populations including barramundi and large aquatic fauna including estuarine crocodiles, freshwater sharks and endangered freshwater sawfish.

Sand and alluvium carried and deposited by the Nicholson River has created a corridor of younger alluvial landforms across the older clayey Gulf Plains. This corridor terminates in a coastal delta and hosts a diversity of productive wetlands including oxbow lagoons and floodplain swamps which form part of the nationally listed Nicholson Delta Aggregation. The broad coastal margin of the basin is dominated by marine plains hosting shallow transitional (fresh-saline) wetland basins, extensive saline mudflats and mangrove lined estuaries. This area forms part of the nationally listed complex and continuous Southern Gulf Aggregation, the largest continuous estuarine wetland aggregation of its type in northern Australia and one of the three most important areas for shorebirds in Australia.

Summary of the conservation values of the Nicholson River basin

The aquatic conservation values of the Nicholson River basin are associated with the extent and volume of discharge from upper catchment limestone and sandstone aquifers, associated groundwater dependent communities, the large size and perenniality of its river systems which provide both evolutionary and geographical refugia and host endemic, disjunct, and threatened fauna populations, and the large extent and number of riverine, palustrine, lacustrine and estuarine wetland aggregations including eight of which are nationally listed. These wetlands include spectacular gorges, remnant rainforest riparian communities, perennial lakes and flowing streams in arid landscapes, large semi-perennial tree swamps, extensive seasonal wetlands hosted on clay plains and within old Tertiary surfaces, rich floodplain wetlands hosted on alluvial landforms associated with the major rivers, complex freshwater to saline transitional wetlands on marine plains and a major portion of the largest continuous estuarine wetland aggregation in northern Australia. Collectively these wetlands also support nationally significant populations of waterfowl and migratory shorebirds and major fisheries.

1.1.4 **Leichhardt River study area**

The Leichhardt River basin has a single mouth to the Gulf of Carpentaria via the Leichhardt River which forms the main named river stem of this northward draining basin and initiates along with a named eastern branch in the southernmost basin headwaters. Several other named drainage systems comprise sub-catchments of the Leichhardt River basin including the Alexandra River which drains the north east, Firey, Sandy and Myally Creeks which drains the north west, and Gunpowder and Mistake Creeks that drain the mid-west. Overall, the basin drains two bioregions. The upper basin is comprised of one bioregional subregion (Mount Isa Inlier) of the North West Highlands Bioregion. These upland areas are characterised by stony hills and ranges comprised of heavily folded sediments that create plateaus and escarpments. Springs are associated with some sedimentary rock types and in conjunction with bedrock hosted reaches create limited areas of permanent or near permanent water. Small areas of alluvium occur throughout narrow upper basin valleys.

The lowlands of the basin are comprised of four bioregional subregions of the Gulf Plains Bioregion. These include an outlier of the Doomadgee Plains Subregion on the western margin characterised by laterised Tertiary surfaces overlain by sandy outwash from the upper catchment, several disjunct occurrences of the Donors Plateau

Subregion in the eastern and near coastal northern margin of the basin characterised by an undulating complex of shales, laterised Tertiary plateaus and sandy outwash comprised of clay plains channelised by braided watercourses and overlain by areas of alluvium, and the northern coastal margin of the basin comprised of the Karumba Plains Subregion which includes a host of landforms associated with areas subject to coastal influences. In the Leichhardt River basin these include beaches, dunes, swale swamps, marine plains hosting shallow wetland basins, saline mudflats and mangrove lined estuaries.

The Leichhardt River basin has a hot, seasonally arid, winter drought, grassland climate with rainfall and associated stream flow concentrated in the summer wet season. Given the seasonal aridity of the basin particularly across the lower rainfall uplands, aquatic conservation values in the basin are primarily associated with areas of perennial aquatic habitat which provide refugia for obligate aquatic biota. Historically, perennial waterholes were very rare in the upper parts of the basin and their occurrence would vary interannually with wet season magnitude and establishment of obligate aquatic biota populations in seasonal upper catchment streams depended on recruitment from downstream perennial refugia. Construction of large, onstream impoundments to serve development and settlement needs around Mt Isa has now created several large perennial waterbodies in the upper basin most of which have over time developed a rich suite of riparian and instream wetland habitats that provide valuable resources for dependent biota. These now form valuable wetlands that function as aquatic refugia with the two largest impoundments, Lake Moondarra and Lake Julius nationally listed in the directory of important wetlands. The importance of these impoundments as recruitment source areas for upstream populations also underpinned by the fish passage barriers their walls present to lower catchment areas.

In comparison to the upper basin, sedimentary rock formations within the central western basin are more suited to supporting groundwater aquifers and associated springs and these areas contain bed rock hosted and groundwater supplemented pools within narrow valley and gorge reaches. These perennial mid catchment riverine wetlands represent the natural aquatic refugia of the upper basin. Where pools occur within or are adjoined by deposits of alluvium, pool persistence can be supplemented by shallow seasonal aquifers and hyporheic flows. These areas also support riparian forest communities which have a more diverse and dense structure and provide a range of associated habitat resources not available in surrounding arid woodlands. Consequently, they represent critical habitat for many fauna species, particularly birds.

Descending onto the Gulf Plains lowlands the main Leichhardt River forms large isolated channel hosted waterholes with fringing areas of alluvium that support seasonal aquifers and riparian forest communities. These larger perennial waterholes of the main Leichhardt River channel also provide aquatic refugia and critical habitat functions. Given their greater size and productivity, larger populations of aquatic biota including fish and freshwater crocodiles are associated with them. However, some fish community diversity and fishery values of the Leichhardt River main channel are constrained by the Leichhardt River Falls. The falls are located just upstream of tidal influence and present a natural fish passage barrier for catadromous species including barramundi and sawfish. Such constraints do not apply to main channel waterholes of the Alexandra River sub catchment which joins the Leichhardt River below the falls.

Mid basin transitional areas between uplands and Gulf Plain lowlands and the north eastern margin of the basin, are comprised of the Donors Plateau Subregion with laterised Tertiary plateaus and sandy outwash overlying sandstones and undulating shales. Springs and groundwater seeps emanating from these areas support palustrine wetlands and groundwater dependent vegetation communities which have refugia and critical habitat values in an otherwise arid landscape.

Across the Gulf plains and towards the northern coastal portion of the basin the river forms distributary networks and broad corridors of younger alluvium that host alluvial landforms including perennial riverine wetlands and extensive areas of seasonal palustrine and lacustrine wetland habitats that form following wet season rains. Groundwater seeps emanating from alluvium, deposited on the clayey Gulf Plains, serves to extend the seasonal duration of some of these floodplain wetland habitats.

A corridor of active younger alluvium accompanies the main Leichhardt River channel almost to its meandering tidal channel terminus within the coastal Karumba Plains province. Well-developed scroll belts associated with the meandering river channel are comprised of fertile well-draining alluvial soils and host dense riparian forests surrounding distributary channel wetlands that collectively provide valuable wildlife habitat resources. The Karumba Plains Subregion forms the coastal margin of the basin and along with a northern occurrence of the Donors Plateau Subregion on its southern boundary, hosts the basin's component of the nationally listed Southern Gulf Aggregation. This is the largest continuous estuarine wetland aggregation of its type in northern Australia which extends west to the Settlement Creek basin and east to Karumba. Within the Leichhardt River basin this aggregation includes the intersection of old laterised surfaces of the Donors Plateau Subregion with the coastal landforms of the Karumba Plains Subregion including a coastline barrier formed by an old beach ridge swale system. This geomorphic juxtaposition has created relatively large shallow sub-catchments that host seasonal fresh to brackish lacustrine wetlands. These areas form productive and important habitats for migratory shorebirds and waterbirds.

Summary of the conservation values of the Leichhardt River basin

The aquatic conservation values of the Leichhardt River basin are associated with a diverse range in type and scale of wetland systems found within the basin. These include perennial wetland habitats, including several nationally listed large artificial impoundments, in the basin's arid upper inland areas, perennial gorge and spring supplemented narrow valley hosted waterholes, springs and groundwater seeps emanating from laterised Tertiary plateaus of the mid basin, large main river channel and associated alluvial landform hosted wetlands on the Gulf Plains of the lower basin, including well-developed regional examples of a particular geomorphic setting (e.g. riverine scroll belt), and extensive areas of post wet season lacustrine and palustrine wetlands hosted on coastal alluvial plains adjoining the two main coastal lowland rivers (Leichhardt and Alexandra). In addition, the complex coastal province wetlands associated with the basin's coastal margin, consist of transitional freshwater to saline wetlands including large seasonal lakes on marine plains, beach ridge swales and a major portion of the largest continuous estuarine wetland aggregation in northern Australia. The extent and size of the Leichhardt River basin's wetlands also support aquatic fauna and fishery conservation values including significant populations of waterfowl and migratory waterbirds, endangered sawfish and large barramundi populations.

1.1.5 Morning Inlet study area

The Morning Inlet basin is comprised of two small adjoining northward draining sub-catchments that have independent mouths on the southern margin of an expansive, featureless tidal mud flats stretching northward to the Gulf and where tidal runoff reforms named tidal channel estuaries. These are M Creek in the east and L Creek in the west, the latter is named Spring Creek at its ultimate mouth to the sea.

The Morning Inlet basin is hosted entirely within the Gulf Plains Bioregion and drains three bioregional subregions. The dominant south western portion is the Donors Plateau Subregion characterised by an undulating complex of shales, laterised Tertiary plateaus and sandy outwash. The eastern portion is comprised of the Woondoola Plains Subregion dominated by clay plains and channelised by braided watercourses that have seasonal and permanent wetlands associated with watercourses and back plains. Both the Donors Plateau Subregion and Woondoola Plains Subregions extend northward into areas under tidal influence. The northern third and coastal margin of the basin is comprised by the Karumba Plains Subregion which includes landforms associated with areas subject to coastal influences. In the Morning Inlet basin these predominantly include extensive saline mudflats, mangrove lined tidal channels and islands within the mud flats of elevated residual Tertiary surfaces hosting fresh to brackish wetland depressions and drainages. The inland margin of this coastal province also includes marine plains hosting shallow transitional fresh to brackish wetland basins.

The Morning Inlet basin has a hot, seasonally arid, winter drought, grassland climate with rainfall and associated stream flow concentrated in the summer wet season. Given the seasonal aridity of the basin, aquatic conservation values are associated with all areas of perennial aquatic habitat which provide refugia for obligate aquatic biota. While there are extensive areas of seasonal coastal lacustrine and palustrine wetlands within the basin, natural perennial waterholes are sparse.

An onstream impoundment constructed on the upper tidal margins of L Creek early in the 20th century has created the largest perennial freshwater body in the basin and this has established valuable wetland habitats including fringing riparian forest and instream macrophyte communities. This waterbody also functions as an aquatic refugia for obligate biota of the L Creek sub-catchment. Several smaller storages constructed on tributary drainages also occur in the upper M Creek catchment and a further eight within the L Creek catchment with the largest having a full supply surface area of up to 20 hectares. Despite their artificial origins most of these dams now function as important aquatic refugia and host natural riparian and macrophyte communities that support regionally significant population of biota including waterfowl.

Many of the natural wetland values of the basin can be attributed to the basin's dominant bioregional subregion. For example, the undulating complex of shales, laterised Tertiary plateaus and sandy outwash characteristic of the Donors Plateau Subregion present complex topographic features and drainage patterns. Elevated plateaus including sandy outwash areas in the basin's uplands host seasonal springs and groundwater seeps that support small palustrine wetlands and dependent vegetation communities. In the lower basin the few natural perennial waterholes that exist are riverine wetlands hosted within stream reaches with impermeable rocky shale or cemented lateritic substrates. Where these same reaches extend into the tidal zone flow barriers created by lateritic rock outcrops create a diverse range of relatively large, seasonally dynamic riverine water bodies that fluctuate annually from fresh to hypersaline and providing productive fishery and waterbird habitats.

In the near coastal zone away from the mainstream drainage lines, depressional features within the old laterised Tertiary surfaces have independently, or in conjunction with alluvial and coastal landforms, created shallow basins that host an aggregation of large seasonal lacustrine wetlands of up to 90ha in size. Several of these lakes (i.e.

Buffalo Lake Aggregation) host nationally significant populations of migratory shorebirds and regionally significant populations of breeding waterfowl and are listed in the National Directory of Important Wetlands. Where these basins have wet season and/or tidal connectivity with estuarine areas they can also provide valuable fishery nursery habitat. An inland undissected example of this tertiary surface also occurs on the south-eastern margin of the basin north east of Macallister Station. Here it forms an aggregation of rich palustrine wetlands predominantly tree swamps, with individual swamps up to 20ha in area.

Islands of this residual Tertiary surface also occur on the basin's coastal tidal mud flats where they have been historically subject to beach sand deposition. Like the shore-based counterparts they host seasonal lacustrine and palustrine wetlands albeit of a smaller scale but with the additional feature of shallow aquifer seeps provided by the beach sand sheet.

In contrast to the topographic complexity of the Donors Plateau Subregion, the Woondoola Plains Subregion, which occupies the eastern margin of the Morning Inlet basin is relatively featureless and low lying. It's clayey plains host only small seasonal palustrine wetlands along the upper reaches of L Creek. However, at its northern coastal margin barriers created by alluvial levee deposition and coastal landforms have created areas of impeded drainage that form a complex aggregation of seasonal lacustrine and palustrine wetlands with well-developed macrophyte communities supporting valuable waterbird and fishery nursery habitat.

Summary of the conservation values of the Morning Intel basin

The aquatic conservation values of the Morning Inlet basin are associated with sparsely distributed perennial freshwater habitats which naturally include isolated perennial riverine wetlands hosted within lateritic outcrop reaches and springs and groundwater seeps emanating from laterised Tertiary surfaces of the Donors Plateau Subregion. Several artificial waterbodies including a relatively large onstream impoundment adjoining Inverleigh Station and several smaller impoundments constructed on minor tributaries for stock watering now also form a valuable component of the basin's perennial freshwater habitats. High aquatic conservation values are also associated with non-perennial wetlands including extensive areas of seasonal lacustrine wetlands hosted within old Tertiary surface depressions in the near coastal zone including the national listed Buffalo Lake Aggregation. Extensive areas of post wet season palustrine and lacustrine wetlands are also hosted in the coastal north-east of the basin on the Woondoola Plains Subregion while a broader complex of dynamic freshwater to hypersaline riverine and lacustrine wetlands are hosted in the lower reaches of the main drainages and adjoining coastal plains where residual laterised Tertiary surfaces create impeded drainage connectivity. A representative portion of the Southern Gulf Aggregation, the largest continuous estuarine wetland aggregation in northern Australia, also occurs on the northern coastal margin of the basin. This aggregation includes expansive tidal mud flats, small mangrove lined tidal inlets and elevated islands of residual Tertiary surfaces hosting fresh to brackish wetland depressions and drainages. The extent and habitat richness of the near coastal wetlands of the Morning Inlet basin also support fauna and fishery conservation values including significant populations of migratory waterbirds and waterfowl and extensive barramundi nursery habitat.

1.1.6 **Mornington Island (Wellesley Islands) study area**

The Mornington Island study area includes the Wellesley Islands basin which fall within the single Wellesley Island Subregion of the Gulf Plains Bioregion. Dominated by laterised Tertiary plateaus underlain by shales and labile sandstones, the Wellesley Island Subregion most closely resembles the mainland Donors Plateau Subregion. Most islands are also fringed by sand dunes and swale and marine plains with associated wetland basins with some landform equivalence to the mainland Karaumba Plains Subregion. The larger of the islands contain several named creek sub-catchments that have well developed estuaries to the Gulf.

The Wellesley Islands basin has a seasonally dry, tropical savanna climate with rainfall concentrated in the summer wet season. Rainfall is higher on the islands than in nearby mainland areas and temperature is moderated by surrounding maritime conditions. While the larger islands support relatively extensive areas of seasonal wetlands following wet season rains, in the extended dry season the extent of perennial freshwater habitat on each of the two largest islands reduces to a small set of perennial waterholes that act as important refugia for obligate aquatic biota. On the smaller islands no perennial surface freshwater persists through the dry season though groundwater seeps and soaks may be present. On the largest island, Mornington Island, an onstream storage waterbody supporting local settlements now provides the largest perennial freshwater habitat on the island and supports associated values.

The occurrence of the Wellesley Islands within the Gulf is related to the fact they're predominantly comprised of erosion resistant residual landforms of elevated, laterised Tertiary plateaus. Sandsheets and underlying sedimentary rocks associated with these landforms support the establishment of seasonal shallow aquifers and springs. Perennial waterholes of the larger islands are associated with drainage lines that drain larger areas of these aquifer sequences and/or are underlain by impermeable lateritic or sedimentary basement rock. Circular depressions and impeded drainage lines within larger expressions of the old laterised surface host seasonal palustrine wetlands including melaleuca tree swamps. Well-developed beach ridge swale systems of the larger islands also support shallow groundwater aquifers. In the more extensive systems these collectively drain into semi-perennial swales including treed palustrine wetlands.

Areas of marine plains formed during higher sea levels in the past occur on non-exposed coast lines or behind currently exposed coast lines of the larger islands. Where these receive freshwater inflows from contributing sub-catchment areas including beach ridge swales, (particularly on Mornington and Bentick Islands) they support a range of seasonally transitional fresh to brackish wetlands including melaleuca tree swamps on their inland margins and seasonal sedge swamps in tidally influenced areas. These marine plains also host mangrove lined estuaries within their tidal reaches.

In contrast to mainland areas, freshwater communities of the Wellesley Islands are isolated by surrounding Gulf marine waters from other freshwater drainage systems that could provide recruitment sources for species lost from local habitats due to severe droughts or other catastrophic events. In this context the perennial aquatic habitats present on the islands assume a greater temporal and spatial significance as evolutionarily important refugia. Consequently, the composition of the islands' freshwater communities, particularly the obligate freshwater biota, have high scientific value in providing a living biogeographic experiment examining their resilience to the effects of isolation following the last period of sea level rise that lead to the formation of the Wellesley Islands.

Summary of the conservation values of the Mornington/Wellesley Islands basin

The aquatic conservation values of the Wellesley Islands are primarily associated with all areas of perennial freshwater habitat which, in the case of island freshwater aquatic communities, are isolated from mainland river basins and act as evolutionarily significant refugia. Perennial habitats are generally sparse and naturally include a small number of riverine wetlands hosted in stream catchments of the larger islands in reaches with impermeable lateritic and sedimentary rock basement potentially supplemented with shallow groundwater contributions. A constructed onstream impoundment near Gunna on Mornington Island similarly has high value as an aquatic refugia as do perennial to semi perennial beach ridge swale systems. Although not always expressed as surface water, groundwater seeps and soaks emanating from seasonal aquifers are locally valuable for dependent vegetation communities on the smaller islands. Regionally significant aquatic conservation values on the larger islands are associated with larger areas of seasonal wetlands, including palustrine tree swamps hosted within depositional areas of the laterised Tertiary surfaces, and transitional fresh to brackish palustrine and lacustrine wetlands hosted on old marine plains. The geographic isolation of the freshwater biota of the Wellesley Islands affords all freshwater aquatic communities some conservation value in terms of scientific interest. High value estuarine wetlands comprised predominantly of mangrove lined tidal channels are also hosted within these marine plain landforms.

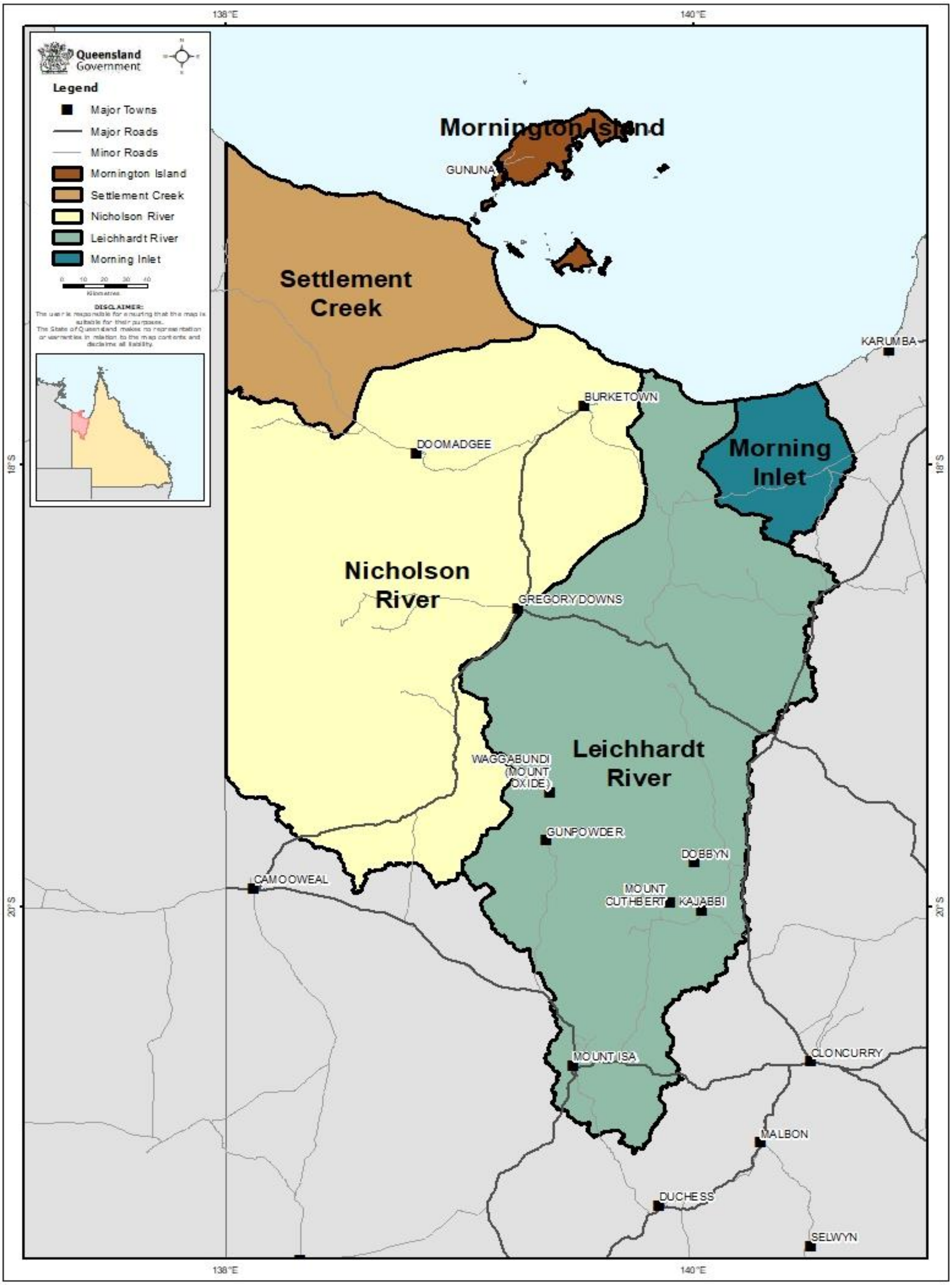


Figure 1. Study areas of the Southern Gulf Catchments Aquatic Conservation Assessment

2 Methods and implementation

2.1 AquaBAMM

The Southern Gulf Catchments Aquatic Conservation Assessments were undertaken using AquaBAMM (Clayton et al 2006). The method has been updated since its development including minor changes to the AquaBAMM tool and revisions to the filter table.

2.2 Spatial Units

In implementing an Aquatic Conservation Assessment, subsections and spatial units are defined in order to calculate and attribute the conservation/ecological values of riverine and non-riverine wetlands. This section describes the subsection and spatial units used for each riverine and non-riverine assessment.

2.2.1 Riverine Spatial Units

Riverine spatial units and subsections were created using ArcHydro tools (v.10.4.0.50) and the Shuttle Radar Topography Mission derived DEM-H Version 1.0, which is a gridded digital elevation model (DEM) that has been hydrologically conditioned and drainage enforced with spatial resolution of 1 arc second (~30 m).

The DEM-H was first corrected to remove small imperfections in the data including the filling of sinks and the exclusion of abrupt peaks. The direction of flow from every cell in the raster was then determined following the eight-direction model (D8) which classifies grid cells into eight valid output directions relating to the eight adjacent cells into which flow could travel. Next, a flow accumulation surface was generated which quantifies the total number of upslope grid cells draining into each individual grid cell. The flow accumulation was then reclassified to generate a gridded stream network with drainage area greater than 125 km^2 (i.e. the number of gird cells to define each reach subcatchment was 126,780). This ensured that every stream starts with the same drainage area or number of drained cells. Each stream junction (node) serves as the spatial unit outlet (pour point). The upstream drainage area for each pour point junction becomes a unique riverine spatial unit.

The Southern Gulf Catchments riverine assessments included 322 riverine spatial units derived from method described above. The minimum, maximum and mean riverine spatial unit size was 163 ha, 136,072 ha and 26,543 ha respectively. For the Southern Gulf Catchments assessments, the riverine spatial units and subsections were treated as synonymous.

2.2.2 Non-Riverine Spatial Units

The Queensland Herbarium uses the Wetland Mapping and Classification Methodology (EPA 2005) to map the location, extent, and attributes of Queensland's wetlands. Linework and attribute descriptions are based on satellite derived waterbody and regional ecosystem mapping (Neldner et al. 2017). The Southern Gulf Catchments assessments used Queensland Wetland Data Version 5.0 – Wetland Data (2017) which is based on Version 11.0 regional ecosystem mapping.

The non-riverine assessments included 4,425 spatial units derived from palustrine and lacustrine wetland waterbody and wet regional ecosystems present in the Queensland Wetland Mapping data (Version 5.0). Only **natural** (H1) and **slightly modified** (H2M1b, H2M1d, H2M2, H2M2a, H2M2b, H2M2c, H2M2d, H2M2e, H2M2f, H2M2g, H2M3 and H2M8) were included; highly modified (H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e and H2M7) and artificial wetlands (H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3) were not assessed as part of the Southern Guld Catchments assessments. There were no H2M1b, H2M1d, H2M2a, H2M2b, H2M2d, H2M2f, H2M2g or H2M8 wetlands in the Southern Gulf Catchments study areas. The natural, slightly modified, highly modified and artificial hydromodification categorisations are based on the categorisations used by the Queensland Herbarium for State of the Environment and Great Barrier Reef Catchments reporting. The minimum, maximum and mean non-riverine spatial unit size was 0.15 ha, 2,745 ha and 22 ha respectively.

Refer to the Wetland Mapping and Classification Methodology (EPA 2005) for more information on hydrological modifiers.

2.2.3 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 results in numerous spring systems displaying unique geomorphic appearances and specialised habitats of high intrinsic conservation value (Fensham 2006).

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

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

The Southern Gulf Catchments 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 (An Aquatic Conservation Assessment for the riverine and non-riverine wetlands of the Southern Gulf of Carpentaria: Flora, fauna and Ecology Expert Panel Report, Version 1.1 Section 4 (DES 2020a)) for more details.

2.3 Assessment parameters

The Criteria, Indicators and Measures (CIM) implemented for each Southern Gulf Catchments Aquatic Conservation Assessment are outlined in Table 2. These CIM lists were developed from the default list of criteria, indicators and measures provided by Clayton et al. (2006). The default CIM list is not mandatory and instead provides a ‘starter set’ for consideration when setting up the assessment parameters for a new Aquatic Conservation Assessment.

Each Aquatic Conservation Assessment can have a different combination of assessment parameters based on a different combination of source datasets. Implementation of these measures can be complex therefore comprehensive implementation tables are maintained throughout the assessment. A description of how each measure was implemented for both the riverine and non-riverine assessment is outlined in the tables contained in Appendix I - Riverine Implementation Tableand Appendix II - Non-riverine Implementation Table.

Measure data used in an Aquatic Conservation Assessment come from different sources and in different data types (i.e. continuous, presence/absence, categorical, etc.). A procedure called thresholding is used to standardise measure data to a common scale so it can be compared within the database. The six threshold types used to standardise AquaBAMM measure data include Categorical, Continuous Ascending, Continuous Descending, Presence Positive, Presence Negative, and User Defined. The threshold type chosen for a particular measure depends upon the type and distribution of the data.

Thresholding involves applying rules to assign a threshold scores of 1 (i.e. Low), 2 (i.e. Medium), 3 (i.e. High), or 4 (i.e. Very High) to each spatial unit for each measure. Threshold scores do not need to be specified for measures with a threshold type of Presence Positive and Presence Negative as these are defined using code within the AquaBAMM database.

Measure scores of -999 are used for spatial units being assessed (e.g. for special features) to have no value (i.e. true-absence) for a particular measure. Using a value of -999 ensures the measure is considered as having data when calculating a spatial unit's dependability score.

Measure scores of No Data indicate there is no data available to evaluate the measure for a particular spatial unit. Measures with No Data lower a spatial unit's dependability score.

Table 2. Criterion, indicator, measure list used for the Southern Gulf Catchments Aquatic Conservation 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 DES 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 Modifications	2.4.1	Farm storage (overland flow harvesting, floodplain	Y	Y

Criteria and Indicators	Measures		Riverine	Non-riverine
		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	3.2.2	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. 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 – NC Act, EPBC Act	Y	Y
	4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NC Act, EPBC Act	Y	Y
4.2 Communities/ assemblages	4.2.1	Conservation status of wetland Regional Ecosystems – Herbarium biodiversity status, NC Act, EPBC Act	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	7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/ or 6	Y	Y
	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
	7.1.3	Presence of aerial or terrestrial migratory route for biological connectivity	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
7.3 Floodplain and wetland ecosystems	7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6	Y	Y
	7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater,	Y	Y

Criteria and Indicators	Measures		Riverine	Non-riverine
		etc.		
7.4 Terrestrial ecosystems	7.4.1	The contribution of the spatial unit to the maintenance of terrestrial ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6	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
	7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.	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
	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 wetland management group within the catchment or study area		Y
	8.2.4	The size of each wetland type relative to others of its wetland management group within a sub-catchment (or estuarine zone)		Y
	8.2.5	Wetland type representative of the study area – identified by expert opinion	Y	Y
	8.2.6	The size of each wetland type relative to others of its type within the catchment or study area		Y

NC Act—*Nature Conservation Act 1992* (Queensland)

EPBC Act—*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

ASFB—Australian Society for Fish Biology

WWF—World Wildlife Fund

JAMBA—Japan–Australia Migratory Bird Agreement

CAMBA—China–Australia Migratory Bird Agreement

ROKAMBA—Republic of Korea–Australia Migratory Bird Agreement

2.4 Wetland management groups

The Queensland Wetlands Program identifies attributes addressing characteristics of lacustrine and palustrine wetlands at increasingly specific scales (continental, ecosystem, landscape, and local). These attributes can be used to develop wetland typologies aimed at classifying wetlands into types or groups useful for wetland management, monitoring and regulation.

Through expert consultation, and an iterative process of reality checking with the mapping, a series of wetland habitat types has been developed that are broad enough to cover Queensland, while allowing the identification and grouping of key wetland ecological and physical processes across the broad climatic zones of Queensland (DES 2020b). As wetlands are spatially and temporally diverse, this typology also allows for combining wetland habitat types which may be found within an individual wetland (e.g. a lacustrine waterbody may have a palustrine fringe). Wetland habitat types are subsequently called wetland management groups for the purposes of an Aquatic Conservation Assessment. Wetland management groups are used for AquaBAMM measures 8.2.1, 8.2.2, 8.2.3 and 8.2.4.

2.5 Stratification

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

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

For the Southern Gulf Catchments, the ecology expert panel noted that fish and some turtle assemblages are likely affected by elevation. A caveat to this is known barriers to fish movement, such as the natural fish barrier caused by the Leichhardt Falls, and road crossings on the Nicholson River at Escot, at Doomadgee, and on Lagoon Creek. The experts also noted that differences in flow regimes and water chemistry can exist between creeks in the Southern Gulf Catchments which may affect fish and turtle diversity, particularly on the coastal alluvial plains. For example, seasonal creeks of the lower Nicholson River generally have different species assemblages to adjacent perennial creeks fed by the limestone springs of the Thorntonia sub region.

On the panel's advice we stratified the study areas for the purpose of assessing like systems for AquaBAMM Measures 3.1.2 (Richness of native fish, 3.1.3 (Richness of native aquatic dependent reptiles (turtles only)). The Wellesley Islands (Mornington Island study area) was one stratum. The Nicholson River, Leichhardt River, Settlement Creek and Morning Inlet study areas were each stratified into three strata including uplands, coastal alluvial lowlands, and the coastal zone. The boundary used for the uplands stratum was based on the North West Highlands and Mitchell Grass Downs Bioregional boundaries. For the coastal zone we used a generalised boundary derived from the maximum extent of estuarine wetlands in the Queensland Wetland Mappings (v5.0). Subsections between the upland and coastal zone strata constituted the coastal alluvial lowlands stratum.

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

The Southern Gulf Catchments coastal zone included systems dominated by estuarine processes. Estuarine wetlands were not assessed as part of this project so the results are only relevant to the freshwater riverine and non-riverine wetlands within these areas. Finer scale hydrological (subsection) modelling is needed to undertake estuarine assessments and this is hindered by the availability of high-resolution digital evaluation models suitable for detecting the small gradients in elevation typical of coastal zone.

Stratification was used in calculating the thresholds for AquaBAMM measures 3.1.2 (Richness of native fish, 3.1.3 (Richness of native aquatic dependent reptiles).

2.6 Weighting of measures

AquaBAMM measures are weighted according to their importance to an indicator based on the following rules:

- At least one measure within each indicator must be weighted 10 which is the highest weighting.
- Other measures within each indicator were weighted compared to the weighting of 10 assigned in the first step.
- It was okay to have different measures with the same weight (i.e. all measures could be weighted 10).
- Some indicators only had one measure and had already been given a weighting of 10.
- Measures shouldn't be weighted down because of the quality or lack of data for that measure.

Expert panel members are asked to weight the measures within each indicator at the expert panel workshops. Weights from all respondents are then averaged and reviewed with particular attention to averages having a high variance.

The measure weights used for the Southern Gulf Catchments assessments were based on the weights derived during the expert panel workshops held in 2019. The weights used for each measure was the average weight from all experts. If no measures within an indicator received an average weight of 10, we then adjusted the weights for all measures within the Indicator relative to each other to ensure that at least one measure had a weight of 10. For example, if an indicator had three measures with average scores of 9.5, 9.0 and 8.0, the adjusted weights were 10, 9.5 and 8.5 (i.e. 0.5 was added to the weights of all three measures). We do this because at least one measure within each Indicator must have a weight of 10.

The riverine and non-riverine measure weights are outlined in Appendix V - Riverine Measure weights relative to each other in the same Indicator and Appendix VI - Non-riverine Measure weights relative to each other in each Indicator.

2.7 Ranking of indicators

AquaBAMM Indicators are ranked according to their importance in contribution to a criterion with a rank of 1 signifying the most important contribution. Indicator ranks are based on the following rules:

- At least one indicator within each criterion must be ranked one which is the highest ranking.
- The other indicators are ranked (within each criterion) relative to the ranking of one assigned in the first step.
- It is possible to have different indicators with the same ranking (i.e. all indicators may be ranked one).
- An Indicator should not be ranked down because of the quality or lack of data for that indicator.

Similar to the measure weights, participants at the expert panel workshops held in 2019 gave a rank to each indicator within a criterion. Ranks from all respondents were reviewed and the common rank for each indicator assigned to each indicator. Where two or more ranks were most common, we used the highest rank for the indicator. For example, if an indicator was raked 1, 1, 2, 2, 3 by the expert panel, we used an indicator rank of 1. In addition, the ranks for Criterion 2.3 and 2.4 were reversed to lower the dominance of Very High Criterion 2 ratings by decreasing the influence of Indicator 4 (Farm storage) relative to Indicator 3 (i.e. landuse based catchment disturbance) which is a bigger threat to aquatic ecosystems in the Southern Gulf Catchments study areas.

The riverine and non-riverine indicator ranks are outlined in Appendix VII - Riverine Indicator Ranks and Appendix VIII - Non-riverine Indicator Ranks.

2.8 Biodiversity / Conservation value categories

The AquaBAMM calculates an overall aquatic conservation score, called an AquaScore, for each spatial unit within a study area. The AquaScore ratings can be Very High, High, Medium, Low or Very Low and are relative within a study area.

The following descriptions provide a summary of the general characteristics of each AquaScore.

Very High

Wetlands given an AquaScore of Very High generally have very high biodiversity values across all criteria (aquatic naturalness, catchment naturalness, diversity and richness, threatened species, special features, connectivity, representativeness), or Very High representativeness values in combination with Very High aquatic naturalness, catchment naturalness or threatened species values. They may also be wetlands nominated by an expert panel as containing very important special or unique features from a flora, fauna and/or ecological perspective regardless of the values across the other criterion.

High

Wetlands given an AquaScore of High are mainly those that have Very High aquatic naturalness or representativeness values in combination with High or Very High values for rare and threatened species or diversity and richness. Combinations of Very High or High values among most criteria may also result in a High AquaScore. They may also be wetlands nominated by an expert panel as containing important special or unique features from a flora, fauna and/or ecological perspective regardless of the values across the other criterion.

Medium

Wetlands given an AquaScore of Medium generally have combinations of High and Medium rating across the various AquaBAMM criteria.

Low

Wetlands given an AquaScore of Low generally have limited aquatic and catchment naturalness values and generally varied combinations of Medium and Low values across the criteria. These wetlands do not contain special or unique features.

Very Low

Wetlands given an AquaScore of Very Low generally have Low naturalness (i.e. criterion 1 and 2) and lack any other known significant values. They may also be wetlands that are largely data deficient across the AquaBAMM measures. These wetlands do not contain special or unique features.

2.9 Filter tables

A series of arithmetic techniques are used to bring measure data through to ratings for each criterion. Arithmetic techniques can mask important effects or insufficiently discriminate between spatial units when used to create an overall AquaScore. Authors such as Chessman 2002 discuss this issue.

Rather than a final arithmetic combination, AquaBAMM uses a criterion rating combination table (i.e. filter table) that provides an ordered series of decisions that are tested against the final criterion ratings for each spatial unit (See Appendix III and Appendix IV - Non-riverine Filter Table for the riverine and non-riverine filter tables). Each decision contains a unique combination of criterion ratings and associated AquaScore. These decisions are essentially a number of ‘if-then’ statements and are tested in sequence for each spatial unit. An AquaScore is assigned immediately when a match is achieved between the criterion rating combination of the decision and that of the spatial unit. This filtering table technique has previously been used successfully in the Biodiversity Assessment and Mapping Methodology (EPA 2002). It is important to note that, unlike previous steps through the AquaBAMM tool, the AquaScore may be one of five categories (i.e. Very High, High, Medium, Low and Very Low). This increased level of discrimination at the AquaScore level provides for a more useful conservation assessment tool and enables more informed management decisions.

2.10 Dependability and data richness

The AquaBAMM calculates a dependability score to provide an indication of the richness of data for each spatial unit. Criterion ratings and AquaScores should be interpreted in conjunction with the corresponding dependability scores, as these provide an overall indication of the amount of data available for each spatial unit.

Dependability scores range from 0 to 1 and are calculated as a fraction representing the number of measures with data for a spatial unit out of the total number of measures used in the assessment. Dependability is calculated as follows:

$$\text{Dependability} = \frac{\text{No. of measures with data (count)}}{\text{Total no. of measures (count)}}$$

Dependability scores indicate the potential for an AquaScore to change (upgrade or downgrade) with the addition of new data. Furthermore, spatial units with low dependability and a Very Low AquaScore should be used with caution as this result can be due to a lack of data rather than a lack of values. Dependability scores can also provide an indication of where additional survey work may be required and which, once completed, may or may not change an AquaScore.

2.11 Transparency of results

Despite presentation as a single AquaScore, Aquatic Conservation Assessments results are available at the AquaScore, criterion, indicator, measure threshold and measure data level. All results are available to the user through the use of user-defined queries inside a Geographical Information System (GIS) (e.g. Figure 2) or other database applications (i.e. Microsoft Excel).

Results may be interrogated at one or more levels in an almost infinite number of combinations. This transparency of results provides Aquatic Conservation Assessment end users with a unique level of flexibility for interrogation, interpretation and presentation. This data access and interrogation flexibility is important as it enables investigation of different data contributions to the overall conservation value, investigation of missing data, and an ability for users to tailor Aquatic Conservation Assessment outputs for a particular purpose. The intent of an Aquatic Conservation Assessment is not only to evaluate aquatic ecological and conservation values, but just as importantly, to identify variability in these values. Links between the Aquatic Conservation Assessment results and GIS facilitate this and constitute the complete Aquatic Conservation Assessment results release package.

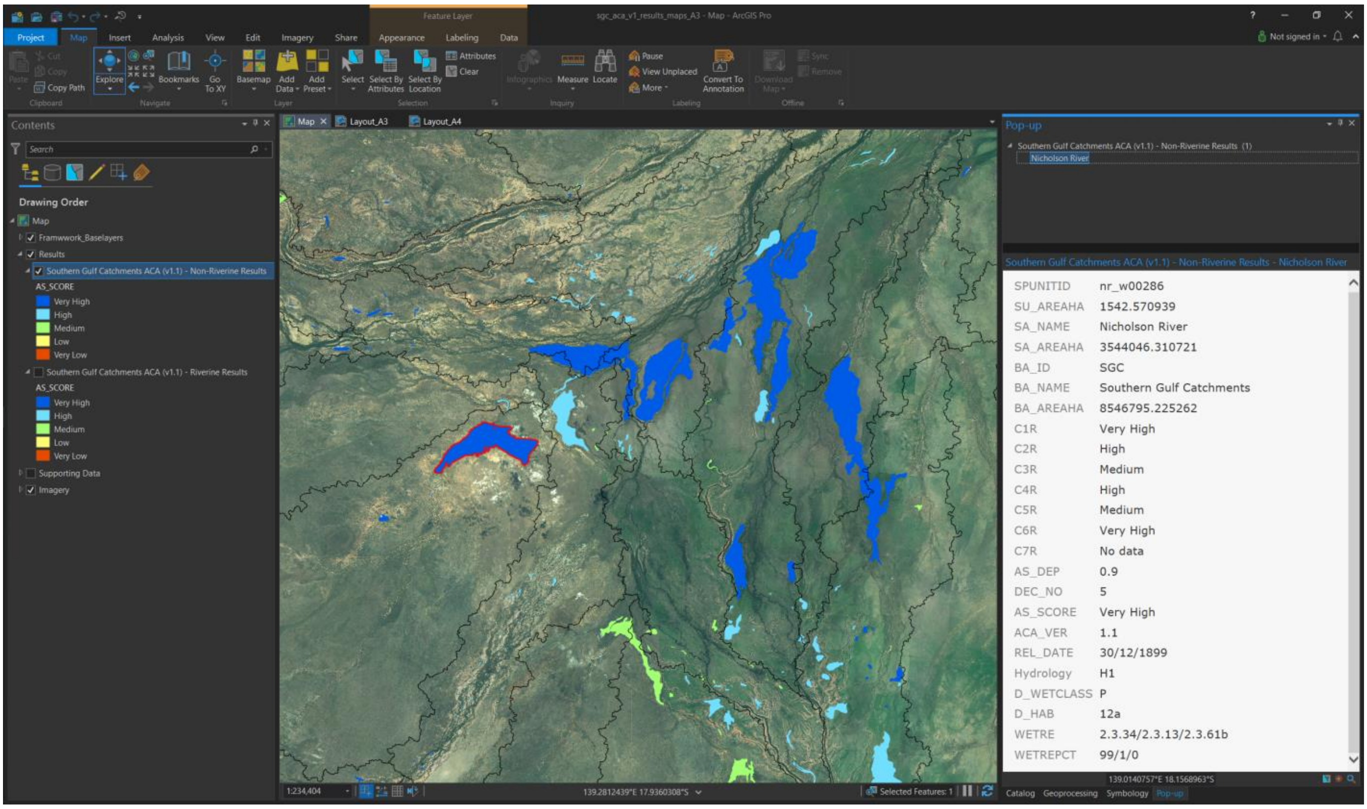


Figure 2. Interrogating the results for non-riverine spatial unit nr_w00286 (polygon with red outline) within ESRI ArcGIS Pro software.

3 Results

3.1 Accuracy and dependability

The Queensland Wetland Mapping data is the core dataset Aquatic Conservation Assessments are built upon. This dataset is mapped at a scale of 1:100,000 with a positional accuracy of ±100 metres, except for areas along the east coast that may be mapped at a scale of 1:50,000 with a positional accuracy of ±50 metres. Wetlands smaller than 1 hectare are not delineated in the wetland data.

The dependability score is a percentage of how many measures, out of those calculated, have data. The dependability does not influence or change the final AquaScore. The Aquatic Conservation Assessment results should be interpreted in conjunction with the dependability score.

3.2 Riverine results

Aquatic Conservation Assessments were conducted for the riverine spatial units within each study area. Figure 3 and Figure 4 contain maps of the riverine AquaScores, AquaScore dependability and criterion ratings for each riverine spatial unit. Table 3 and Table 4 provide a summary of the riverine AquaScores, dependability scores and criterion ratings by study area.

AquaScores

Riverine AquaScores were predominantly Very High or High across all study areas. In fact, over half (54.7%: 176/322) of all riverine spatial units received an AquaScore of Very High. A further 26.7% (86/322) of riverine spatial units received an AquaScore of High. Together, High and Very High AquaScores accounted for 81.4%% (262/322) of all riverine spatial units assessed. A further 12.4% (40/322) of riverine spatial units received an AquaScore of Medium, and 6.2% (20/322) an AquaScore of Low (44.1%: 15/34). No riverine spatial units received an AquaScore of Very Low in the Southern Guld Catchments assessments.

AquaScores in the Leichhardt River, Mornington Island and Settlement Creek study areas all ranged from Very High to Low, while AquaScores in the Nicholson River study area ranged from Very High to Medium. Morning Inlet AquaScores were either Very High or High. Morning Inlet (72.7%: 8/11), Nicholson River (69.8%: 81/116) and Settlement Creek (70.8%: 34/48) study areas were dominated by AquaScores of Very High, while riverine spatial units in the Mornington Island study area were dominated by AquaScores of Low. Riverine spatial units in the Leichhardt River study areas were dominated by roughly equal proportions of Very High (38.9%: 44/113), High (31%: 35/113) and Medium (26.3%: 30/113) AquaScores.

AquaBAMM filter table decisions

The top four AquaBAMM filter table decisions triggered were decisions 3 (46.3%: 149/322), 8 (8.1%: 26/322) and 7 (7.5%: 24/322) and 24 (7.5%: 24/322). Together, these four decisions accounted for 69.3% (223/322) of all riverine spatial unit AquaScores. The most frequently triggered decision was decision 3, indicating high levels of aquatic naturalness (i.e. Criterion 1) in combination with Very High criterion ratings for at least three other criteria. Simile, decision 8 reflected high levels of aquatic naturalness (i.e. Criterion 1) but in combination with high values for priority ecosystems or significant bird habitat (Criterion 5). Decision 7 also reflected high aquatic naturalness (i.e. Criterion 1) but this time in combination with the presence of rare or threatened wetland regional ecosystems (Criterion 4). Like decision 7, decision 24 reflected the presence of wetland regional ecosystems with an 'endangered' or 'of concern' biodiversity status (Criterion 4).

Dependability

Dependability scores are used to reflect the number of measures with data out of the total number of measures used for each spatial unit. Riverine dependability scores were relatively high across all study areas. For example, with the exception of Mornington Island, all riverine spatial units had dependability scores >= 0.78. This means most riverine spatial units had data for at least 39 of the 49 riverine measures used. In fact, most riverine spatial units (80%: 258/322) had dependability scores between 0.8 to 0.9. Mornington Inland had slightly lower dependability scores where 82% (28/34) of riverine spatial units had scores between 0.67 and 0.8.

Criterion 1 - Aquatic Naturalness

With the exception of one spatial unit in the Leichhardt River study area, Criterion 1 (Aquatic Naturalness) riverine ratings were Very High or High across all study areas. In fact, Criterion 1 ratings of Very High dominated the Leichhardt River (68.1%: 77/113), Morning Inlet (54.5%: 6/11), Mornington Island (100%: 34/34), Nicholson River (81%: 94/116) and Settlement Creek (93.8%: 45/48) study areas. For the Southern Gulf Catchments assessments, Criterion 1 ratings of Very High or High reflect the low degree to which exotic fish, exotic aquatic invertebrates, and aquatic and semi-aquatic exotic plants are impacting wetlands, in combination with low levels of wetland hydrological modification, low levels of inundation by dams or weirs, and high levels of remnant wetland vegetation relative pre-clearing extent.

Criterion 2 - Catchment Naturalness

Like Criterion 1, Criterion 2 (Catchment Naturalness) riverine ratings were either Very High or High across all study areas. In contrast to Criterion 1, Criterion 2 ratings of High dominated all study areas except Mornington Island (i.e. Leichhardt River (98.2%: 111/113), Morning Inlet (90.9%: 10/34), Nicholson River (72.4%: 84/116) and Settlement Creek (54.2%: 26/48)). Very High Criterion 2 ratings dominated Mornington Island due to the absence of grazing when compared to the other four study areas. Southern Gulf Catchments Criterion 2 riverine results reflect low levels of overland flow harvesting, low levels of intensive land use such as cropping, intensive horticulture or high density urban centres, and high levels of remnant vegetation relative to pre-clearing extent in area surrounding wetlands.

Criterion 3 - Diversity and Richness

Criterion 3 (Diversity and Richness) riverine ratings varied somewhat between study areas. For example, Criterion 3 riverine ratings ranged from Very High to High in the Morning Inlet study area, and from Very High to Medium in the Settlement Creek study area. In contrast, riverine spatial units in the Leichhardt River, Mornington Island and Nicholson River study areas had Criterion 3 ratings ranging from Very High to Low. Criterion 3 ratings of Very High dominated the Morning Inlet (72.7%: 8/11) study area, while High or Medium Criterion 3 ratings dominated the Leichhardt River (Medium: 54.9%; 62/113), Nicholson River (High: 42.2%; 49/116) and Settlement Creek (High: 56.3%; 27/48) study areas. Mornington Island was dominated by roughly equal proportions of Very High (35.3%: 12/34) and Low (32.4%: 11/34) Criterion 3 ratings. For the Southern Gulf Catchments assessments, Very High and High Criterion 3 ratings reflect high levels of aquatic species diversity and high richness of riverine wetland types.

Criterion 4 - Threatened Species and Ecosystems

Criterion 4 (Threatened Species and Ecosystems) riverine ratings ranged from Very High to Low and No Data in the Leichhardt River study area, from Very High to Medium in the Morning Inlet study area, and from Very High to Medium and No Data in the Nicholson River and Settlement Creek study areas. Criterion 4 ratings were predominantly High across the Leichhardt River (45.1%: 51/113), Morning Inlet (72.7%: 8/11), Nicholson River (42.2%: 49/116) and Settlement Creek (62.5%: 30/48) study areas. Most riverine spatial units in the Mornington Island (88.2%: 30/34) study area had no data or no values for the Criterion 4, with the remainder of riverine spatial units receiving a Criterion 4 rating of Very High (2.9%: 1/34) or High (8.8%: 3/34). Similar to the non-riverine assessments, only a handful of riverine species sightings records occurred within the study areas resulting in most spatial units receiving a score of No Data for measures 4.1.1 (Rare or threatened fauna) and 4.1.2 (Rare or threatened flora). For example, only 61 or the 322 riverine spatial units had one or more sighting records for rare or threatened fauna species (i.e. measure 4.1.1) and only four of the 322 riverine spatial units had one or more sightings records for rare or threatened flora species. Low numbers of sighting records meant that measure 4.2.1 (Biodiversity status of the dominant wetland regional ecosystem) drove the Criterion 4 results. Over 60% of riverine spatialunits units had riverine wetland regional ecosystems with a Queensland Herbarium biodiversity status of 'Endangered' or 'Of concern' in the Leichhardt River (72.6%: 82/113), Morning Inlet (63.6%: 7/11), Nicholson River (77.6%: 90/116) and Settlement Creek (70.8%: 34/48) study areas. In contrast, Mornington Island had one spatial unit with one riverine wetland regional ecosystems with a biodiversity status of 'Of concern' explaining the high number riverine spatial units with Criterion 4 ratings of No Data in the Mornington Island study area. There were no EPBC listed ecological communities mapped within the Southern Gulf Catchments study areas.

Criterion 5 - Priority Species and Ecosystems

Criterion 5 (Priority Species and Ecosystems) riverine ratings ranged from Very High to Medium and No Data in the Leichhardt River and Nicholson River study areas. In the Mornington Island and Settlement Creek study areas, Criterion 5 riverine ratings were either Very High, Medium or No Data, while Morning Inlet study area Criterion 5 riverine ratings were all Very High or No Data. Like Criterion 4, a high percentage (76.5%: 26/34) of the Mornington Island riverine spatial units had no data for Criterion 5. In contrast to Criterion 4, Criterion 5 riverine ratings of Very High dominated the Leichhardt River (44.2%: 50/113), Morning Inlet (81.8%: 9/77), Nicholson River (66.4%: 77/116) and Settlement Creek (77.1%: 37/48) study areas. Similar to Criterion 4, many spatial units across all study areas had no data for the Criterion 5 measures based on sightings records (i.e. 5.1.1: 76.4%, 5.1.2: 68.3%, 5.1.3: 76.4%). As a result, Criterion 5 riverine scores were driven mainly by measures 5.1.4 (Significant Waterbird Habitat Areas) and 5.2.1 (Priority Ecosystems). Measures 5.1.4 and 5.2.1 were both expert elicited and all riverine spatial units flagged by the expert panel were given a measure score of 4 (i.e. Very High). In total, the experts identified 30.1% (97/322) of riverine spatial units as containing significant bird habitat areas (i.e. Measure 5.1.4) and 40.7% (131/322) riverine spatial units as containing priority ecosystems (i.e. Measure 5.2.1).

Criterion 6 - Special Features

Criterion 6 (Special Features) riverine ratings across all study areas were either Very High, High or No Data. Very High Criterion 6 ratings dominated the Morning Inlet (72.7%: 8/11), Nicholson River (68.1%: 79/116) and Settlement Creek (68.75%: 33/48) study areas, while No Data dominated the Leichhardt River (50.4%: 57/113) and Mornington Island (73.5%: 25/34) study areas respectfully. Overall, 53.7% (173/322) of riverine spatial units assessed as part of the Southern Gulf Catchments assessments scored Very High and 15.8% (51/322) of riverine spatial units scored High for Criterion 6. With the exception of Measure 6.3.2 (Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Area, etc.) all Criterion 6 riverine measures were expert panel derived. 69.6% (224/322) of all riverine spatial units assessed had one or more Criterion 6 special features. Notable special features in the Morning Inlet, Nicholson River and Settlement Creek study areas due to the high area triggered include: Riverine systems containing Terminalia bursarina (30,895 km^2: lr_r_fl_16, nr_r_fl_16, sc_r_fl_16); Low woodlands fringing major or minor watercourses (16,073km^2: lr_r_fl_17, nr_r_fl_17).

Criterion 7 - Connectivity

Criterion 7 (Connectivity) riverine ratings displayed a similar trend to Criterion 6. The main difference was less Criterion 7 riverine ratings of High in the Leichhardt River, Morning Inlet, Nicholson River and Settlement Creek study areas. Similar to Criterion 6, Criterion 7 ratings of Very High dominated the Morning Inlet (54.5%: 6/11), Nicholson River (59.5%: 69/116) and Settlement Creek (66.7%: 32/48) study areas. In contrast, the Leichhardt River and Mornington Islands study areas were dominated by Criterion 7 ratings of No Data, however both study areas (i.e. Leichhardt River: 38.1% (43/113); Mornington Island: 26.5%(9/34)) still had a relatively high proportions of riverine spatial units with Criterion 7 ratings of Very High. Unlike Criterion 6, all Criterion 7 measures were expert panel derived meaning riverine spatial units with Criterion 7 ratings of No Data had no connectivity values identified as part of the expert panel process.

Criterion 8 - Representativeness

Criterion 8 (Representativeness) riverine ratings were based entirely on Measure 8.2.5 (Wetland type representative of the study). Measure 8.2.5 is expert panel derived, and all riverine spatial unit identified by the experts as containing "riverine wetland types representative of the study area" were given a score of 4 (i.e. Very High). In total, 38.2% (123/322) of riverine spatial units contained riverine wetland types representative of the study area. In the Morning Inlet and Nicholson River study areas over 50% of riverine spatial units were identified as containing riverine wetland types representative of the study area.

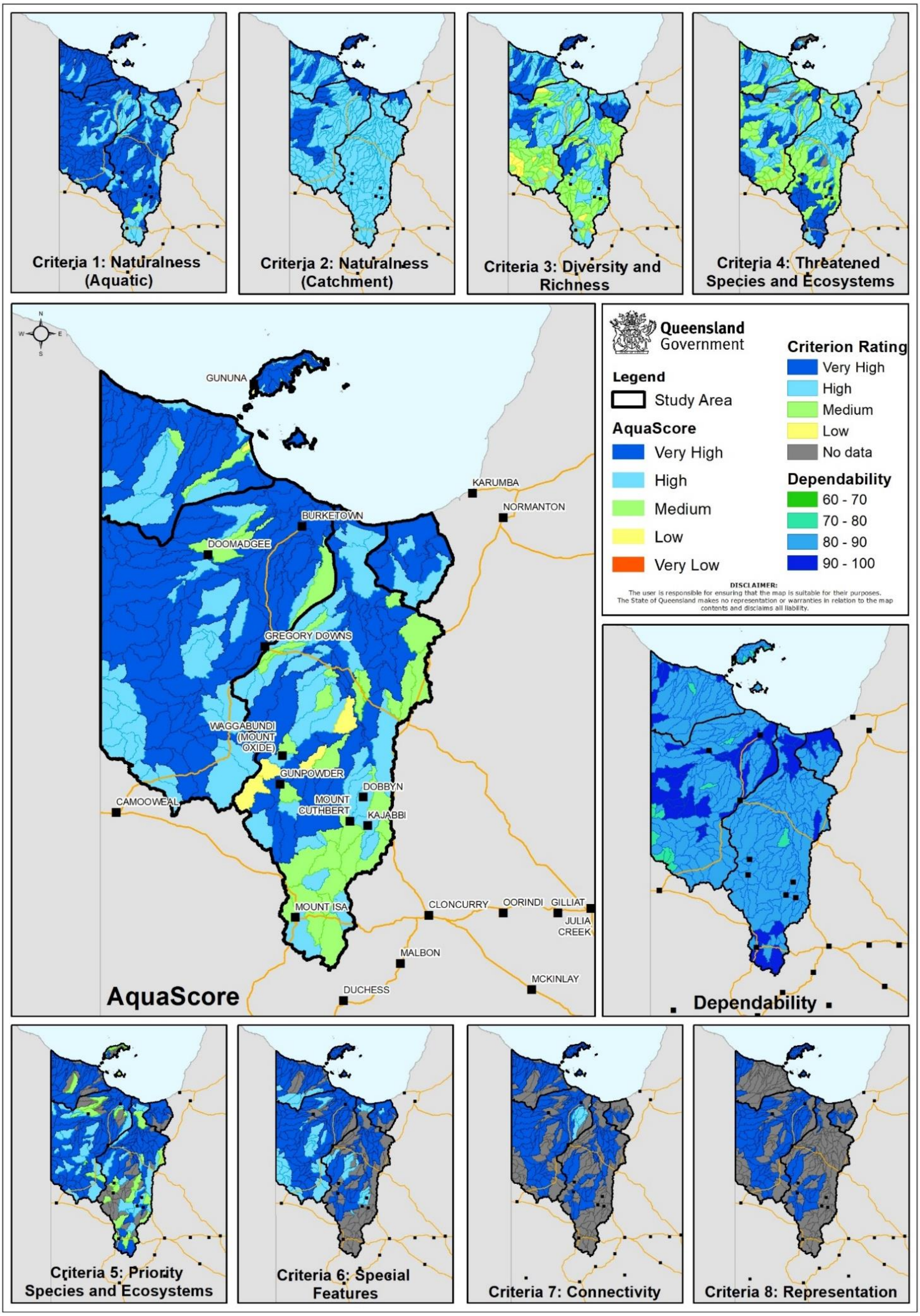


Figure 3. AquaScore, Dependability and Criterion rating by riverine spatial unit.

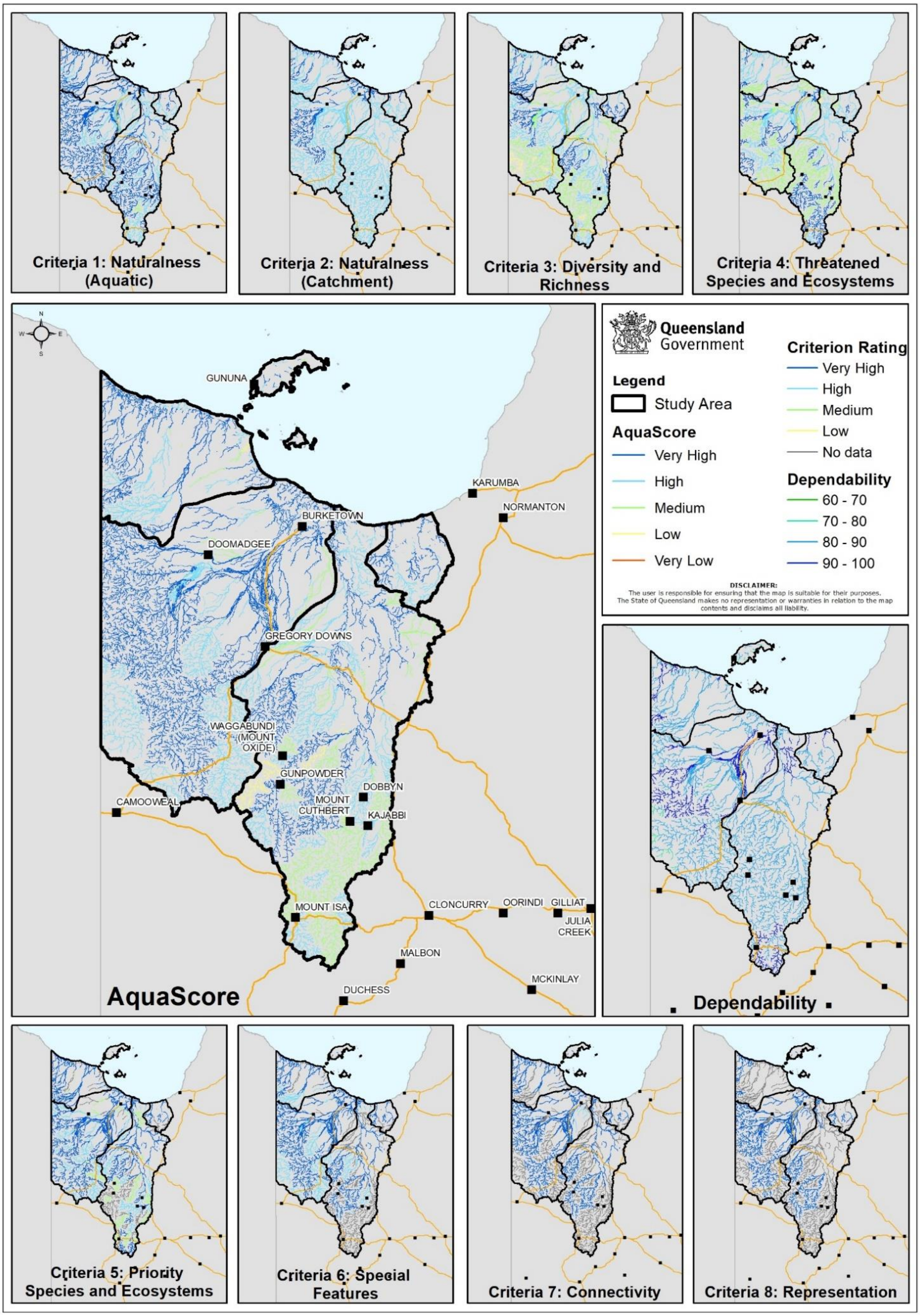
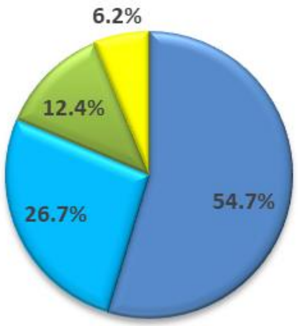


Figure 4. AquaScore, Dependability and Criterion rating by riverine drainage lines.

3.2.1 **Riverine AquaScores**

Table 3. Riverine spatial unit AquaScore and Dependability summary statistics by study area.

<table>
<tr><th>Catchment</th><th>AquaScore by % of spatial units</th><th>AquaScore by % of total area of spatial units</th><th>AquaScore dependability</th></tr>
<tr>
<td>All
Very High
High
Medium
Low
Very Low</td>
<td>
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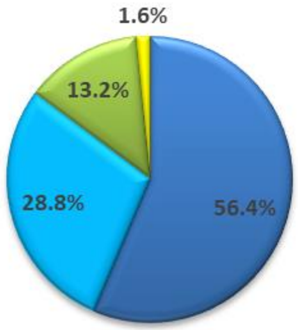
<td>
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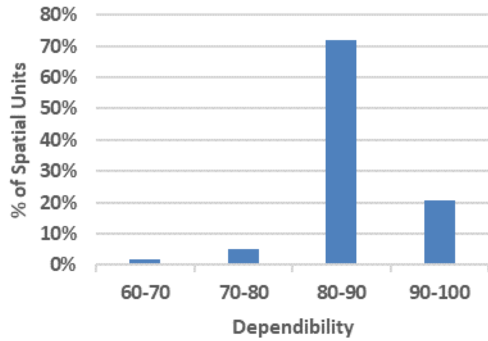
<td>
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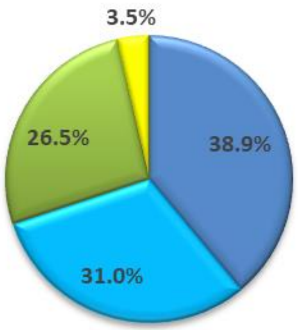
</tr>
<tr>
<td>Leichhardt River
Very High
High
Medium
Low
Very Low</td>
<td>
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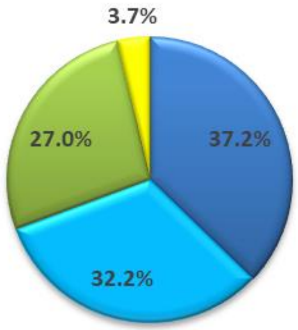
<td>
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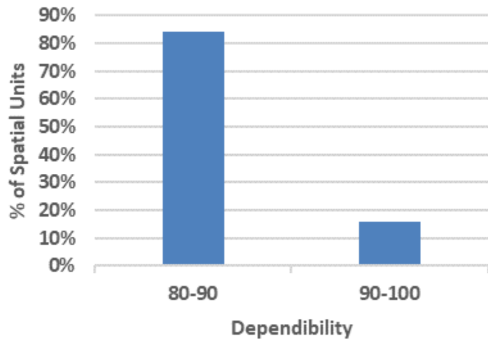
<td>
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<tr><th>Catchment</th><th>AquaScore by % of spatial units</th><th>AquaScore by % of total area of spatial units</th><th>AquaScore dependability</th></tr>
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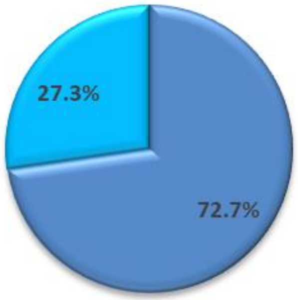
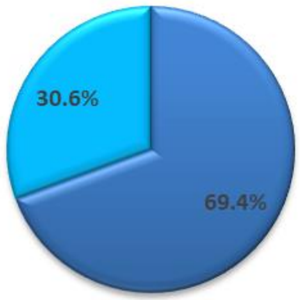
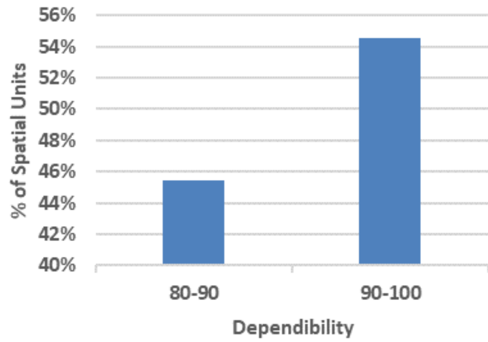
Very High
High
Medium
Low
Very Low</td><td>
</td><td>
</td><td>
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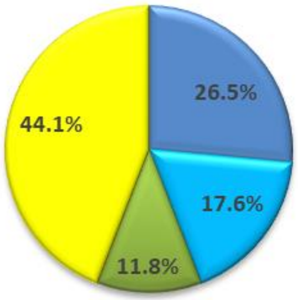
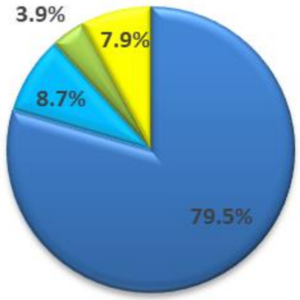
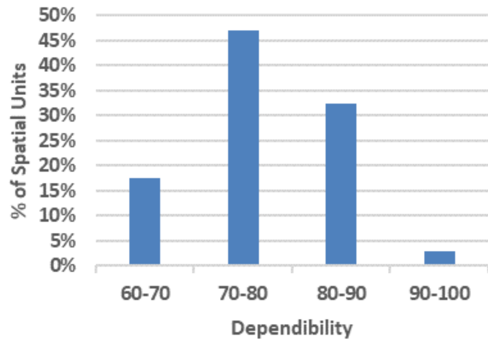
Very High
High
Medium
Low
Very Low</td><td>
</td><td>
</td><td>
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<table>
<tr><th>Catchment</th><th>AquaScore by % of spatial units</th><th>AquaScore by % of total area of spatial units</th><th>AquaScore dependability</th></tr>
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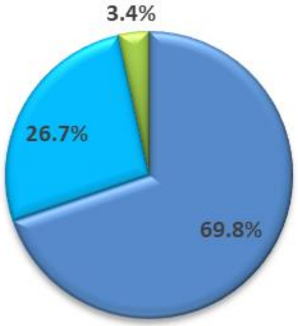
Nicholson River

Very High
High
Medium
Low
Very Low

</td><td>



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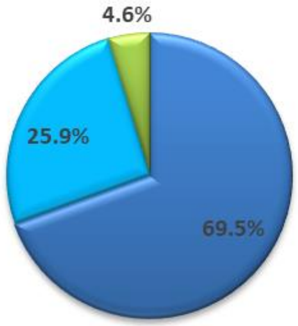

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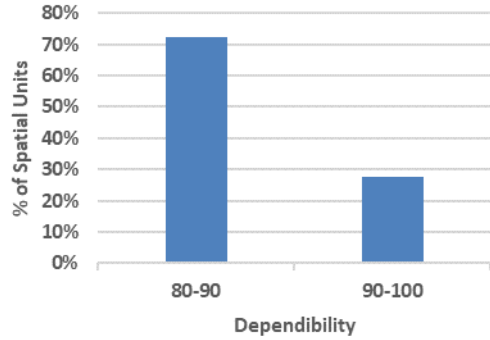

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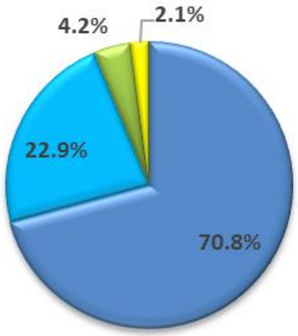
<tr><td>

Settlement Creek

Very High
High
Medium
Low
Very Low

</td><td>



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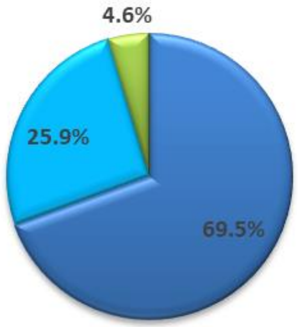

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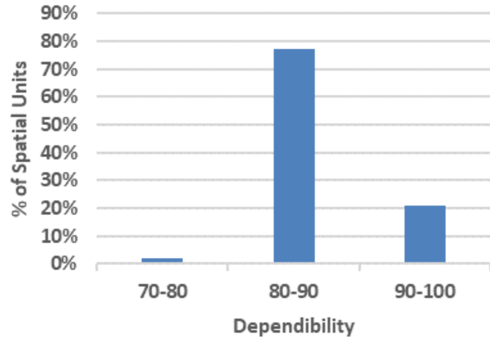

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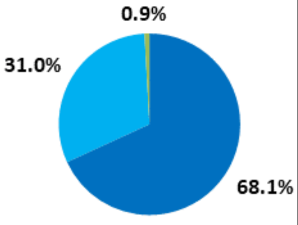
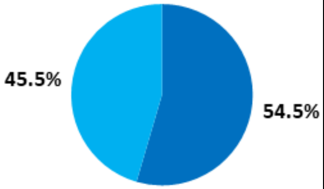
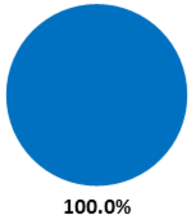
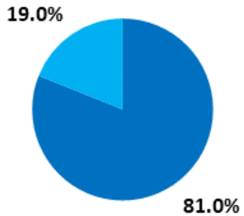
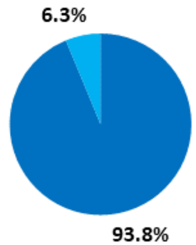
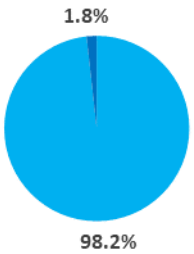
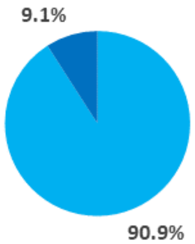
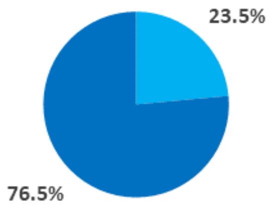
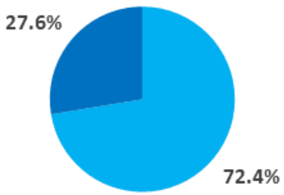
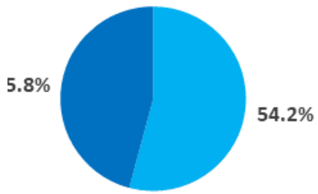
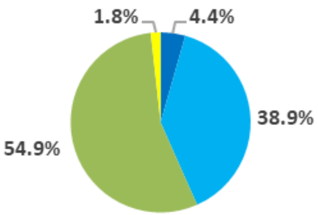
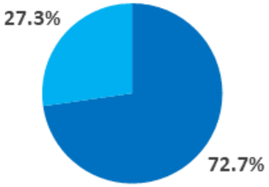
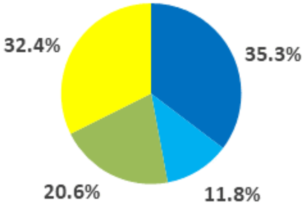
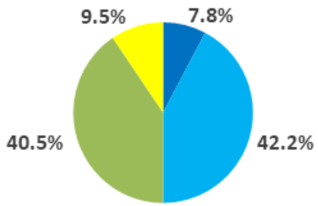
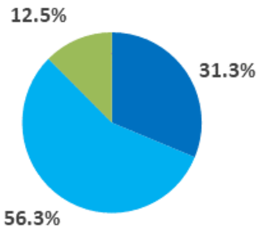
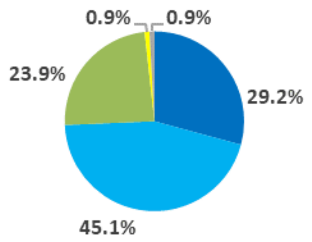
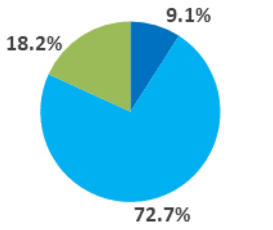
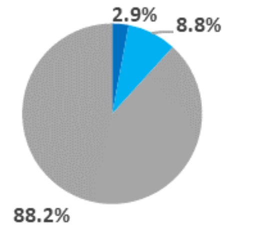
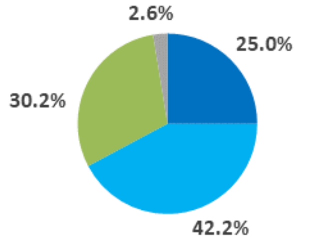
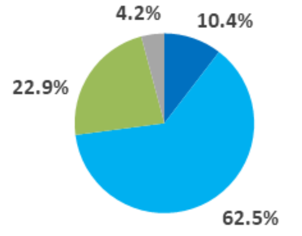
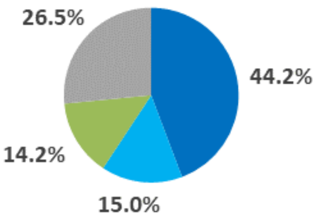
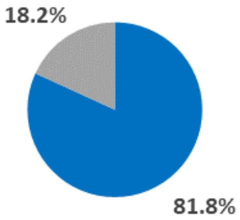
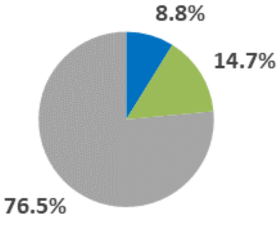
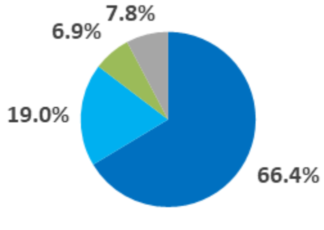
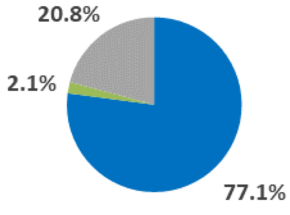
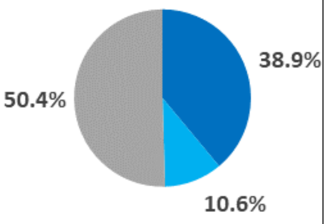
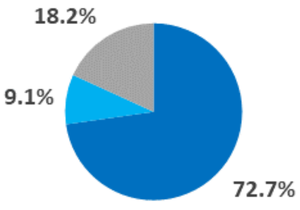
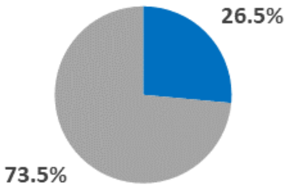
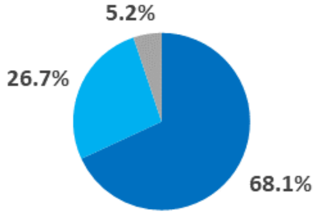
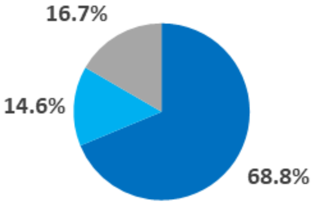
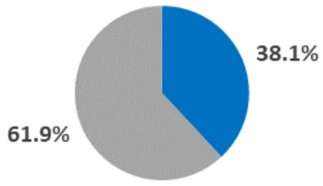
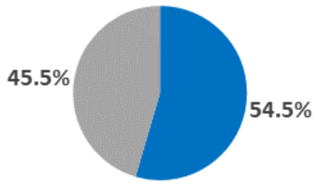
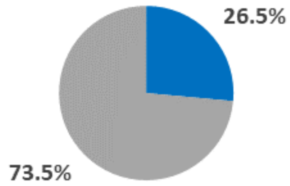
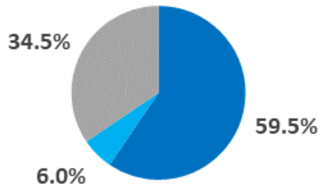
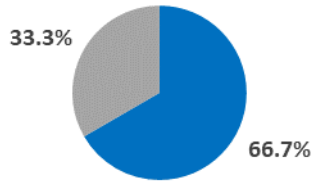
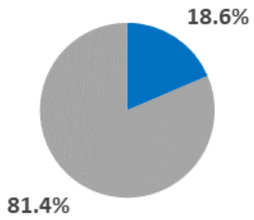
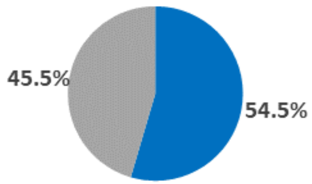
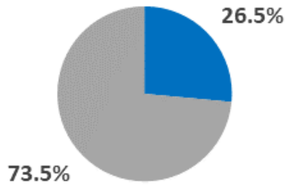
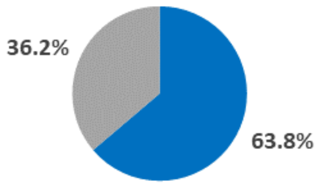
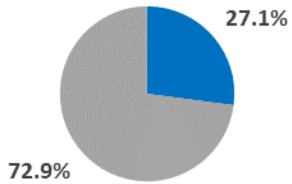
3.2.2 Riverine Criteria scores

Table 4. Riverine spatial unit criterion ratings by study area

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 1 Very High High Medium Low No data					
Criterion 2 Very High High Medium Low No data					
Criterion 3 Very High High Medium Low No data					

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 4 Very High High Medium Low No data					
Criterion 5 Very High High Medium Low No data					
Criterion 6 Very High High Medium Low No data					

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 7 Very High High Medium Low No data					
Criterion 8 Very High High Medium Low No data					

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3.3 Non-riverine results

Aquatic Conservation Assessments were conducted for the non-riverine spatial units within each study area. Figure 5 contains a map of the non-riverine AquaScores, AquaScore dependability and criterion ratings for each non-riverine spatial unit. Table 5. Non-riverine spatial unit AquaScore and Dependability summary statistics by study area. and Table 6. Non-Riverine spatial unit criterion ratings by study area provide a summary of the non-riverine AquaScores, dependability scores and criterion ratings by study area.

AquaScores

Non-riverine AquaScores were predominantly Very High or High across all study areas. In fact, over two thirds (67.7%: 2,996/4,225) of non-riverine spatial units received and AquaScore of Very High, and a further 16.7% (738/4,425) received an AquaScore of High. Together, Very High and High AquaScores accounted for 84.3% of all non-riverine spatial units. Both the Mornington Island (94.7%: 126/133) and Leichhardt River (81.3%: 1,358/1,671) study areas had particularly high percentages of spatialunits with Very High AquaScores. A further 14.2% (630/4,425) of all non-riverine spatial units received an AquaScore of Medium, while just under 1% (44/4,425) received an AquaScore of Low. Only 0.4% (17/4,425) of non-riverine spatial units received an AquaScore of Very Low.

Non-riverine AquaScores in the Leichhardt River and Nicholson River study areas ranged from Very High to Very Low. The Settlement Creek study area had AquaScores ranging from Very High to Low, while in the Morning Inlet study area AquaScores ranged from Very High to Medium. AquaScores in the Mornington Island study area were either Very High or High. AquaScores of Very High dominated all study areas (e.g. Leichhardt River (81.2%: 1,358/1,671), Morning Inlet (52.4%: 119/227), Mornington Island (94.7%: 126/133), Nicholson River (65.6%: 768/1,176) and Settlement Creek (51.1%: 625/1,123). Only the Leichhardt River (0.9%: 15/1,671) and Nicholson River (0.2%: 2/1,171) study areas had spatial units with an AquaScore of Very Low, and the total number of spatialunits with Very Low in each of these study areas was low. Very Low AquaScores were triggered by filter table decision 28 which applies when the number of criteria with Low or No data ratings is greater than or equal to four.

AquaBAMM filter table decisions

The top 3 filter table decisions triggered were decisions 27 (42.7%), 5 (20.8%) and 8 (12.1%). Together, these decisions accounted for 75.6% (3,345/4/425) of all non-riverine spatial units. The most frequently triggered decision was decision 27 which indicates high levels of aquatic naturalness (i.e. Criterion 1) in combination with at least three other criteria with Very High ratings. Decision 5 reflects the high number of spatial units identified by experts as containing one or more special features (i.e. Criterion 6). For example, 63.7% (2,730/4,425) of spatial units were identified by experts at the flora, fauna or ecology expert panel workshops as containing one or more special features of Very High conservation value. A further 1.4% (63.4,425) spatial units were identified as having one or more special features of High value.

Dependability

Non-riverine dependability scores were high across all study areas. In fact, all non-riverine spatial units had had dependability scores >= 0.77. This means all non-riverine spatial units had data for at least 40 of the 52 non-riverine measures used. In fact, most spatial units (97.5%: 4,314/4,425) had dependability scores between 0.8 to 0.9 signifying AquaScores with high dependability.

Criterion 1 - Aquatic Naturalness

Criterion 1 (Aquatic Naturalness) non-riverine ratings were high across all study areas with more than 90% of spatial units in each study area receiving a Criterion 1 rating of Very High. For the Southern Gulf Catchments assessments this result reflects the low degree to which exotic fish, exotic aquatic invertebrates and aquatic and semi-aquatic exotic plants are impacting wetlands, in combination with low level of wetland hydrological modification, and high levels of remnant wetland vegetation relative to pre-clearing extent.

Criterion 2 - Catchment Naturalness

Criterion 2 (Catchment Naturalness) non-riverine ratings ranged from Very High to Medium in the Leichhardt River and Morning Inlet study areas, and Very High to High in the Nicholson River and Settlement Creek study areas. Criterion 2 ratings were predominantly High in the Leichhardt River (99.5%: 1,162/1,671), Morning Inlet (89.4%: 203/227) and Nicholson River (61.9%: 725/1,171) study, areas, and Very High in the Settlement Creek (62.4%: 763/1,223) study area. All Mornington Island (100%: 133/133) non-riverine spatial units received a Criterion 2 rating of Very High. For the Southern Gulf Catchments assessments, Very High and High Criterion 2 ratings reflect low levels of overland flow harvesting, low levels of intensive land use such as cropping, intensive horticulture or high density urban centres, and high levels of remnant vegetation relative to preclearing extent in area surrounding each non-riverine spatial units.

Criterion 3 - Diversity and Richness

Criterion 3 (Diversity and Richness) non-riverine ratings ranged from Very High to Medium across the Leichhardt River, Mornington Island and Settlement Creek study areas. Criterion 3 non-riverine ratings in the Nicholson River ranged predominantly from Very High to Medium, with a small number of spatial units (0.3%: 4/1,171) receiving a Criterion 3 rating or Low. Criterion 3 ratings of Very High dominated the Morning Inlet (100%: 227/227), Mornington Island (84.2%: 112/133) and Settlement Creek (69.6%: 851/1,123) study areas, while Criterion 3 ratings of High dominated the Leichhardt River (52.8%: 883/1,671) and Nicholson River (46.2%: 541/1,171) study areas. In fact, for the Southern Gulf Catchments assessments over 75% (3,796/4,425) of all non-riverine spatial units assessed had Criterion 3 ratings of Very High or High reflecting high levels of aquatic species diversity and high richness of non-riverine wetland types.

Criterion 4 - Threatened Species and Ecosystems

Criterion 4 (Threatened Species and Ecosystems) non-riverine ratings ranged from Very High to Low in the Leichhardt River, Morning Inlet, Nicholson River and Settlement Creek study areas, and from High to Medium in the Morning Island study area, but were predominantly High or Medium across all study areas (i.e. Leichhardt River (High: 81.3%; 1,359/1,671), Morning Inlet (High: 54.6%: 124/227), Mornington Island (Medium: 74.4%: 99/133), Nicholson River (Medium: 56.5%; 662/1,171), Settlement Creek (Medium: 62.7%; 767/1,223)). The Leichhardt River, Morning Inlet, Nicholson River and Settlement Creek study areas all had low percentages of non-riverine spatial units with Criterion 4 ratings of Low. Similar to the riverine assessments there was only a handful of non-riverine sightings records within the study areas resulting in most non-riverine spatial units receiving a score of No Data for measure 4.1.1 (Rare or threatened fauna). For example, only 181 or the 4,425 non-riverine spatial units had one or more sighting records for rare or threatened fauna species (i.e. measure 4.1.1) and there were no sightings records for rare or threatened flora (i.e. measure 4.1.2) species. Low numbers of sighting records meant that Measure 4.2.1 (Biodiversity status of the dominant wetland regional ecosystem) drove the Criterion 4 results. The Queensland Herbarium biodiversity status of wetland regional ecosystems in the Leichhardt River and Morning Inlet study areas were predominantly 'Of concern', while wetland regional ecosystems in the Mornington Island, Nicholson River and Settlement Creek study areas were predominantly 'Not concern at present/Least concern'. There were no EPBC listed ecological communities mapped within the southern Gulf catchments study areas.

Criterion 5 - Priority Species and Ecosystems

Criterion 5 (Priority Species and Ecosystems) non-riverine ratings ranged from Very High to Medium across the Leichhardt River, Nicholson River and Settlement Creek study areas. Morning Inlet Criterion 5 ratings were either Very High or Medium, while Mornington Island Criterion 5 ratings ranged from Very High to High. High percentages of non-riverine spatialunits in the Leichhardt River (57%: 953/1,671), Morning Inlet (35.7%: 81/227), Nicholson River (59.4%: 696/1,171) and Settlement Creek (67.4%: 824/1,223) study areas had No Data or no values for Criterion 5. Similar to the Criterion 4, many spatial units across most study areas had no data for the Criterion 5 species measures (i.e. 5.1.1, 5.1.2, 5.1.3). Mornington Island and Morning Inlet were the exception, but this reflects, in part, the low number of non-riverine spatial units within these study areas. As a result, Criterion 5 non-riverine ratings were driven mainly by measures 5.1.4 (Significant Waterbird Habitat Areas) and 5.2.1 (Priority Ecosystems). Measure 5.1.4 and 5.2.1 were both expert elicited and all non-riverine spatial units flagged by the expert panel were given a measure score of 4 (i.e. Very High) or 3 (i.e. High). In total, the experts identified 29.2% (1,291/4,425) of non-riverine spatial units as containing significant bird habitat areas (i.e. Measure 5.1.4) and 15% (664/4,425) of non-riverine spatial units as containing priority ecosystems (i.e. Measure 5.2.1).

Criterion 6 - Special Features

Criterion 6 (Special Features) non-riverine ratings in the Leichhardt River, Morning Inlet and Mornington Island study areas were all Very High or No Data. In fact, most non-riverine spatial units in the Mornington Island (94.7%: 126/133) and Leichhardt River (80.9%: 1,352/1,671) study areas received a Very High rating for Criterion 6. Non-riverine spatial units in the Nicholson River and Settlement Creek study areas received Criterion 6 ratings of Very High or No Data, but the dominant Criterion 6 rating for the Nicholson River (54.1%: 633/1,171) was also Very High. Criterion 6 non-riverine ratings of No Data dominated the Settlement Creek (58.5%: 715/1,223) study area. High percentages of non-riverine spatial units in the Morning Inlet (49.3%: 112/227), Nicholson River (40.9%: 479/1,171) and Settlement Creek (58.5%: 715/1,223) study areas also received had No Data for Criterion 6. With the exception of Measure 6.3.2 (Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Area, etc.) all Criterion 6 non-riverine measures were expert panel derived. 63.1% (3,292/4,425) of all non-riverine spatial units assessed had one or more Criterion 6 special features identified as part of the expert panel process. Notable special features in Leichhardt River, Morning Inlet, Mornington Island Nicholson River and Settlement Creek study areas due to the area triggered include: Seasonal wooded swamps dominated by Eucalyptus microtheca (180km^2: lr_nr_fl_15, mi_nr_fl_15, nr_nr_fl_15); Alexandra River floodplain aggregation (non-riverine component) (122km^2: lr_nr_ec_02);

Semi-perennial channel supplied palustrine wetland complexes on the Gulf Plains in the lower Gregory River subcatchment (104km^2: nr_nr_ec_10).

Criterion 7 - Connectivity

Criterion 7 (Connectivity) non-riverine ratings displayed a similar trend to Criterion 6. For example, Criterion 7 (Connectivity) non-riverine ratings in the Leichhardt River (Very High: 68.5%; 1,145/1,671) and Mornington Island (Very High: 94.7%; 126/133) study areas were predominantly Very High. Morning Inlet and Settlement Creek both also had non-riverine spatial units with Criterion 7 ratings of Very High but were dominated by Criterion 7 ratings of No Data (Morning Inlet (81.9%: 186/227); Settlement Creek (71%%: 868/1,223)). Non-riverine spatial units in the Nicholson River study area received Criterion 7 ratings of Very High and High but was dominated by Criterion 7 ratings of No Data (72%: 843/1,171). No data for Criterion 7 indicates no connectivity values were identified as part of the expert panel process.

Criterion 8 - Representativeness

Apart from Mornington Island, all study areas displayed a reasonable spread of Criterion 8 (Representativeness) non-riverine ratings however the dominant Criterion 8 rating across all study areas was Very High or High. For example, Criterion 8 non-riverine ratings of Very High dominated the Nicholson River (63.2%: 740/1,171) and Morning Inlet (42.7%: 97/227) study areas, while Criterion 8 ratings of High dominated the Leichhardt River (43.6%: 729/1.671), Mornington Island (66.2%: 88/227) and Settlement Creek (43.4%: 531/1,223) study areas. Mornington Island Criterion 8 ratings were all Very High (33.8%: 45/133) or High (66.2%: 88/133).

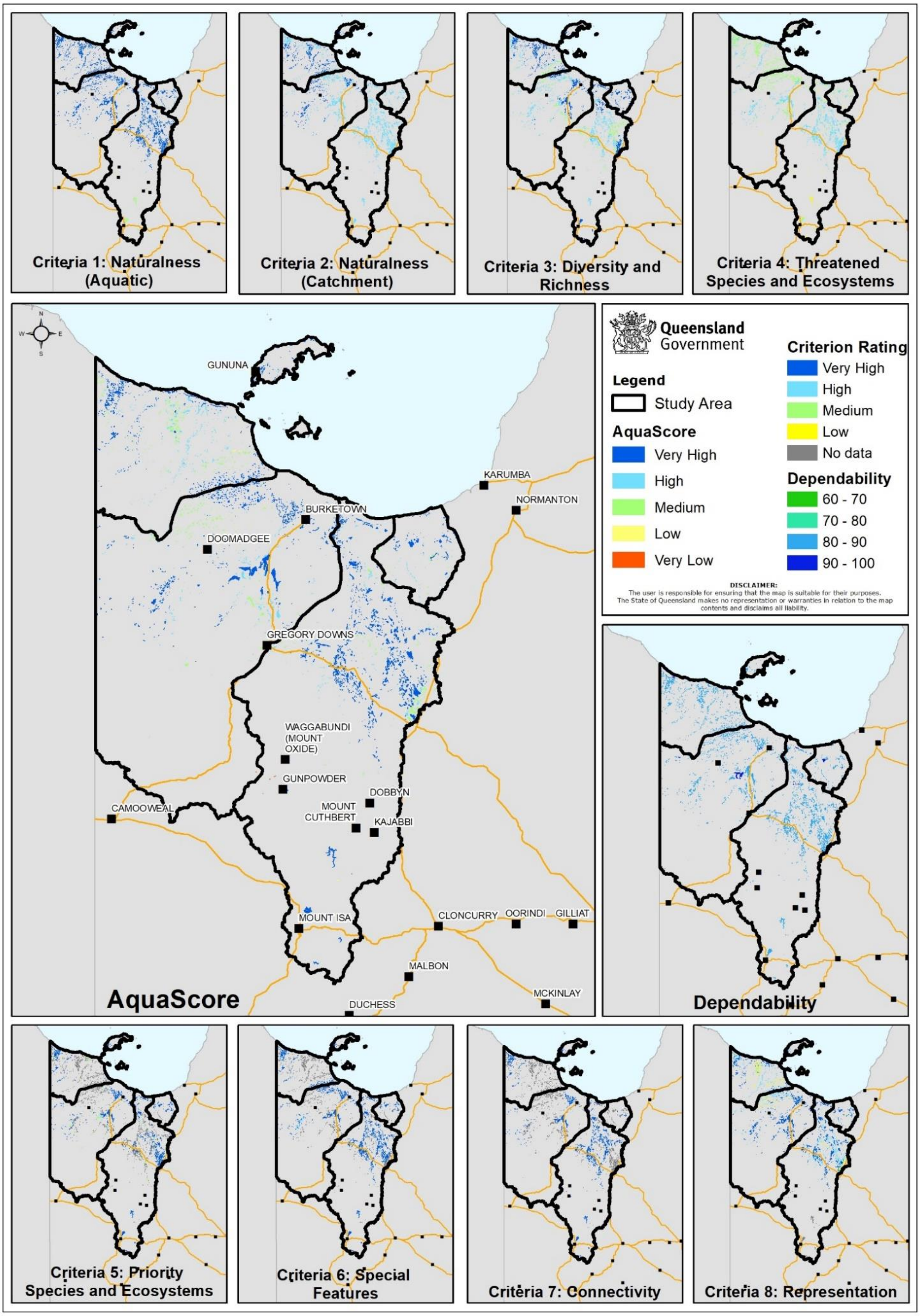

Figure 5. AquaScore, Dependability and Criterion rating by non-riverine spatial unit.

3.3.1 **AquaScore**

Table 5. Non-riverine spatial unit AquaScore and Dependability summary statistics by study area.

<table>
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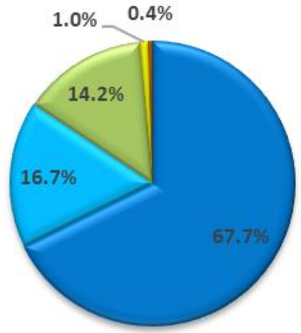
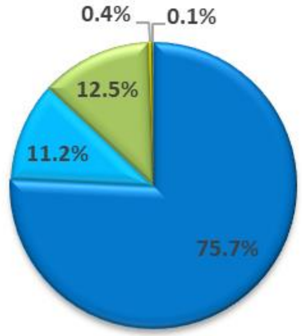
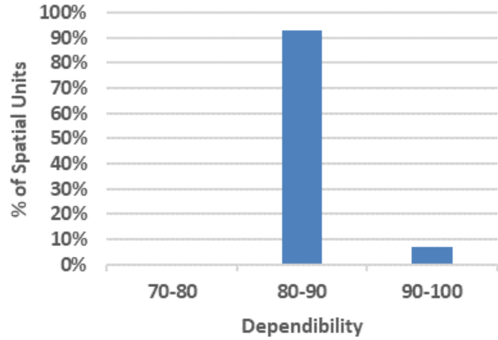
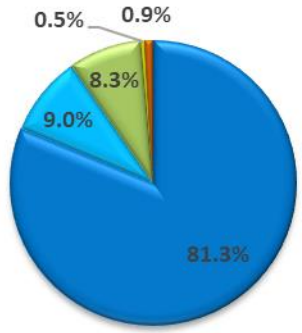
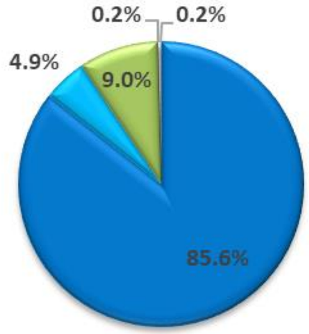
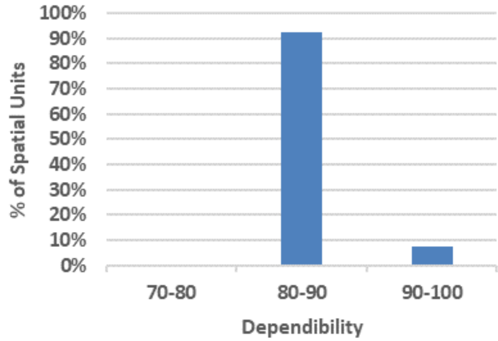
Medium
Low
Very Low</td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Leichhardt River
Very High
High
Medium
Low
Very Low</td><td>
</td><td>
</td><td>
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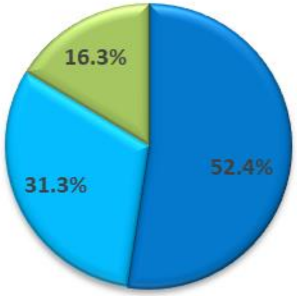
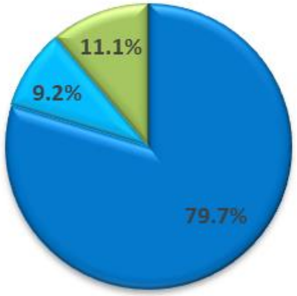
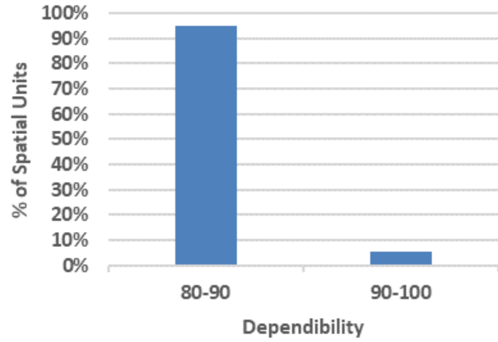
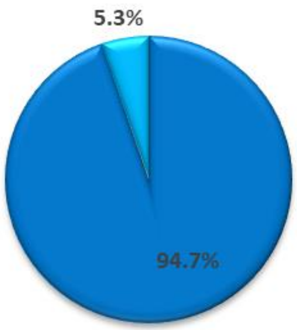
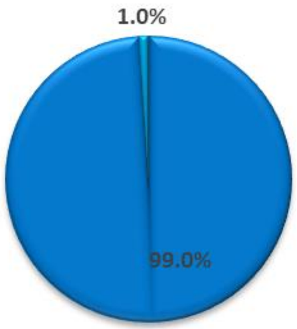
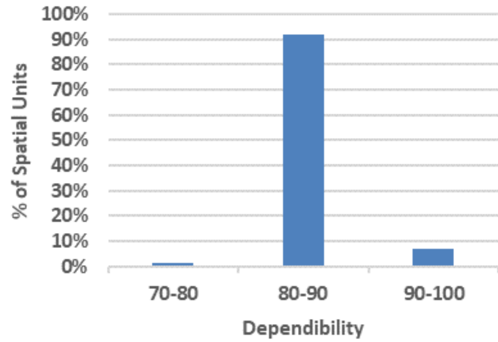
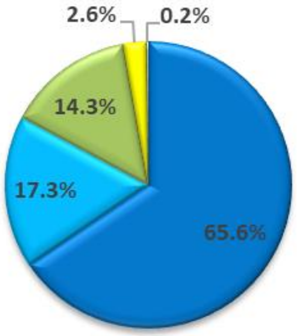
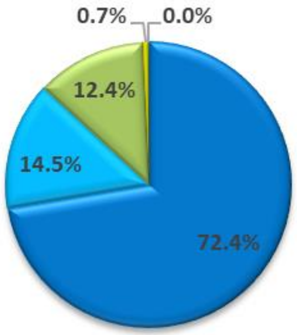
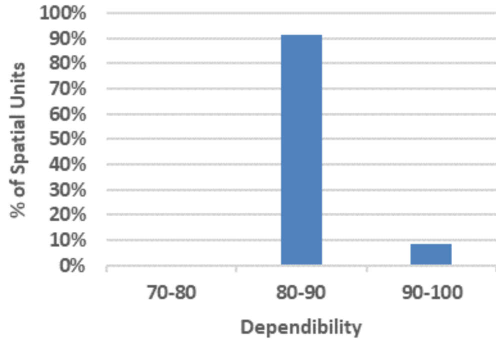
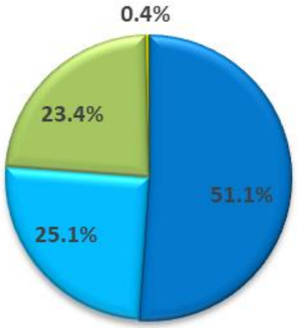
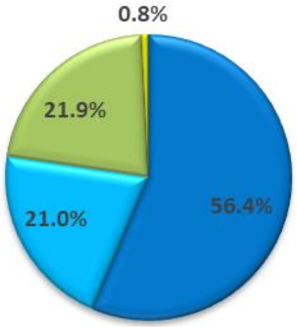
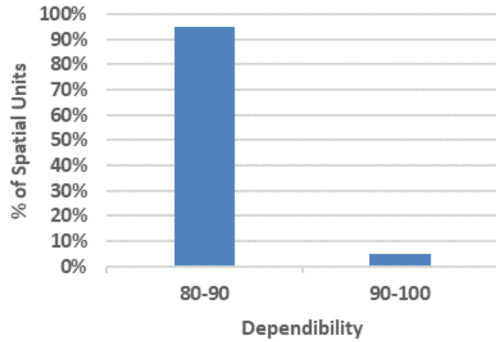
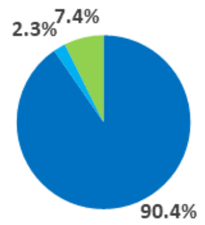
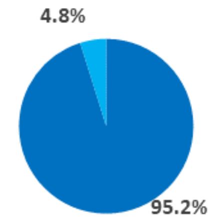
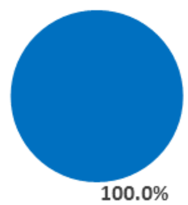
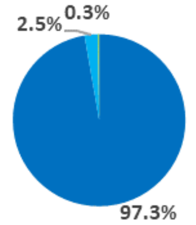
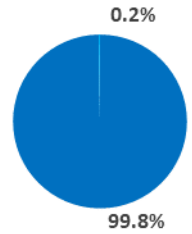
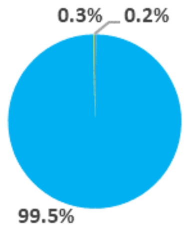
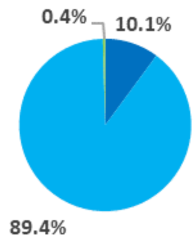
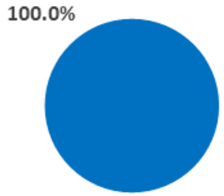
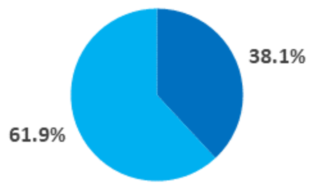
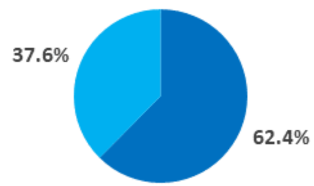
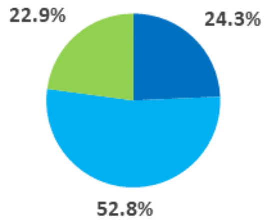
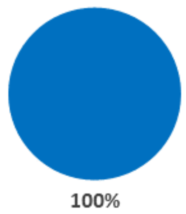
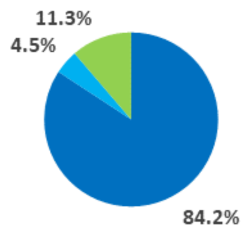
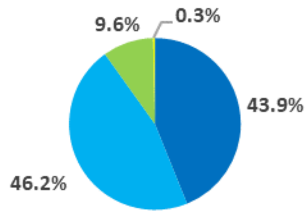
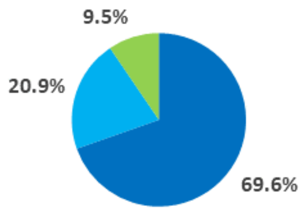
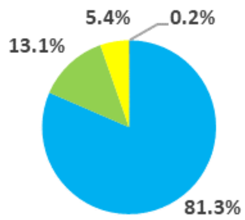
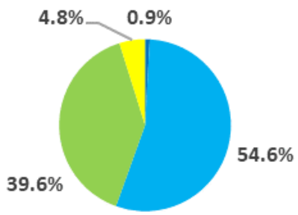
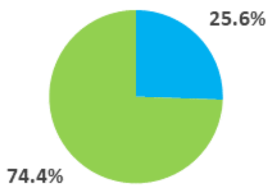
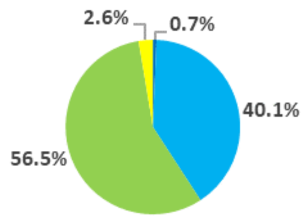
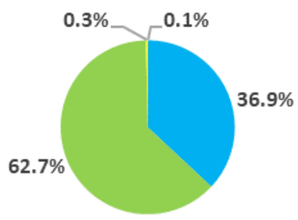
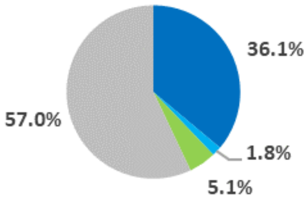
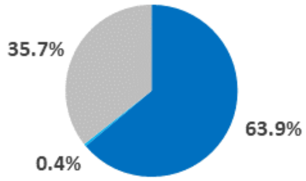
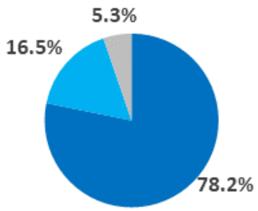
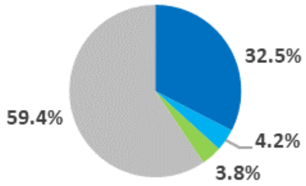
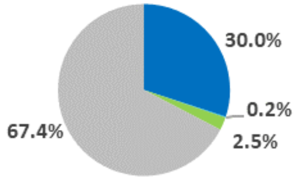
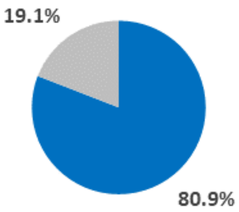
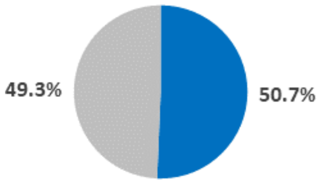
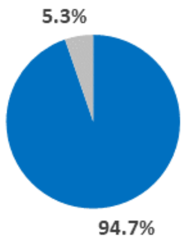
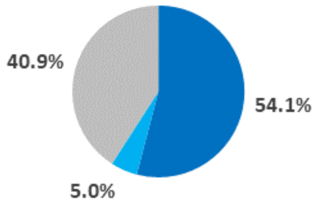
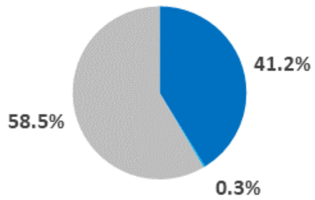
Catchment	AquaScore by % of spatial units	AquaScore by % of total area of spatial units	AquaScore dependability
Morning Inlet Very High High Medium Low Very Low			
Mornington Island Very High High Medium Low Very Low			

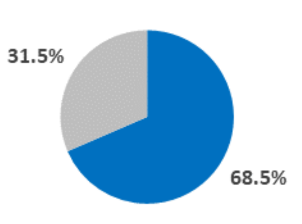
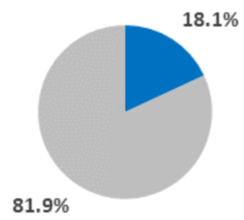
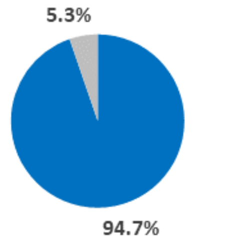
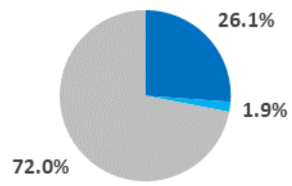
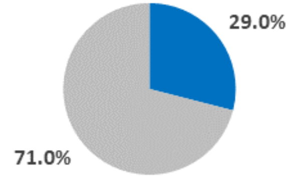
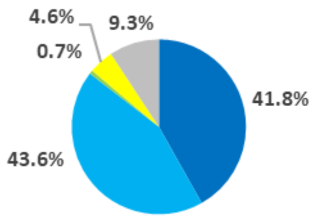
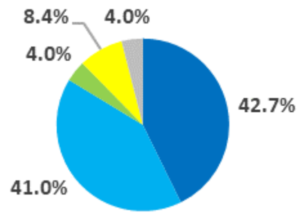
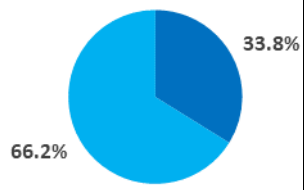
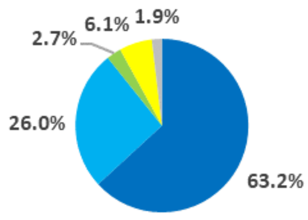
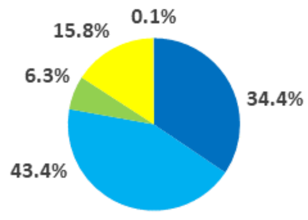
Catchment	AquaScore by % of spatial units	AquaScore by % of total area of spatial units	AquaScore dependability
Nicholson River Very High High Medium Low Very Low			
Settlement Creek Very High High Medium Low Very Low			

3.3.2 Criteria ratings

Table 6. Non-Riverine spatial unit criterion ratings by study area

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 1 Very High High Medium Low No data					
Criterion 2 Very High High Medium Low No data					
Criterion 3 Very High High Medium Low No data					

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 4 Very High High Medium Low No data					
Criterion 5 Very High High Medium Low No data					
Criterion 6 Very High High Medium Low No data					

Criteria	Leichhardt River	Morning Inlet	Mornington Island	Nicholson River	Settlement Creek
Criterion 7 Very High High Medium Low No data					
Criterion 8 Very High High Medium Low No data					

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3.4 Field validation

Field validation is important to identify potential anomalies in assessment results or data implementation. Field-truthing is a critical step in any Aquatic Conservation Assessment and it precedes method adjustments and corrections prior to a final run of the AquaBAMM assessment tool.

Covid-19 travel restrictions interfered with the field validation and so no field validation was carried out. Recommendations stemming from the field validation carried out for the Eastern Gulf of Carpentaria Aquatic Conservation Assessments were reviewed for the Southern Gulf Catchments Assessments.

3.4.1 Field interpretation of Aquatic Conservation Assessment results–ecological versus condition assessment

When visually assessing the assessment results there is a strong tendency for observations to be made from a ‘condition’ or 'naturalness' perspective. Wetland ‘condition’ or ‘health’ has been a major focus of aquatic assessment in Australia (such as the nationally agreed protocol of Monitoring River Health Initiative, Index of Stream Condition, Queensland State of the Rivers) (Dunn 2000). However, several authors make a clear distinction between ‘river health’ and ‘ecological value’ of a river (Dunn 2000; Bennett et al. 2002; Chessman 2002). Wetland health data may inform assessment of ‘value’, and usually does so where data are available, but is not interchangeable with it and the two are not necessarily correlated.

Aquatic Conservation Assessments are primarily focussed on aquatic ecological or conservation value, such that the condition contributes to, but does not solely determine its value. Of the measures used in these assessments, usually less than 10 per cent are related to aquatic, riparian and/or catchment condition. Consequently, when in the field, the successful interpretation of a spatial unit’s conservation value is reliant on the observer viewing ‘condition’ in combination with the other values (seen or unseen).

3.4.2 Field validation principles

Field inspection of the draft Aquatic Conservation Assessment results is important to test the validity of the implementation method. In general, the field validation will:

- Inspect spatial units across the range of values from Very Low to Very High. There is usually a focus on spatial units with Very Low, Low and Very High values as these are considered to have the most influence to reduce the potential of a false negative (type I error) or a false positive (type II error) result.
- Ascertain from observation, whether the implementation of Criterion 1 and Criterion 2 needs any adjustment with respect to Measure weights and Indicator ranks. Some Measures or Indicators may have an overpowering influence which is not consistent with observation e.g. influence of dams or weirs. This may be due to limitations and availability of relevant base datasets.
- Ascertain whether the size of subsections is adequate to discern variability in criteria (1 and 2) scores or whether values are extrapolated too far an area.
- For non-riverine wetlands inspected, ascertain if the criteria values and AquaScore ascribed are logical as determined by implementation methodology.
- Inspect wetlands with different levels of hydro-modification (i.e. H1, H2M1, H3C1 etc.)
- Check where scores or ratings differ markedly between adjacent wetlands.

4 Discussion

Results from the Southern Gulf Catchments Aquatic Conservations Assessments indicate high proportions of wetlands with high or very high aquatic conservation values within the Southern Gulf Catchments study areas. For the non-riverine assessments these results can be attributed to high levels of aquatic naturalness (Criterion 1), low levels of intensive landuse (Criterion 2.3), high species diversity and habitat richness (Criterion 3.1 and 3.3), and high numbers of non-riverine wetlands with special features (Criterion 6) or connectivity values (Criterion 7). For the riverine assessments these results can be attributed to high levels of aquatic naturalness (Criterion 1) in combination with high or very high values for three or more other AquaBAMM Criteria, or high numbers of priority species or ecosystems including areas of significant bird habitat (Criterion 5). Exotic vertebrates, riparian weeds, grazing on natural pastures and climate change were identified at the expert panel workshops as the main hazards affecting aquatic ecosystems in the region. No exotic fish, exotic invertebrates, aquatic or semi-aquatic exotic plants were considered by the experts as significant enough in the study areas to warrant inclusion as hazards to aquatic naturalness (Criterion 1).

Relative to other Aquatic Conservation Assessments, dependability scores were high for all spatial units across all study areas. An important factor contributing to this was the use of NAWFA TRaCK (Northern Australia Water Futures Assessment Tropical Rivers and Coastal Knowledge) fish, water bird and turtle habitat models in Criterion 3. The use of habitat models for rare or threatened (i.e. EVNT (Endangered, Vulnerable and Near Threatened)) species measures in Criterion 4 would further increase dependability scores. The lowest dependability scores were for spatial units in the Mornington Island (Wellesley Island group) study area highlighting limited survey effort and published literature for that region. Furthermore, experts noted that the Queensland Wetland Mapping currently misses important wetland ecosystems, including ground water dependent ecosystems on Mornington Island and in the Nicholson Catchment, which are described in the expert panel report.

Gridded pest distribution (species occurrence) maps produced by Biosecurity Queensland (Department of Agriculture and Fisheries) were used for Indicators 1.1 and 2.1. Biosecurity Queensland also produce distribution (i.e. degree of infestation) and density (i.e. abundance) maps, however these were not used for the Southern Gulf assessments because they have a lower level of accuracy than the occurrence maps. At 16.67km, the occurrence maps are also quite course. Higher resolution exotic species occurrence maps, in combination with more accurate distribution and density maps, would benefit Aquatic Conservation Assessments by increasing the accuracy of Criterion 1 and 2 results.

Another important issue to note was the lack of data for key measures, particularly from Criterion 1 and 2. For example, data on macroinvertebrates was sparse for the region meaning the Criterion 3 richness of macroinvertebrates measure could not be used. Some Aquatic Conservation Assessments have used maximum richness scores derived from higher-level macroinvertebrates studies undertaken using recognised survey and analysis methods (e.g. such as those used by Conrick & Cockayne 2000, Chessman 2003, and Healthy Waterways 2012). These methods estimate macroinvertebrate diversity at the broad taxonomic group level (e.g. sub-family, family, order or class) and can provide suitable representations of macroinvertebrate richness. The availability of this type of data for the Southern Gulf Catchments study areas would help improve the Criterion 3 results.

Data from the State of the Rivers program, which featured heavily in early Aquatic Conservation Assessments, was also unavailable for the Southern Gulf Catchments. Data collection for this program ceased in the early 2000's and is incomplete for the state. Similarly, consistent and up-to-date flow data (i.e. Integrated Quality Quantify Modelling) is also incomplete or dated for the Southern Gulf Catchments study areas. To try and deal with issues of data availability, the AquaBAMM project team are developing a new implementation for Criterion 1 and 2. This new implementation aims to use more current datasets and datasets that cover the entire state. Our aim is to incorporate this new implementation into future Aquatic Conservation Assessments.

Another important point to mention is that non-riverine wetlands below the scale (i.e. 1:100,000) or minimum polygon threshold size (i.e. 1 Ha) of the Queensland Wetlands Mapping were not been assessed as part of the Southern Gulf Catchments assessments. For example, Aquatic Conservation Assessments derive the non-riverine spatial units from Queensland Wetland Mapping wetland area features which are sourced from classified Landsat 5 TM (Thematic Mapper) or 7 ETM+ (Enhanced Thematic Mapper Plus) satellite imagery, digital topographic data (GEODATA TOPO 250K Series), and Queensland Herbarium regional ecosystem mapping. Wetlands below the mapping scale of these products are not present in the Queensland Wetland Mapping data. Furthermore, Aquatic Conservation Assessments only include non-riverine wetland area features from the Queensland Wetland where palustrine or lacustrine wetlands are dominant, or the sum of subdominant palustrine or lacustrine wetland regional ecosystem area is >50%. Therefore, non-riverine wetlands with an area below the mapping scale of the Queensland Wetland Mapping or which occupy less than <=50% of a heterogenous wetland regional ecosystem polygon were not assessed as part of the Southern Gulf Catchments assessments. Finer scale mapping of non-riverine wetlands would allow more precise delineation of wetland conservation values particularly special features and connectivity values.

Riverine waterbodies, such instream rock holes, are also often well below the minimum mapping scale of the Queensland Wetland Mapping. Furthermore, the linear nature of many riverine wetlands means they are commonly included as subdominant wetland regional ecosystems within much larger regional ecosystem polygons. Both of these factors result in riverine wetland areas generally not being as well represented in the Queensland Wetland Mapping as their non-riverine counterparts. To deal with this, riverine Aquatic Conservation Assessments use fine-scale riverine catchments for their spatial units. These fine-scale catchments are used to represent specific stream reaches, or groups of reaches, and are synonymous with State of the Rivers subsections or fine-scale subcatchments of the Australian Hydrological Geospatial Fabric (Geofabric). The implications of this from and an Aquatic Conservation Assessment perspective are two-fold. Firstly, riverine conservation values calculated as part of an Aquatic Conservation Assessment generally only apply to the watercourses within each riverine spatial unit. Secondly, riverine special features may only apply to specific reaches, sections of reaches, or discrete locations (e.g. waterholes) within a riverine spatial unit. Where possible, descriptions of the precise location and extent of riverine special features have been included with the riverine special feature values descriptions and this information can be used to aid interpretation. Finer scale riverine wetland area mapping similar to the non-riverine wetlands would allow more precise delineation of riverine conservation values particular special features and connectivity values.

While running the Southern Gulf Catchments assessments we also noticed a number of attribute issues (mainly in the Leichhardt River study area) resulting from the Queensland Herbarium's transitioning to an updated set of hydromodification (i.e. HYDROMOD) attributes in the Queensland Wetland Mapping data. All of the issues encountered related to the "H2M1" hydromodification class and resulted in several wetland complexes being made up of multiple parts including one larger parent feature with a HYDROMOD of "H2M1a" surrounded by one or more smaller feature parts with a HYDROMOD of "H2M1". This issue led to seven non-riverine wetland complexes being made up of multiple non-riverine spatial units each of which received a different AquaScore in our early runs of the AquaBAMM database tool. One way to fix this would have been to combine (i.e. dissolve) the affected wetland features when building the non-riverine spatial units. However, we try and avoid changing the underlying Queensland Wetland Mapping. Instead, a fix was applied by adjusting the measure results for all affected spatial units. For example, the measure results of all child H2M1 features surrounding the seven parent H2M1a features were modified to reflect the parent H2M1a. The seven parent wetland features affected included Lake Moondara, Lake May Kathleen, Waggaboonya Lake (at or about 139.38965, 19.69339), a small lake near Desert Creek in the Nicholson River (at or about 139.2730, -19.62115 near Waggaboonya Lake), a dam on Spring Creek (at or about 139.6749889, -19.519658), Manooka Dam (at or about 139.996279, -18.101083) and a small dam near One Mile Creek at or about 139.6749899, -19.519658).

The Southern Gulf Catchments coastal zone included systems dominated by estuarine processes. Estuarine wetlands were not assessed as part of this project and the results presented in this report are only relevant to the freshwater riverine and non-riverine wetlands within the coastal zone. Finer scale hydrological (subsection) modelling will be required before undertaking estuarine assessments and this type of modelling is hindered by the availability of high-resolution digital evaluation models suitable for detecting small gradients in elevation typical of coastal zone. Finally, significant breaks in slope (i.e. waterfalls) that cause rapid changes in watercourse height should be incorporated in the boundaries of riverine spatial units as this will help to better reflect functional boundaries (Pers. Comms. J. Tait).

5 Constraints and Caveats

The following constraints and caveats should be considered when interpreting the results:

- A general lack of survey data for the region.
- A general lack of knowledge of the ecology especially wetlands associated with the Wellesley Island group.
- Bias in species point records due to the difficulty of collection in remote areas.
- Small non-riverine wetlands below the scale of the source Wetland Mapping have not have been assessed.
- The end user should use terrestrial (BPA) and aquatic (ACA) assessments in conjunction to obtain comprehensive information and analysis of biodiversity values.
- There were some limitations in engaging with experts due to time constraints and the availability of experts.
- The size of the riverine spatial units can influence species counts.
- Riverine conservation values presented here generally only relate to the watercourses within each riverine spatial unit.
- Certain conservation values, such as special features and connectivity values may only apply to specific locations (e.g instream waterholes) or reaches within each riverine spatial unit.

Another constraint is the issue of AquaScores being driven by high scoring measures within criterion containing few measures. This was identified as part of an independent sensitivity analysis (Robinson & Lee 2009) and is a known limitation of the AquaBAMM.

6 Recommendations

Aquatic Conservation Assessment results have a wide range of applications. Well-founded ecological or conservation values for aquatic ecosystems are a useful input to natural resource management and regulatory decision-making processes including, for example, regional planning, development assessment, and tenure negotiations such as those related to protected area estates. In addition to the overall AquaScore, individual criteria, indicators and measures from each assessment may be used for management and planning purposes.

At its most basic level this product is an inventory of the ecological values associated with individual wetlands. It is not undertaken with any special considerations of policy or legislation. It is up to the end user to carefully gauge suitability for their intended purpose, giving due diligence to the caveats and constraints discussed above.

The improvement of data inputs to this type of assessment is ongoing. Input data, especially for remote areas such as the Southern Gulf Catchments region, is often sparse, dated or limited in spatial extent. The use of incomplete data is unavoidable in an ecological assessment of this size and nature. Specific examples of where future data enhancements could improve the quality of output of this type of assessment include:

- the use of species habitat models for Criterion 4 threatened species and Criterion 5 priority species measures.
- integration of a new method for calculating aquatic and catchment naturalness (i.e. Criterion 1 and 2) as the current implementation is limited by data availability.
- finer scale mapping of both riverine and non-riverine wetlands, particularly in the Wellesley Islands, Nicholson River, and Morning Inlet catchments, would allow more precise delineation of wetland conservation values particularly special features and connectivity values.
- finalisation of the transitioning of all Queensland Wetland Mapping Area features, particularly features within the H2M1 class, to Queensland Herbarium's new hydromodification classes.
- the incorporation of significant breaks in slope (i.e. waterfalls) into riverine spatial unit boundaries as this will help to reflect functional boundaries.

7 References

Bamford, M, Watkins, D, Bancroft, W, Tischler, G, Wahl, J 2008, *Migratory shorebirds of the East Asian — Australasian flyway: population estimates and internationally important sites*, Wetlands International — Oceania, Canberra.

Bayliss, P, Buckworth, R, Dichmont, C (eds) 2014, *Assessing the water needs of fisheries and ecological values in the Gulf of Carpentaria,* Final report prepared for the Queensland Department of Natural Resources and Mines (DNRM), CSIRO, Australia.

Bennett, J, Sanders N, Moulton, D, Phillips, N, Luckacs, G, Walker, K and Redfern, F 2002, Guidelines for Protecting Australian Waterways, Land and Water Australia, Canberra.

Blackman, JG, Perry, TW, Ford, GI, Craven, SA, Gardiner, SJ, De Lai, RJ 1999, *Characteristics of important wetlands in Queensland*, Environmental Protection Agency, Queensland.

Chessman, B 2002, Assessing the conservation value and health of New South Wales rivers. The PBH (Pressure-Biota-Habitat) Project, New South Wales Department of Land and Water Conservation, Parramatta.

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

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

CSIRO 2009, *Water in the Gulf of Carpentaria Drainage Division. A report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project*, CSIRO Water for a Healthy Country Flagship, Australia.

DERM 2010, *Aquatic Conservation Assessment for the non-riverine, riverine and estuarine wetlands of Southern Gulf of Carpentaria Version 1.1 (Draft). Aquatic fauna expert panel report*, Department of Environment and Resource Management, Brisbane.

DES 2020a, *Aquatic Conservation using AquaBAMM for the riverine and non-riverine wetlands of the Southern Gulf Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 1.1*. Department of Environment and Science, Queensland Government.

DES 2020b. Queensland wetland classification method, Wetland*Info*, Department of Environment and Science, Queensland, viewed 13 July 2020,<https://wetlandinfo.des.qld.gov.au/wetlands/what-are-wetlands/definitions-classification/classification-systems-background/typology.html>.

Driscoll, PV 2001, *Gulf of Carpentaria Wader Surveys 1998-9*, Report to Queensland Environmental Protection Agency. Queensland Wader Study Group of Birds Queensland.

Dunn, H 2000, Identifying and Protecting Rivers of High Ecological Value, LWRRDC Occasional Paper 01/00.

Dutson, G, Garnett, S, Gole, C 2009, *Australia's Important Bird Areas - Key sites for bird conservation*, Conservation Statement Number 15, Birds Australia, Melbourne.

EPA 2002, Biodiversity Assessment and Mapping Methodology. Version 2.1, July2002, (Environmental Protection Agency, Brisbane), < https://www.qld.gov.au/environment/plants-animals/biodiversity/planning>

EPA 2005, *Wetland mapping and classification methodology—overall framework: A method to provide baseline mapping and classification for wetlands in Queensland, Version 1.2*, Environmental Protection Agency, Brisbane.

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

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

Garnett, S, Taplin, A 1990, *Wading bird abundance and distribution during the wet season on the Queensland coast of the Gulf of Carpentaria*, Report to Queensland National Parks and Wildlife Service, RAOU, Moonee Ponds.

Halliday, IA, Saunders, T, Sellin, MJ, Allsop, Q, Robins, JB, McLennan, M, Kurnoth, P 2012, *Flow impacts on estuarine finfish fisheries of the Gulf of Carpentaria*, Department of Agriculture, Fisheries and Forestry, Queensland, Brisbane.

Healthy Waterways 2012, *Report Card Methods - How are the grades calculated?* Healthy Waterways, Brisbane.

Jaensch, R, Richardson, P 2013, Waterbird breeding colonies in the Gulf Plains, 2009-2013, *Sunbird* 43, 45-64.

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S. and Butler, D.W. 2017 *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. Version 4.0*. Updated May 2017. Queensland Herbarium, Queensland Department of Science, Information Technology and Innovation, Brisbane. 124 pp.

Petheram C, Watson I, Stone P (eds) 2013, *Agricultural resource assessment for the Gilbert catchment. A report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment, part of the North Queensland Irrigated Agriculture Strategy*, CSIRO Water for a Healthy Country and Sustainable Agriculture flagships, Australia.

Robinson, W, Lee, J 2009, *AquaBAMM: sensitivity analysis using the Burnett River catchment results*, Report by University of the Sunshine Coast.

Sattler, PS, Williams, RD (eds) 1999, The Conservation Status of Queensland's Bioregional Ecosystems, Environmental Protection Agency, Brisbane.

Tait, J, Rizvi, S, Waller, N 2015, Northern Gulf Inland Waters Regional NRM Assessment, Northern Gulf Resource Management Group, Georgetown.

Appendix I - Riverine Implementation Table

Measure	Description	Implementation	Primary data sets used	Threshold type
1.1.1	Presence of ‘alien' fish species within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Species records (year ≥1950, precision ≤2000m) were used to count the exotic riverine species found within riverine spatial unit. A score of NODATA was allocated to any riverine spatial unit that had an absence of exotic species data. Note that no alien fish were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: point records or site based lists, year ≥1950, and precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by riverine spatial unit. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the riverine spatial units. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, the number of species present within each riverine spatial unit was compiled. A score of NODATA was allocated to any riverine spatial unit that had an absence of species data. Note that no exotic aquatic or semi-aquatic plants were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel. DAF pest species grid data from 2011 to 2017	Presence Negative (-2)

Measure	Description	Implementation	Primary data sets used	Threshold type
1.1.3	Presence of exotic invertebrate fauna within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: Point records or site-based lists, ≥1950, and precision ≤2000m). The number of species present within each riverine spatial unit was compiled. A score of NODATA was allocated to any riverine spatial unit that had an absence of species data. Note that no exotic invertebrates were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: point records or site based lists, ≥1950, and precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by riverine spatial unit. Applied to all wetlands. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the riverine spatial units. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, the number of species present within each riverine spatial unit was compiled. A score of NODATA was allocated to any riverine spatial unit that had an absence of species data.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF pest species grid data from 2011 to 2017	Presence Negative (-2)

Measure	Description	Implementation	Primary data sets used	Threshold type
1.3.4	Presence/absence of dams/weirs within the wetland	For each riverine spatial unit, calculate the total number of dams/weirs using dam and weir points from the 100K DNRM dams and weirs dataset, and non-riverine spatial units with a Queensland Wetland mapping HYDRMOD attribute of H2M1, H2M1a, H2M1b, H2M1c.	DNRME Dams and Weirs (ams_Weirs_Barrages_QLD_100k_NRM) including private dams do not included in original data. DES QLD Wetland Mapping data v5.	Presence Negative (-2)
1.3.5	Inundation by dams/weirs (% of waterway length within the wetland)	The reservoir layer was intersected against SGC ACA watercourses. The proportional length covered by a reservoir was then calculated for each riverine spatial unit.	DNRME watercourses (NAT.WatercourseLines)	Logarithmic (User Defined >100 =1, <10 = 2, <0.1 = 3, 0 = 4)
1.3.7	% area of remnant wetland relative to preclear extent for each riverine spatial unit	Extract from the preclear regional ecosystems mapping polygons that contain P, L, PL, C, R, F and IR. Add to this unmodified (H1) (excluding estuarine types) and extract by the riparian mask. Overlay the riverine spatial units and dissolve. This defines the preclear wetland boundary extent. Overlay the remnant regional ecosystems and the QLD wetland mapping v4. Overlay the remnant and the QLD wetland mapping v5. Where the overlayed area is remnant and or not a highly modified or artificial wetland (i.e. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3), add the area as connected, else if the preclear extent is a H1, add the area as connected, else if the preclear extent is H2M2, H2M3, H2M5, H2M8 and covered in remnant, add the area as connected. Assessable wetlands with no underlying preclear extent were given a value of NO DATA.	DES Queensland wetland mapping data v454, remnant and preclear regional ecosystem mapping v11, REDD v11.	Quartered mean of the maximum 3 in the sample. Continuous Ascending

Measure	Description	Implementation	Primary data sets used	Threshold type
2.1.1	Presence of exotic terrestrial plants in the assessment unit	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: species recorded (point records or site-based lists, ≥1950, precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by riverine spatial unit. Applied to all wetlands. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the riverine spatial units. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, where presence of exotic species was found within riverine spatial unit, a score of -2 was applied. This was then attributed to all the riverine spatial units unit nested within it. -999 (No data) was allocated to any riverine spatial units unit that had an absence of exotic species data.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel. DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
2.2.1	% area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	The pre-clear and remnant regional ecosystem mapping was overlayed with the riparian mask. The percentage of remnant/preclear was then calculated for each riverine spatial unit.	DES remnant and preclear regional ecosystem mapping v11. River buffers based on DNRME watercourses (NAT.WatercourseLines)	Quartered mean of the maximum 3 in the sample. Continuous Ascending

Measure	Description	Implementation	Primary data sets used	Threshold type
2.2.2	Total number of remnant regional ecosystems relative to preclear number of REs within buffered riverine wetland or watercourses	Using the pre-clear x remnant regional ecosystems x study area intersection product from 2.2.1, the numbers of distinct REs and pre-clear regional ecosystems in each riverine spatial unit was calculated. The regional ecosystems count was compared to that of the preclear extent.	DES remnant and preclear regional ecosystem mapping v11. River buffers based on DNRME watercourses (NAT.WatercourseLines)	Quartered mean of the maximum 3 in the sample. Continuous Ascending
2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	"Agricultural" land-use included (QLUMP secondary categories) intensive animal production, intensive horticulture, cropping, cropping-Cotton, Cropping-sugar, perennial horticulture, plantation forestry, irrigated cropping, irrigated perennial horticulture, irrigated seasonal horticulture and reservoir/dam, irrigated and in transition. These land-use types were allocated an agriculture attribute and a % area was calculated for agricultural areas within each subsection. These land-use types were allocated an agriculture attribute and a % area was calculated for agricultural areas within each riverine spatial unit.	DES QLUMP (version March 2018).	Logarithmic (User Defined, 0 = 4, <0.1 = 3, <10 = 2, <100 =1)
2.3.2	% "grazing" land-use area	"Grazing" land-use included (QLUMP secondary categories) Livestock grazing, grazing natural vegetation, grazing modified pastures. These land-use types were allocated a grazing attribute and a % area was calculated for grazing areas within each riverine spatial unit.	DES QLUMP (version March 2018).	Quartered mean of the maximum 3 in the sample. Continuous Descending
2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	"Vegetation" land-use included (QLUMP secondary categories): waters, Lake, Managed resource protection, Marsh/wetland, Nature conservation, Other minimal use, Production native forests, River, Uncertain. These land-use types were allocated a vegetation attribute and a % area was calculated for vegetation areas within each riverine spatial unit.	DES QLUMP (version March 2018).	Quartered mean of the maximum 3 in the sample. Continuous Ascending

Measure	Description	Implementation	Primary data sets used	Threshold type
2.3.4	% "settlement" land-use area (i.e. towns, cities, etc.)	“Settlement” land-use included (QLUMP secondary categories): manufacturing and industrial, mining, residential, services, transport and communication, utilities, waste treatment and disposal, and channel/aqueduct. These land-use types were allocated a settlement attribute and a % area was calculated for settlement areas within each riverine spatial unit.	DES QLUMP (version March 2018).	Logarithmic (User Defined, 0 = 4, <0.1 = 3, <10 = 2, <100 =1)
2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	Selects all non-riverine spatialunits with a HYDROMOD of H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2 from the Queensland Wetland mapping. Then appends the NRM RESERVOIRS (Rural Water Storage Category only).	DES Queensland Wetland Mapping data v5; NRM Reservoirs	Continuous Descending
3.1.1	Richness of native amphibians (riverine wetland breeders)	An expert panel list of native amphibians (riverine wetland breeders) was used to calculate this measure. Records ≥1975, precision ≤ 2000m were included. Records were used to derive a count of species for each riverine spatial unit, with NODATA allocated where the riverine spatial unit had an absence of species information.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Quartile thresholds (Q2, Q3 above and below) Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.1.2	Richness of native fish	An expert panel list of native fish dependent on riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to riverine spatial units. Processing steps included: • Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. • Clip the TRaCK model polygons to the SGC ACA bounding area • Convert the clipped TRaCK polygons to points. Use Inside option. • Intersect the TRaCK points with the r_spatialunits. • Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. • Convert TRaCK models to points. • Merge TRaCK points with SGC point datasets. Upland and lowland stratification was applied. Riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. TRaCK Models 2010, Australian Rivers Institute.	Quartered mean of the maximum 3 in the sample. Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.1.3	Richness of native aquatic dependent reptiles	An expert panel list of native reptiles dependent on riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to riverine spatial units. Processing steps included: • Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. • Clip the TRaCK model polygons to the SGC ACA bounding area • Convert the clipped TRaCK polygons to points. Use Inside option. • Intersect the TRaCK points with the r_spatialunits. • Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. • Convert TRaCK models to points. • Merge TRaCK points with SGC point datasets. Upland and lowland stratification was applied. Riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. TRaCK Models 2010, Australian Rivers Institute.	Quartile thresholds, Q3 above and below) Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.1.4	Richness of native waterbirds	An expert panel list of native (freshwater) waterbirds fish dependent on riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to riverine spatial units. Processing steps included: • Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. • Clip the TRaCK model polygons to the SGC ACA bounding area • Convert the clipped TRaCK polygons to points. Use Inside option. • Intersect the TRaCK points with the r_spatialunits. • Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. • Convert TRaCK models to points. • Merge TRaCK points with SGC point datasets. Upland and lowland stratification was applied. Riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. TRaCK Models 2010, Australian Rivers Institute.	Continuous Ascending or Categorical
3.1.5	Richness of native aquatic plants	An expert panel list of aquatic and semi-aquatic plants was used to calculate this measure. Records ≥1950 and a precision ≤2000m were included. Records were used to derive a count of species for each riverine spatial unit, with NODATA allocated where the associated spatial unit had an absence of species information.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel.	Quartered mean of the maximum 3 in the sample. Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.1.7	Richness of native aquatic dependent mammals	An expert panel list of native mammal dependent on fresh water streams for all or part of their lifecycles was used to calculate this measure. Records ≥1975, precision ≤ 2000m were included. Records were used to derive a count of species for each riverine spatial unit, with NODATA where the associated spatial unit had an absence of species information.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Quartered mean of the maximum 3 in the sample. Continuous Ascending.
3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance	A count of regional ecosystems within the riparian mask was calculated for each riverine spatial unit.	DES remnant and preclear regional ecosystem mapping v11. River buffers based on DNRME watercourses (NAT.WatercourseLines)	Quartered mean of the maximum 3 in the sample. Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.3.2	Richness of wetland types within the local catchment	A count of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each riverine spatial unit. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5, SGC ACA subsections.	Quartered mean of the maximum three riverine spatial units within the study area. Continuous Ascending.

Measure	Description	Implementation	Primary data sets used	Threshold type
3.3.3	Richness of wetland types within the sub-catchment	A count of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each sub-catchment. This count was then applied to each non-riverine spatial unit based on its subcatchment membership. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5, SGC ACA subsections. River buffers based on DNRME watercourses (NAT.WatercourseLines)	Quartered mean of the maximum three subcatchments within the study area. Continuous Ascending.
4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA Act, EPBC Act	A list of rare or threatened (NCA or EPBC) riverine aquatic ecosystem dependent fauna species identified by the expert fauna panel was used to generate the records dataset. These records were intersected with the riverine spatial units to determine species richness in each. Riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Presence Positive

Measure	Description	Implementation	Primary data sets used	Threshold type
4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCA Act, EPBC Act	A list of rare or threatened (NCA or EPBC) riverine aquatic ecosystem dependent flora species identified by the expert fauna panel was used to generate the records dataset. These records were intersected with each riverine spatial units to determine species richness in each. Riverine spatial units without records were given a value of NODATA.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel.	Presence Positive

Measure	Description	Implementation	Primary data sets used	Threshold type
4.2.1	Conservation status of wetland Regional Ecosystems — Herbarium biodiversity status, NCA Act, EPBC Act	The following Queensland Wetland data wetland types were assessed within buffer areas around drainage lines: R, F, IR, P, and C. XRE types from remnant regional ecosystem mapping where used where no wetland mapping was present. The following ratings were applied based on the Queensland Herbarium Biodiversity Status and EPBC Status of palustrine and lacustrine regional ecosystems: For biodiversity status: Endangered = 4 Of Concern = 3 No Concern at Present/Least Concern = 2 For EPBC listed communities: Critically Endangered or Endangered = 4 Vulnerable = 3 Other = 2 Presence of the highest conservation status regional ecosystem in the riverine spatial unit was applied. Spatial units that contained no regional ecosystems of those type received a score of 1.	DES Queensland Wetland Mapping data v5, REDD version 11. EPBC community regional ecosystem list.	Categorical
5.1.1	Presence of aquatic ecosystem dependent priority fauna species (expert panel list/discussion or other lists such as ASFB, etc.)	An expert panel derived list of priority riverine aquatic ecosystem dependent fauna species was used to generate the records dataset. These records were intersected with each riverine spatial unit to determine species richness. Spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Quartile thresholds (Q2, Q3 above and below)

Measure	Description	Implementation	Primary data sets used	Threshold type
5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	An expert panel derived list of priority riverine aquatic ecosystem dependent flora species was used to generate the records dataset. These records were intersected with each riverine spatial unit to determine species richness. Spatial units without records were given a value of NODATA.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel.	Quartile thresholds (Q2, Q3 above and below)
5.1.3	Habitat for, or presence of, migratory species (Expert Panel list/discussion and/or JAMBA/ CAMBA/ ROKAMBA agreement lists and/or Bonn Convention)	An expert panel derived list of migratory species dependent on riverine wetlands for all or part of their lifecycles was used to calculate this measure. These records were intersected with each riverine spatial unit to determine species richness. Spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Using the quartile thresholds (Q2, Q3 above and below)
5.1.4	Habitat for significant numbers of waterbirds	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
5.2.1	Presence of 'priority' aquatic ecosystem	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary data sets used	Threshold type
6.1.1	Presence of distinct, unique or special geomorphic features	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
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.	Combine significant wetland category 4 areas (Ramsar, World Heritage) and significant wetland category 3 areas (DIOW). These were then overlayed with the riverine spatial units. Calculate the proportion for each riverine spatial unit that overlaps a category 4 and category 3 signification wetland category. These are not mutually exclusive. For Score 4 area; if proportion >= 0.05 score as 4. For Score 3 area; if proportion >= 0.05 score as 3. Spatial units not identified by experts for this measure were given a known absence value of -999.	RAMSAR areas. World Heritage Areas. Directory of Important Wetlands (DIWA).	Categorical

Measure	Description	Implementation	Primary data sets used	Threshold type
6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Documented reports external to the ACA process.	Categorical
6.3.4	Climate change refugia	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss).	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/ or 6.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.1.2	Biodiversity service a wetland provides to support the migration or routine movement aquatic species.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary data sets used	Threshold type
7.1.3	Presence of aerial or terrestrial migratory route for biological connectivity.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.2.1	The contribution (upstream or downstream) of the riverine spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6,	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.4.1	The contribution of the spatial unit to the maintenance of terrestrial ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary data sets used	Threshold type
7.5.1	The contribution of the riverine spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
8.2.5	Wetland type representative of the study area – identified by expert opinion.	Expert panels identified riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Appendix II - Non-riverine Implementation Table

Measure	Description	Implementation	Primary datasets used	Threshold type
1.1.1	Presence of ‘alien' fish species within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Species records (year ≥1950, precision ≤2000m) were used to count the exotic species found within an subsection. This was then attributed to all the non-riverine spatial units nested within it. A score of NODATA was allocated to any non-riverine spatial unit that had an absence of species data. Note that no alien fish were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: point records or site-based lists, ≥1950, and precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by subsection. Applied to all wetlands. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the subsection. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, the number of species present within each subsection was compiled and applied to each nested non-riverine spatial unit. A score of NODATA was allocated to any non-riverine spatial unit that had an absence of species data. Note that no exotic aquatic or semi-aquatic plants were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel DAF pest species grid data from 2011 to 2017	Presence Negative (-2)

Measure	Description	Implementation	Primary datasets used	Threshold type
1.1.3	Presence of exotic invertebrate fauna within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: point records or site-based lists, ≥1950, and precision ≤2000m). The number of species present within each subsection was compiled and applied to each non-riverine spatial unit. A score of NO DATA was allocated to any non-riverine spatial unit that had an absence of species data. Note that no exotic invertebrates were nominated by the panel. All spatial units were given a score of 0 (i.e. true-absence).	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: species recorded (point records or site-based lists, ≥1950, precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by subsection. Applied to all wetlands. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the subsection. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, the number of species present within each subsection was compiled and applied to each nested non-riverine spatial unit. A score of NODATA was allocated to any non-riverine spatial unit that had an absence of species data.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel DAF pest species grid data from 2011 to 2017	Presence Negative (-2)

Measure	Description	Implementation	Primary datasets used	Threshold type
1.3.7	% area of remnant wetland relative to preclear extent for each non-riverine spatial unit	Extract from the preclear mapping polygons that contain P, L, PL, C. Add to this unmodified (H1) wetlands from non-riverine spatial units. Overlay the study areas and dissolve (single part) on SA_ID. This defines the preclear wetland boundary extent. Overlay the remnant and the QLD wetland mapping v5. Where the overlayed area is remnant and or not a highly modified or artificial wetland (H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3) , add the area as connected, else if the preclear extent is a H1, add the area as connected, else if the preclear extent is H2M2, H2M3, H2M5, H2M8 and covered in remnant, add the area as connected. Assessable wetlands with no underlying preclear extent were given a value of NO DATA.	DES Queensland Wetland Mapping data v5, remnant and preclear regional ecosystem mapping v11, REDD v11	Continuous Ascending Quartered mean of the theoretical maximum (i.e. 100%) within the study area.
1.4.5	Hydrological disturbance/modification of the wetland (e.g. as determined through DES wetland mapping and classification)	Score non-riverine spatial units according to their level of Queensland Wetland Mapping hydromodification: H1 = 4; H2M1b, H2M1d, H2M2, H2M2a, H2M2b, H2M2c, H2M2d, H2M2e, H2M2f, H2M2g, H2M3, H2M8 = 3; H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7 = 2; H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 = 1.	DES Queensland Wetland Mapping data v5	Categorical

Measure	Description	Implementation	Primary datasets used	Threshold type
2.1.1	Presence of exotic terrestrial plants in the assessment unit	An expert panel list of relevant exotic species was used to calculate this measure. Records were utilised as follows: Records: species recorded (point records or site-based lists, ≥1950, precision ≤2000m). DAF pest grids: For listed non-riverine exotic species. Conducted a frequency of species by subsection. Applied to all wetlands. 1. Convert the pest grid to point then buffer by 4.5 km. This makes a circle which is half the diameter of the original grid. 2. Intersect this circle with the subsection. Convert to point (inside polygon). 3. For areas that were missed by the steps in 1 and 2. A straight intersect and count by species of all overlapping grids was applied. Using the points derived from both methods, where presence of exotic species was found within an subsection, a score of -2 was applied. This was then attributed to all the non-riverine spatial unit nested within it.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel DAF pest species grid data from 2011 to 2017	Presence Negative (-2)
2.2.5	% area of remnant vegetation relative to preclear extent within buffered non-riverine wetland: 500 m buffer for wetlands ≥ 8 ha, 200 m buffer for smaller wetlands	Each non-riverine spatial unit was buffered by 500m buffer for wetlands >= 8ha, 200m buffer for smaller wetlands. A multi-ring buffer was used as it allowed for the exclusion of the wetland itself from the analysis. The remnant and pre-clear vegetation mapping was then intersected with area calculated. De-concatenating the RE and PERCENT, the area of each value with a valid RE vegetation code was calculated to get the total area occupied by RE for pre-clear and remnant. The percentage of remnant to pre-clear was calculated and applied to each non-riverine spatial unit.	DES remnant and preclear regional ecosystem mapping v11, Queensland Wetland Mapping data v5	Continuous Ascending Quartered mean of the theoretical maximum (i.e. 100%) within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	"Agricultural" land-use included (QLUMP secondary categories) intensive animal production, intensive horticulture, cropping, cropping-Cotton, Cropping-sugar, perennial horticulture, plantation forestry, irrigated cropping, irrigated perennial horticulture, irrigated seasonal horticulture and reservoir/dam, irrigated and in transition. These land-use types were allocated an agriculture attribute and a % area was calculated for agricultural areas within each subsection. This value was then applied to all nested non-riverine spatial unit.	DES QLUMP (version March 2018)	Continuous Descending Logarithmic (>=100 =1, >=10 = 2, >=1 = 3, >=0 = 4)
2.3.2	% "grazing" land-use area	"Grazing" land-use included (QLUMP secondary categories) Livestock grazing, grazing natural vegetation, grazing modified pastures. These land-use types were allocated a grazing attribute and a % area was calculated for grazing areas within each subsection. This value was then applied to all nested non-riverine spatial unit.	DES QLUMP (version March 2018)	Continuous Descending Quartered mean of the theoretical maximum (i.e. 100%) within the study area.
2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	"Vegetation" land-use included (QLUMP secondary categories): waters, Lake, Managed resource protection, Marsh/wetland, Nature conservation, Other minimal use, Production native forests, River, Uncertain. These land-use types were allocated a vegetation attribute and a % area was calculated for vegetation areas within each subsection. This value was then applied to all nested non-riverine spatial unit.	DES QLUMP (version March 2018)	Continuous Ascending Quartered mean of the theoretical maximum (i.e. 100%) within the study area.
2.3.4	% "settlement" land-use area (i.e. towns, cities, etc.)	"Settlement" land-use included (QLUMP secondary categories): Land in transition, Manufacturing and industrial, Mining, Residential, Services, Transport and communication, Utilities, Waste treatment and disposal. These land-use types were allocated a settlement attribute and a % area was calculated for settlement areas within each subsection. This value was then applied to all nested non-riverine spatial unit.	DES QLUMP (version March 2018)	Continuous Descending Logarithmic (>=100 =1, >=10 = 2, >=1 = 3, >=0 = 4)

Measure	Description	Implementation	Primary datasets used	Threshold type
2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	Selects all non-riverine spatialunits with a HYDROMOD of H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2 from the Queensland Wetland mapping. Then appends the NRM RESERVOIRS (Rural Water Storage Category only).	DES Queensland Wetland Mapping data v5; NRM Reservoirs	Continuous Descending Logarithmic (>=100 =1, >=10 = 2, >=1 = 3, >=0 = 4)
3.1.2	Richness of native fish	An expert panel list of native fish dependent on non-riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units. Processing steps included: Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. Clip the TRaCK model polygons to the SGC ACA bounding area Convert the clipped TRaCK polygons to points. Use Inside option. Intersect the TRaCK points with the r_spatialunits. Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. Convert TRaCK models to points. Merge TRaCK points with SGC point datasets. Upland and lowland stratification was applied. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel TRaCK Models 2010, Australian Rivers Institute.	Continuous Ascending Quarter of the mean of the 3 maximum scores within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
3.1.3	Richness of native aquatic dependent reptiles	An expert panel list of native reptiles dependent on non-riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units. Processing steps included: Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. Clip the TRaCK model polygons to the SGC ACA bounding area Convert the clipped TRaCK polygons to points. Use Inside option. Intersect the TRaCK points with the r_spatialunits. Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. Convert TRaCK models to points. Merge TRaCK points with SGC point datasets. Upland and lowland stratification was applied. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. TRaCK Models 2010, Australian Rivers Institute	Continuous Ascending Quarter of the mean of the 3 maximum scores within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
3.1.4	Richness of native waterbirds	An expert panel list of native (freshwater) waterbirds dependent on non-riverine wetlands for all or part of their lifecycles was used to calculate this measure. A combination of species records (≥1975, precision ≤ 2000m) and TRaCK species habitat models were included. Upland and lowland stratification was applied. Records and the centroids derived from the TRaCK models were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units. Processing steps included: Check and correct for taxonomic consistency between TRaCK models and SGC datasets/EP lists. Clip the TRaCK model polygons to the SGC ACA bounding area Convert the clipped TRaCK polygons to points. Use Inside option. Intersect the TRaCK points with the r_spatialunits. Dissolve the intersected TRaCK points x r_spatialunits by SPUNITID and all TRaCK species code fields. Convert TRaCK models to points. Merge TRaCK points with SGC point datasets. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel TRaCK Models 2010, Australian Rivers Institute.	Continuous Ascending Quarter of the mean of the 3 maximum scores within the study area.
3.1.5	Richness of native aquatic plants	An expert panel list of aquatic and semi-aquatic plants was used to calculate this measure. Records ≥1950 and a precision ≤2000m were included. Records were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units, with NODATA allocated where the associated spatial unit had an absence of species information.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel	Continuous Ascending Quarter of the mean of the 3 maximum scores within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
3.1.6	Richness of native amphibians (non-riverine wetland breeders)	An expert panel list of native amphibians (non-riverine wetland breeders) was used to calculate this measure. Records ≥1975, precision ≤ 2000m were included. Upland and lowland stratification was applied. Records were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units, with NODATA allocated where the associated spatial unit had an absence of species information. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel	User Defined Quarter of the mean of the 3 maximum scores within the study area. (Mornington Island and Morning Inlet study areas had a maximum of 1 species so used Presence Positive).
3.1.7	Richness of native aquatic dependent mammals	An expert panel list of native mammal dependent on non-riverine wetlands for all or part of their lifecycles was used to calculate this measure. Records ≥1975, precision ≤ 2000m were included. Upland and lowland stratification was applied. Records were used to derive a count of species for each subsection. This value was then attributed to nested non-riverine spatial units, with NODATA allocated where the associated spatial unit had an absence of species information. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel	User Defined (Settlement Creek study areas had a maximum of 1 species so used Presence Positive).
3.3.2	Richness of wetland types within the local catchment	A count of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each subsection. This count was then applied to each non-riverine spatial unit based on its subsection membership. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5, SGC ACA subsections	Continuous Ascending Quarter of the mean of the maximum three non-riverine spatial units within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
3.3.3	Richness of wetland types within the sub-catchment	A count of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each sub-catchment. This count was then applied to each non-riverine spatial unit based on its subcatchment membership. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5, SGC ACA subsections	Continuous Ascending Quarter of the mean of the maximum three subcatchments within the study area.
4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA Act, EPBC Act	A list of rare or threatened (NCA or EPBC) non-riverine aquatic ecosystem dependent fauna species identified by the expert fauna panel was used to generate the records dataset. Records were intersected with subsections to determine species richness in each. This value was then attributed to all nested non-riverine spatial units. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Presence Positive (Mornington Island study areas had a maximum of 1 species so used Presence Positive).
4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCA Act, EPBC Act	A list of rare or threatened (NCA or EPBC) non-riverine aquatic ecosystem dependent flora species identified by the expert fauna panel was used to generate the records dataset. Records were intersected with subsections to determine species richness in each. This value was then attributed to all nested non-riverine spatial units. Non-riverine spatial units without records were given a value of NODATA.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel.	Presence Positive

Measure	Description	Implementation	Primary datasets used	Threshold type
4.2.1	Conservation status of wetland Regional Ecosystems — Herbarium biodiversity status, NCA Act, EPBC Act	The following ratings were applied based on the Queensland Herbarium Biodiversity Status and EPBC Status of palustrine and lacustrine regional ecosystems: For biodiversity status: Endangered = 4 Of Concern = 3 No Concern at Present/Least Concern = 2 For EPBC listed communities: Critically Endangered or Endangered = 4 Vulnerable = 3 Other = 2 The maximum score was applied within each non-riverine spatial unit.	DES Queensland Wetland Mapping data v5, REDD version 11. EPBC community regional ecosystem list.	Categorical
5.1.1	Presence of aquatic ecosystem dependent priority fauna species (expert panel list/discussion or other lists such as ASFB, etc.)	An expert panel derived list of priority non-riverine aquatic ecosystem dependent fauna species was used to generate the records dataset. Records were intersected with subsections to determine species richness in each. This was then attributed to all nested non-riverine spatial units. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	User Defined Quarter of the mean of the maximum three non-riverine spatial units within the study area. (Morning Inlet study areas had a maximum of 1 species so used Presence Positive).
5.1.2	Presence of aquatic ecosystem dependent priority flora species	An expert panel derived list of priority non-riverine aquatic ecosystem dependent flora species was used to generate the records dataset. Records were intersected with subsections to determine species richness in each. This was then attributed to all nested non-riverine spatial units. Non-riverine spatial units without records were given a value of NODATA.	Flora species records from DES databases WildNet, Herbrecs, Corveg and Expert Panel.	User Defined Quarter of the mean of the maximum three non-riverine spatial units within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
5.1.3	Habitat for, or presence of, migratory species (Expert Panel list/discussion and/or JAMBA / CAMBA / ROKAMBA agreement lists and/or Bonn Convention)	An expert panel derived list of migratory species dependent on non-riverine wetlands for all or part of their lifecycles was used to calculate this measure. Records were intersected with subsections to determine species richness in each. This was then attributed to all nested non-riverine spatial units. Non-riverine spatial units without records were given a value of NODATA.	DES QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	User Defined Quarter of the mean of the maximum three non-riverine spatial units within the study area.
5.1.4	Habitat for significant numbers of waterbirds	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
5.2.1	Presence of priority aquatic ecosystem	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.1.1	Presence of distinct, unique or special geomorphic features	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary datasets used	Threshold type
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.	Combine significant wetland category 4 areas (Ramsar, World Heritage) and significant wetland category 3 areas (DIWA). These were then overlayed with the non-riverine spatial units. Calculate the proportion for each non-riverine spatial unit that overlaps a category 4 and category 3 wetland category. These are not mutually exclusive. For Score 4 area; if proportion >= 0.05 score as 4. For Score 3 area; if proportion >= 0.05 score as 3. Spatial units not identified by experts for this measure were given a known absence value of -999.	RAMSAR areas. World Heritage Areas. Directory of Important wetlands (DIWA).	Categorical
6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Documented reports external to the ACA process.	Categorical
6.3.4	Climate change refugia	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss).	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/ or 6.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary datasets used	Threshold type
7.1.2	Biodiversity service a wetland provides to support the migration or routine movement aquatic species.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.1.3	Presence of aerial or terrestrial migratory route for biological connectivity.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.2.1	The contribution (upstream or downstream) of the non-riverine spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6,	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.4.1	The contribution of the spatial unit to the maintenance of terrestrial ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical

Measure	Description	Implementation	Primary datasets used	Threshold type
7.5.1	The contribution of the non-riverine spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
8.1.1	% area of each wetland type within Protected Areas.	Protected area estates (CP, FR, NC, NP, NS, RR, SF and TR) and nature refuge data was used to calculate the % area of each wetland habitat type (based on TYPE_RE field—a concatenation of wetland class, water regime, salinity modifier and WETRE fields from the QWM data) located within these protected areas. The minimum % area was used for individual wetlands with more than one wetland habitat type to account for habitats less protected. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5, QLD protected area estate.	Continuous Descending (Sattler & Williams 1999) (>10% = 1; >4% = 2; >1% = 3; <1% = 4)

Measure	Description	Implementation	Primary datasets used	Threshold type
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)	Utilising the habitat classification in the Queensland Wetland Mapping [HAB] a frequency habitat types occurring in the nr_wethabitats layer of each was calculated for the study area. For each non-riverine spatial units a list of habitat types were then identified, and a score applied based on the habitat with the lowest abundance present. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure.	DES Queensland Wetland Mapping data v5.	Continuous Desc Quarter of the mean of the maximum three non-riverine spatial units within the study area.
8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the sub-catchment (management groups ranked least common to most common)	Utilising the habitat classification in the Queensland Wetland Mapping [HAB] a frequency habitat types occurring in the nr_wethabitats layer of each was calculated for the sub-catchment. For each non-riverine spatial units a list of habitat types were then identified, and a score applied based on the habitat with the lowest abundance present. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure.	DES Queensland Wetland Mapping data v5.	Continuous Desc Quarter of the mean of the maximum three non-riverine spatial units within the study area.

Measure	Description	Implementation	Primary datasets used	Threshold type
8.2.3	The size of each wetland type relative to others of its wetland management group within the catchment or study area	Utilising the habitat classification in the Queensland Wetland Mapping [HAB] the size of each wetland in the nr_wethabitats layer was calculated and grouped into their respective habitat classification by study area. A threshold based on a quartering of the mean of the top 3 sizes was then calculated for each habitat type. The maximum threshold was then applied to each non-riverine spatial unit based on the habitat types present in each. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure.	DES Queensland Wetland Mapping data v5.	Categorical
8.2.4	The size of each wetland type relative to others of its wetland management group within a sub-catchment.	Utilising the habitat classification in the Queensland Wetland Mapping [HAB] the size of each wetland in the nr_wethabitats layer was calculated and grouped into their respective habitat classification by sub-catchment. A threshold based on a quartering of the mean of the top 3 sizes was then calculated for each habitat type and group. The maximum threshold was then applied to each non-riverine spatial unit based on the habitat types present in each. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure.	DES Queensland Wetland Mapping data v5.	Categorical

Measure	Description	Implementation	Primary datasets used	Threshold type
8.2.5	Wetland type representative of the study area – identified by expert opinion.	Expert panels identified non-riverine spatial units that contained notable values associated with this measure. The resulting value was then given a conservation rating out of 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical
8.2.6	The size of each wetland type relative to others of its type within the catchment or study area.	Based on a concatenation of wetland class, water regime, salinity modifier and WETRE fields from the QWM data [TYPE_RE], the size distribution of each type was derived from the nr_wethabitats layer and grouped into their respective study area. A threshold based on a quartering of the mean of the top 3 sizes was then calculated. The maximum threshold was then applied to each non-riverine spatial unit based on the types present. For the SGC ACA the in-set included non-riverine spatial units with a HYDROMOD of H1, H2M2, H2M2c, H2M2e, H2M3, H2M5 and H2M8; there were no H2M8 and H2M5. H2M1, H2M1a, H2M1c, H2M5, H2M6, H2M6a, H2M6b, H2M6c, H2M6e, H2M7, H3C1, H3C1a, H3C1b, H3C1c, H3C1d, H3C2, H3C3 wetlands are all Highly Modified or Artificial are not valid for this measure. All non-valid spatial units were given a score of -999 (i.e. true-absence) for this measure. In addition, non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of No Data.	DES Queensland Wetland Mapping data v5.	Categorical

Appendix III - Riverine Filter Table

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
0	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data)			No data
1	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High)			Very High
2	equal to (Very High) and			equal to (Very High) and	equal to (Very High) and		equal to (Very High)			Very High
3	equal to (Very High or High)								and number of Criteria with Very High >= 4	Very High
4						equal to (Very High)				Very High
5	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low)			Very Low
6	equal to (Low) and	equal to (Medium) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low)			Very Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
7	equal to (Very High) and			equal to (Very High)						High
8	equal to (Very High) and				equal to (Very High)					High
9		equal to (Very High) and		equal to (Very High)						High
10			equal to (Very High) and				equal to (Very High)			High
11	equal to (Very High) and	equal to (Very High) and	equal to (Very High)							High
12	equal to (High) and		equal to (Very High)							High
13	equal to (Very High or High) and						equal to (Very High)			High
14			equal to (Very High) and	equal to (Very High) and	equal to (Very High)					High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
15					equal to (Very High or High) and		equal to (Very High)			High
18	equal to (High) and	equal to (Very High) and				equal to (High)				High
16		equal to (Very High) and	equal to (Very High) and			equal to (High)				High
19		equal to (Very High) and		equal to (High) and		equal to (High)				High
20		equal to (Very High) and			equal to (High) and	equal to (High)				High
17		equal to (Very High) and				equal to (High)				High
21	equal to (High) and			equal to (High) and	equal to (High)					High
22					equal to (Very High or High) and	equal to (High)				High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
23	equal to (Very High or High) and		equal to (High) and	equal to (High)						High
23a						equal to (High)				High
24				equal to (Very High or High)						Medium
25					equal to (Very High or High)					Medium
26			equal to (High) and				equal to (High)			Medium
27	equal to (Very High or High or Medium) and		equal to (Very High or High)							Medium
28	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and					equal to (High)			Medium
29			equal to (High) and		equal to (Medium)					Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
30					equal to (Medium) and		equal to (High)			Medium
36	equal to (Very High or High or Medium) and			equal to (Medium) and	equal to (Medium)					Medium
36a						equal to (Medium)				Medium
37	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and				equal to (Very High or High or Medium)			Medium
37a									and number of Criteria with Very High >= 3	Medium
37b									and number of Criteria with High >= 3	Medium
37c	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)		and number of Criteria with Very High >= 2	Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
37d									and number of Criteria with Very High >= 2	Low
37e									and number of Criteria with High >= 2	Low
37f	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)		and number of Criteria with Very High >= 1	Low
38	not equal to (Very High) and	not equal to (Very High)							and number of Criteria with Low or No data >= 4	Very Low
1000	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data)			Low

Appendix IV - Non-riverine Filter Table

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
0	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data)		No data
1	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High)		Very High
2	equal to (Very High) and			equal to (Very High) and	equal to (Very High) and			equal to (Very High)		Very High
27	equal to (Very High or High)								and number of Criteria with Very High >= 4	Very High
3	equal to (Very High) and	equal to (Very High) and						equal to (Very High)		Very High
4	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and		equal to (Very High) and				equal to (Very High)		Very High
5						equal to (Very High)				Very High
6	equal to	equal to	equal to	equal to	equal to	equal to	equal to	equal to (Low)		Very Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
	(Low) and	(Low) and	(Low) and	(Low) and	(Low) and	(Low) and	(Low) and			
7		equal to (Medium or Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low or No data) and	equal to (Low) and	equal to (Medium or Low)		Very Low
8	equal to (Very High) and			equal to (Very High or High) and				equal to (Very High or High)		High
9	equal to (Very High) and				equal to (Very High) and			equal to (High)		High
10	equal to (Very High) and	equal to (Very High) and			equal to (Very High)					High
10a			equal to (Very High) and				equal to (Very High)			High
11			equal to (Very High) and					equal to (Very High)		High
11a	equal to (Very High or High) and						equal to (Very High)			High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
12	equal to (Very High) and				equal to (Very High or High) and			equal to (Very High)		High
13	equal to (Very High or High) and	equal to (Very High) and		equal to (Very High or High)						High
14	equal to (High) and	equal to (Very High) and			equal to (Very High)					High
15	equal to (Very High or High) and	equal to (Very High or High) and	equal to (Very High) and					equal to (High)		High
15a						equal to (High)				High
16		equal to (Very High or High) and	equal to (Very High)							Medium
17			equal to (Very High) and					equal to (High)		Medium
18	equal to (Very High or High)	equal to (Very High or High or						equal to (Very High or High)		Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
	and	Medium) and								
19				equal to (Very High or High)						Medium
20					equal to (Very High or High)					Medium
20b			equal to (High) and				equal to (Very High)			Medium
21	equal to (Very High or High or Medium) and	equal to (Very High or High) and				equal to (Medium)				Medium
22		equal to (Very High or High) and	equal to (High) and		equal to (Medium)					Medium
23		equal to (Very High or High) and		equal to (Medium) and		equal to (Medium)				Medium
24	equal to (Very High or High or Medium)			equal to (Medium) and				equal to (Very High or High or Medium)		Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
	and									
25	equal to (Very High or High or Medium) and	equal to (Very High)								Medium
25a	equal to (Very High or High or Medium) and	equal to (High or Medium) and					equal to (High)			Medium
26	equal to (Very High or High or Medium) and	equal to (High or Medium) and	equal to (Medium) and					equal to (Medium)		Medium
26a						equal to (Medium)				Medium
26c					equal to (Medium) and		equal to (High)			Medium
29									and number of Criteria with High >= 3	Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
30									and number of Criteria with Medium >= 4	Medium
30a									and number of Criteria with Very High >= 3	Medium
30c	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)	and number of Criteria with Very High >= 2	Medium
30d									and number of Criteria with Very High >= 2	Low
30e									and number of Criteria with High >= 2	Low
30f	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)	and number of Criteria with Very High >= 1	Low
28									and number of Criteria with Low or No data >= 4	Very Low
1000	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium	equal to (Very High or High or Medium or Low or No	equal to (Very High or High or Medium or Low or No data)		Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Representativeness	Additional Criteria	AquaScore
	data) and	data) and	data) and	data) and	data) and	or Low or No data) and	data) and			

Appendix V - Riverine Measure weights relative to each other in the same Indicator

Maximum weight is 10

Criteria and indicators	Measure	Measure description	Weight
1 Naturalness aquatic			
1.1 Exotic flora/fauna	1.1.1	Presence of ‘alien' fish species within the wetland	7.7
	1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	8.6
	1.1.3	Presence of exotic invertebrate fauna within the wetland	7.2
	1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	10
1.3 Habitat features modification	1.3.4	Presence/absence of dams/weirs within the wetland	10
	1.3.5	Inundation by dams/weirs (% of waterway length within the wetland)	8.9
	1.3.7	% area of remnant wetland relative to preclear extent for each spatial unit	9.8
2 Naturalness catchment			
2.1 Exotic flora/fauna	2.1.1	Presence of exotic terrestrial plants in the assessment unit	10
2.2 Riparian disturbance	2.2.1	% area of remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	10
	2.2.2	Total number of REs relative to preclear number of REs within buffered riverine wetland or watercourses	8.5
2.3 Catchment disturbance	2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	9.1
	2.3.2	% "grazing" land-use area	10
	2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	9.4
	2.3.4	% "settlement" land-use area (i.e. towns, cities, etc.)	8.6
2.4 Flow modification	2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	10
3 Diversity and richness			
3.1 Species	3.1.1	Richness of native amphibians (riverine wetland breeders)	9.4
	3.1.2	Richness of native fish	10
	3.1.3	Richness of native aquatic dependent reptiles	9.6
	3.1.4	Richness of native waterbirds	10
	3.1.5	Richness of native aquatic plants	9.5
	3.1.7	Richness of native aquatic dependent mammals	9.4

Criteria and indicators	Measure	Measure description	Weight
3.2 Communities/ assemblages	3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance	10
3.3 Habitat	3.3.2	Richness of wetland types within the local catchment (e.g. SOR sub-section)	10
	3.3.3	Richness of wetland types within the sub-catchment	10
4 Threatened species and ecosystems			
4.1 Species	4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA, EPBC Act	10
	4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species — NCA, EPBC Act	10
4.2 Communities/ assemblages	4.2.1	Conservation status of wetland Regional Ecosystems — Herbarium biodiversity status, NCA, EPBC Act	10
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.)	9.5
	5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	10
	5.1.3	Habitat for, or presence of, migratory species (expert panel list/discussion and/or JAMBA / CAMBA / ROKAMBA agreement lists and/or Bonn Convention)	8.6
	5.1.4	Habitat for significant numbers of waterbirds	8.8
5.2 Ecosystems	5.2.1	Presence of 'priority' aquatic ecosystem	10
6 Special Features			
6.1 Geomorphic features	6.1.1	Presence of distinct, unique or special geomorphic features	10
6.2 Ecological processes	6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	10
6.3 Habitat	6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	10
	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.	9.1
	6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	9.6
	6.3.4	Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)	9.1
6.4 Hydrological	6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss)	10
7 Connectivity			

Criteria and indicators	Measure	Measure description	Weight
7.1 Significant species or populations	7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/or 6	10
	7.1.2	Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit	10
	7.1.3	Presence of aerial or terrestrial migratory route for biological connectivity	10
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)	10
7.3 Floodplain and wetland ecosystems	7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/ 6	10
	7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	10
7.4 Terrestrial ecosystems	7.4.1	The contribution of the spatial unit to the maintenance of terrestrial ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6	10
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	10
	7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas	10
8 Representativeness			
8.2 Wetland uniqueness	8.2.5	Wetland type representative of the study area - identified by expert opinion	10

Appendix VI - Non-riverine Measure weights relative to each other in each Indicator

Maximum score is 10

Criteria and indicators	Measure	Measure description	Weight
1 Naturalness aquatic			
1.1 Exotic flora/fauna	1.1.1	Presence of ‘alien' fish species within the wetland	7.7
	1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	8.6
	1.1.3	Presence of exotic invertebrate fauna within the wetland	7.2
	1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	10
1.3 Habitat features modification	1.3.7	% area of remnant wetland relative to preclear extent for each spatial unit	10
1.4 Hydrological Modification	1.4.5	Hydrological disturbance/modification of the wetland (as determined through the DES wetland mapping and classification)	10
2 Naturalness catchment			
2.1 Exotic flora/fauna	2.1.1	Presence of exotic terrestrial plants in the assessment unit	10
2.2 Riparian disturbance	2.2.5	% area of remnant vegetation relative to preclear extent within buffered non-riverine wetland: 500m buffer for wetlands >= 8Ha, 200m buffer for smaller wetlands	10
2.3 Catchment disturbance	2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	9.1
	2.3.2	% "grazing" land-use area	10
	2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	9.4
	2.3.4	% "settlement" land-use area (i.e. towns, cities, etc.)	8.6
3 Diversity and richness			
3.1 Species	3.1.2	Richness of native fish	10
	3.1.3	Richness of native aquatic dependent reptiles	9.6
	3.1.4	Richness of native waterbirds	10
	3.1.5	Richness of native aquatic plants	9.5
	3.1.6	Richness of native amphibians (non-riverine wetland breeders)	9.4
	3.1.7	Richness of native aquatic dependent mammals	9.4
3.3 Habitat	3.3.2	Richness of wetland types within the local catchment (e.g. SOR sub-section)	10
	3.3.3	Richness of wetland types within the sub-catchment	10

Criteria and indicators	Measure	Measure description	Weight
4 Threatened species and ecosystems			
4.1 Species	4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA, EPBC Act	10
	4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species — NCA, EPBC Act	10
4.2 Communities/ assemblages	4.2.1	Conservation status of wetland Regional Ecosystems — Herbarium biodiversity status, NCA, EPBC Act	10
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.)	9.5
	5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	10
	5.1.3	Habitat for, or presence of, migratory species (Expert Panel list/discussion and/or JAMBA / CAMBA / ROKAMBA agreement lists and/or Bonn Convention)	8.6
	5.1.4	Habitat for significant numbers of waterbirds	8.8
5.2 Ecosystems	5.2.1	Presence of 'priority' aquatic ecosystem	10
6 Special features			
6.1 Geomorphic features	6.1.1	Presence of distinct, unique or special geomorphic features	10
6.2 Ecological processes	6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes.	10
6.3 Habitat	6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	10
	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.	9.1
	6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	9.6
	6.3.4	Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)	9.1
6.4 Hydrological	6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss)	10
7 Connectivity			
7.1 Significant species or populations	7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations, including those features identified through Criteria 5 and/or 6	10
	7.1.2	Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit.	10

Criteria and indicators	Measure	Measure description	Weight
	7.1.3	Presence of aerial or terrestrial migratory route for biological connectivity	10
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)	10
7.3 Floodplain and wetland ecosystems	7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6	10
	7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	10
7.4 Terrestrial ecosystems	7.4.1	The contribution of the spatial unit to the maintenance of terrestrial ecosystems with significant biodiversity values, including those features identified through Criteria 5 and/or 6	10
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	10
	7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas	10
8 Representativeness			
8.1 Wetland protection	8.1.1	The percentage of each wetland type within Protected Areas	10
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)	10
	8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the subcatchment or estuarine/marine zone (management groups ranked least common to most common)	9.4
	8.2.3	The size of each wetland type relative to others of its wetland management group within the catchment or study area	8.1
	8.2.4	The size of each wetland type relative to others of its wetland management group within a subcatchment (or estuarine zone)	7.8
	8.2.5	Wetland type representative of the study area – identified by expert opinion	9.9
	8.2.6	The size of each wetland type relative to others of its type within the catchment or study area	8.1

Appendix VII - Riverine Indicator Ranks

The maximum rank is 1. If both Indicators within a Criterion are ranked 1 - they are considered of equal importance.

Criterion	Indicator description	Rank
1 Naturalness aquatic		
1.1	Exotic flora / fauna	2
1.3	Habitat features modification	1
2 Naturalness catchment		
2.1	Exotic flora / fauna	2
2.2	Riparian disturbance	1
2.3	Catchment disturbance	1
2.4	Flow modification	2
3 Diversity and richness		
3.1	Species	1
3.2	Communities / assemblages	1
3.3	Habitat	2
4 Threatened species and ecosystems		
4.1	Species	1
4.2	Communities / assemblages	1
5 Priority species and ecosystems		
5.1	Species	1
5.2	Communities / assemblages	1
6 Special features		
6.1	Geomorphic features	2
6.2	Ecological processes	1
6.3	Habitat	1
6.4	Hydrological	1
7 Connectivity		
7.1	Significant species or populations	2
7.2	Groundwater dependent ecosystems	2
7.3	Floodplain and wetland ecosystems	1
7.4	Terrestrial ecosystems	2

Criterion	Indicator description	Rank
7.5	Estuarine and marine ecosystems	3
8 Representativeness		
8.2	Wetland uniqueness	1

Appendix VIII - Non-riverine Indicator Ranks

The maximum rank is 1. If both Indicators within a Criterion are ranked 1 - they are considered of equal importance.

Criterion	Indicator	Rank
1 Naturalness aquatic		
1.1	Exotic flora / fauna	2
1.3	Habitat features modification	1
1.4	Hydrological modification	1
2 Naturalness catchment		
2.1	Exotic flora / fauna	2
2.2	Riparian disturbance	1
2.3	Catchment disturbance	1
2.4	Flow modification	2
3 Diversity and richness		
3.1	Species	1
3.3	Habitat	2
4 Threatened species and ecosystems		
4.1	Species	1
4.2	Communities / assemblages	1
5 Priority species and ecosystems		
5.1	Species	1
5.2	Communities / assemblages	1
6 Special features		
6.1	Geomorphic features	2
6.2	Ecological processes	1
6.3	Habitat	1
6.4	Hydrological	1
7 Connectivity		
7.1	Significant species or populations	2
7.2	Groundwater dependent ecosystems	1
7.3	Floodplain and wetland ecosystems	1
7.4	Terrestrial ecosystems	2

Criterion	Indicator	Rank
7.5	Estuarine and marine ecosystems	2
8 Representativeness		
8.1	Wetland protection	2
8.2	Wetland uniqueness	1

Attachment A - An Aquatic Conservation Assessment for the riverine and non-riverine wetlands of the Southern Gulf Catchments - Flora, Fauna and Ecology Expert Panel Report, Version 1.1.