Healthy Waters Management Plan

Maranoa and Balonne River Basin

This Healthy Waters Management Plan meets accreditation requirements for relevant water quality sections under the Water Act 2007- Basin Plan 2012.

Queensland Government

Acknowledgement of the Traditional Owners of the Maranoa and Balonne region

The Department of Environment and Science (the department) would like to acknowledge and pay respect to the past and present Traditional Owners of the region and their Nations, and thank the representatives of the Aboriginal communities, including the Elders, who provided their knowledge of natural resource management throughout the consultation process. The department acknowledges that the Traditional Owners of the Maranoa and Balonne basins have a deep cultural connection to their lands and waters. The department understands the need for recognition of Traditional Owner knowledge and cultural values in water quality planning.

Prepared by: Department of Environment and Science.

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Front cover photo: Balonne River, Beardmore Dam, A. Prior, 2016.

February 2019

Foreword

This document has been prepared in accordance with the Healthy Waters Management Plan requirements under the Queensland *Environmental Protection Act 1994* and Environmental Protection (Water) Policy 2009. This document also contributes to meeting particular requirements of a Water Quality Management Plan under the Commonwealth *Water Act 2007—Basin Plan 2012* (Basin Plan). The requirement for a Water Quality Management Plan is listed under Chapter 10, Part 7 of the Basin Plan. Text boxes such as this include explanations as to how this Healthy Waters Management Plan for the Queensland Maranoa and Balonne River basin (Refer to Figure 1) contributes to meeting the requirements of a Water Quality Management Plan under the Basin Plan.

What is a Healthy Waters Management Plan?

The Environmental Protection (Water) Policy 2009 (EPP Water), subordinate legislation under the *Environmental Protection Act 1994* (Qld.), establishes Healthy Waters Management Plans (HWMPs) as a key planning mechanism to improve the quality of Queensland waters.

HWMPs advance achievement of the purpose of the EPP Water to protect Queensland's water environment whilst allowing for development that is ecologically sustainable.

HWMPs include:

- identification and mapping of environmental values, desired levels of aquatic ecosystem protection and management goals for Queensland waters;
- water quality objectives (under the National Water Quality Management Strategy (NWQMS)[1]) to protect the environmental values; and
- management responses, which address point and diffuse emission sources, and may include market-based instruments, best management practice and adaptive management.

HWMPs provide an ecosystem-based approach to integrated water management, supported by best available science. The preparation of HWMPs includes:

- engaging with the local government, natural resource management groups, industry groups, local Aboriginal Nations and the community;
- addressing identified priority threats to water quality; and
- incorporating local catchment-based approaches to develop management responses.

What is a Water Quality Management Plan?

The Commonwealth *Water Act 2007—Basin Plan 2012* (Basin Plan) requires a water resource plan to include a Water Quality Management Plan (WQM Plan), prepared in accordance with Chapter 10, Part 7 of the Basin Plan. WQM Plans advance the achievement of the Basin Plan objectives and outcomes through:

- identifying the key causes, or likely causes, of water quality degradation;
- including measures to address risks arising from water quality degradation;
- identifying water quality target values;
- specifying measures to be undertaken in, or in relation to, the water resources of the water resource plan area;
- identifying locations of water quality targets for irrigation water; and
- assessing and having regard to the impact of the WQM Plan on the water resources of another Basin State.

Queensland's approach to the WQM Plan is an index which refers to relevant State and Commonwealth instruments to fulfil the requirements of the Basin Plan Chapter 10, Part 7. The HWMP prepared under the EPP Water fulfils most requirements of a WQM Plan. As a result, the HWMP is the primary document referred to under the WQM Plan (Refer to Figure 2).

The sections of this report that fulfil requirements of a WQM Plan under the Basin Plan include parts of Section 4 and Section 7 to Section 10.

[1] The NWQMS is a joint strategy developed by two Ministerial Councils – the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ).

Figure 1: The Queensland Healthy Waters Management Plan areas that intersect the Murray-Darling Basin. This HWMP applies to the Maranoa and Balonne River basin only.

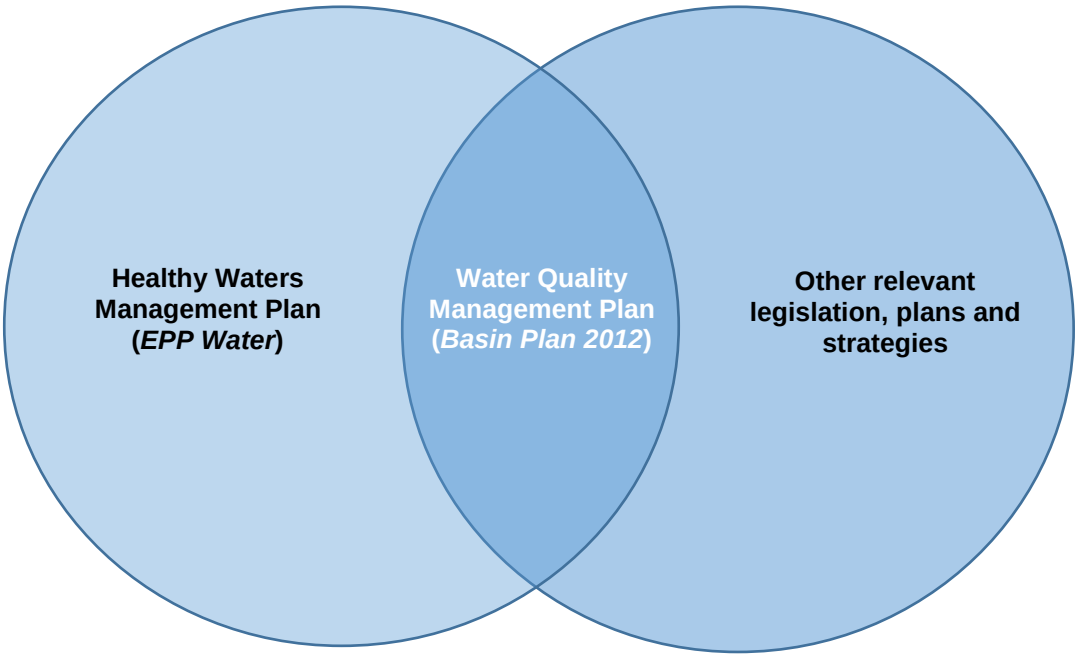

Figure 2: Queensland's approach to meeting Water Quality Management Plan requirements under Basin Plan.

The WQM Plan, prepared under Chapter 10, Part 7 of the Basin Plan, is an index that refers to relevant legislation, plans and strategies that address water quality. HWMPs, prepared under the EPP Water, are the primary documents referred to under the WQM Plan. Other relevant instruments that are referenced by the WQM Plan include Queensland Water Plans prepared under the *Water Act 2000* and the Basin Salinity Management Strategy (Schedule B to the Murray-Darling Basin Agreement).

Contents

Figures

Tables

Executive summary

The Healthy Waters Management Plan (HWMP) for the Maranoa and Balonne River basin has been prepared under the Environmental Protection (Water) Policy 2009 (EPP Water), which is subordinate legislation under the *Environmental Protection Act 1994* (Qld.). HWMPs present ways to improve the quality of water for a specified region in Queensland. As the Maranoa and Balonne River basin are located within the Murray-Darling Basin, this HWMP also contributes to the requirements of a Water Quality Management Plan (WQM Plan) under the Commonwealth *Water Act 2007— Basin Plan 2012.*

The HWMP for the Maranoa and Balonne River basin identifies the environmental, economic, social, cultural, spiritual and ceremonial values associated with the rivers, creeks, waterholes, floodplains, overflow channels, lakes, wetlands and groundwaters of the Maranoa and Balonne region. These are referred to under the EPP Water as 'environmental values' and are the qualities that make water suitable for supporting aquatic ecosystems and human use. The HWMP also identifies and maps the levels of aquatic ecosystem protection to inform the management of different types of aquatic ecosystems. The HWMP for the Maranoa and Balonne River basin was developed in consultation with a range of stakeholders, including Queensland and New South Wales government representatives, natural resource management groups, industry groups, environmental groups, local Aboriginal Nations, and the community.

Management goals are established in the HWMP for the Maranoa and Balonne River basin as the objectives and outcomes for water resources. They focus on achieving locally appropriate water quality target values (water quality objectives) that have been established at a sub-catchment level to protect identified aquatic ecosystem and human use environmental values for the waters. Long-term salinity planning and management is also addressed, with reference to the End-of-Valley Targets in Appendix 1 of Schedule B to the Murray-Darling Basin Agreement.

The extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished. Targets to maintain the extent of wetlands and riparian forest in the plan area are included in this report to help protect these important ecosystems.

A water quality risk assessment was conducted to identify the potential key types of water quality degradation that could occur in the Maranoa and Balonne River basin. It is important to note that just because a risk was highlighted through the assessment, does not mean the set of circumstances is currently present for the risk to materialise. The factors contributing to the potential risks are summarised in the healthy waters management plan.

The risks that were identified are presented below and are addressed through management responses included in the HWMP:

- elevated levels of salinity as a potential medium risk in surface waters of the Upper Balonne at Miles and in the groundwaters of the St George Alluvium: Condamine-Balonne (Deep) (GS61);
- elevated levels of suspended matter as a potential medium risk to aquaculture in Lower Balonne and Upper Balonne;
- elevated levels of nutrients as a potential medium risk in the surface waters of the Upper and Lower Balonne;
- elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds as a potential medium risk in the surface waters of Upper and Lower Balonne;
- water temperature outside natural ranges as a potential high risk in the surface waters of Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir, if stratification of the storages occurs. There is also a potential medium risk at Yuleba Creek due to connectivity with Great Artesian Basin waters;
- dissolved oxygen outside natural (ambient) ranges as a potential high risk in the surface waters of the Upper Balonne for Yuleba Creek as natural blackwater events have occurred here previously, as well as for the Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir, if stratification of the storages occurs;
- elevated levels of pesticides and other contaminants as a potential medium risk in the surface waters of the Upper Balonne between Dalby and Condamine;
- pH outside natural ranges as a potential medium risk in the surface waters of the Lower Balonne associated with acid sulfate soils;
- degradation of aquatic habitat connectivity and condition within and between water-dependent ecosystems and the degradation of riparian extent, connectivity and condition as medium risk in the Upper and Lower Balonne;
- climate change as high risk in the Condamine, Balonne and Maranoa and as medium risk in Lower Balonne;
- pest fauna (aquatic) as high risk in the Condamine, Balonne and Maranoa and Lower Balonne; and
- pest flora (land) as medium risk in the Lower Balonne.

The management responses included in this document seek to maintain, and where practical improve, water

quality towards achieving water quality target values (water quality objectives) that protect the environmental values across the plan area. These management responses recognise the existing projects being conducted across Queensland Murray-Darling Basin drainage basins, which may inform future updates to this document. The HWMP for the Maranoa and Balonne River basin also presents opportunities to strengthen the protection of Aboriginal peoples' values and uses of water, based on consultation with people from Aboriginal Nations in the plan area. The HWMP also encourages the implementation of Aboriginal Waterways Assessments (AWAs), where funded opportunities are available. AWAs are an in-field assessment of stream health from the perspective of Traditional Owners, and are a key initiative to increase the participation of Traditional Owners in natural resource and waterway management.

This HWMP advances the protection of the aquatic environment of the Maranoa and Balonne River basin through the achievement of objectives and outcomes in relation to water quality and salinity. The plan seeks to maintain appropriate water quality for environmental, social, cultural and economic uses; protect and restore water-dependent ecosystems; and ensure water resources remain fit-for-purpose.

SECTION 1: INTRODUCTION

1 Introduction

A Healthy Waters Management Plan (HWMP) presents ways to improve the quality of water for a specified region. HWMPs are a component of the framework for managing water quality in Queensland under the Environmental Protection (Water) Policy 2009 (EPP Water), which is subordinate legislation to the *Environmental Protection Act 1994* (Qld.).

1.1 Water to which this plan applies

HWMPs address water quality improvement within spatially defined geographic planning areas referred to as 'management units', which may range in scale from sub-region, to whole of catchment, to whole of basin (comprised of multiple catchments). A HWMP applies to all Queensland State waters within the defined management units (that is rivers, creeks, wetlands, lakes and groundwaters), except the types of water listed in Part 4, section 10(3) of the EPP Water.

This HWMP applies to the surface waters and groundwaters in the Maranoa and Balonne River basin (Refer to Figure 3), which fall within the Southern Queensland NRM regional organisation area. This HWMP also contributes to the Water Quality Management Plan for the Condamine-Balonne water resource plan area under Chapter 10, Part 7 of the *Basin Plan 2012* (Basin Plan).

1.2 Healthy Waters Management Plans under the Environmental Protection (Water) Policy 2009

In the following section, terminology under the Basin Plan is indicated in brackets.

HWMPs, as defined by the EPP Water, support achievement of the purpose of the EPP Water by identifying the environmental values (values and uses), water quality objectives (water quality target values) and management goals (objectives and outcomes) of the waters in a specified region, and identifying and prioritising ways to improve water quality.

The issues identified through a HWMP are broader than 'just water quality'. They include land management issues that can impact water quality, such as the health of the riparian zone or the management of grazing lands.

The economic and social impacts of protecting environmental values through water quality objectives are considered through consultation and via a socio-economic assessment. At the completion of consultation and consideration of all submissions, the environmental values and water quality objectives are subsequently recommended for inclusion under Schedule 1 of the EPP Water.

Water quality objectives under the EPP Water are long-term goals for water quality management. They are measurements, levels or narrative statements of particular indicators of water quality that protect identified environmental values. Once scheduled within the EPP Water, environmental values and water quality objectives inform statutory and non-statutory water quality management planning and decision-making.

1.3 Water Quality Management Plan under the Basin Plan

The Basin Plan, prepared by the Murray-Darling Basin Authority under the Commonwealth *Water Act 2007*, was approved in November 2012. The Basin Plan provides a coordinated approach to water use across the State and Territory government areas that intersect the Murray-Darling Basin (specifically Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory). The Basin Plan aims to achieve a balance between environmental, economic and social considerations.

The Basin Plan specifies that a WQM Plan is a component of a Water Resource Plan (Commonwealth Water Resource Plan). Commonwealth Water Resource Plans under the Basin Plan are to be submitted to the Murray-Darling Basin Authority for accreditation by the Commonwealth Minister responsible for water. In Queensland, Commonwealth Water Resource Plans will be comprised of a package of existing State instruments, primarily Queensland water plans and resource operations plans under the *Water Act 2000* (Qld.) (Refer to Section 1.5 of this report for more information) and HWMPs under the EPP Water.

A HWMP prepared under the EPP Water contributes to meeting the requirements of a WQM Plan under Chapter 10, Part 7 of the Basin Plan. HWMPs that fulfil select requirements of a WQM Plan have been developed for all Queensland Murray-Darling Basin (QMDB) drainage basins in collaboration with the natural resource management organisations for the region – currently Southern Queensland NRM. For each Commonwealth Water Resource Plan package submitted to the Murray-Darling Basin Authority for accreditation under the Basin Plan, the Queensland Government will include a HWMP for the relevant water resource plan area.

Three Commonwealth Water Resource Plan packages will be prepared for QMDB catchments, to be compliant with the Basin Plan by 2019:

1. Warrego-Paroo-Nebine water resource plan area
2. Condamine-Balonne water resource plan area
3. Queensland Border Rivers-Moonie water resource plan area.

Note: The Bulloo drainage basin is external to the Murray–Darling Basin and is therefore not subject to the Basin Plan.

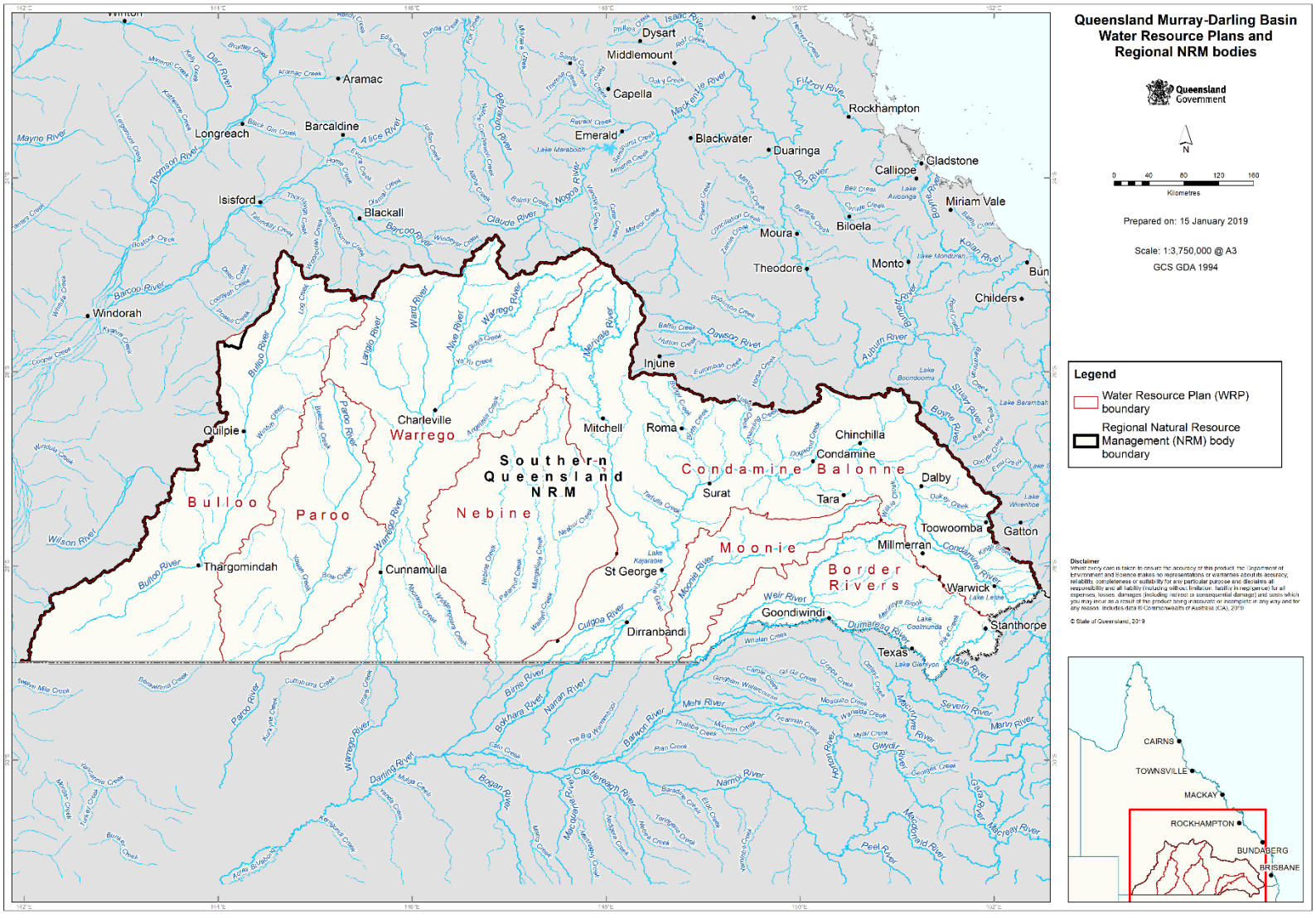

Figure 3: Queensland Murray-Darling Basin Water Resource Plan areas and project area for each NRM body in QMDB. This HWMP applies to the surface and groundwater of the Maranoa and Balonne River basin, in the Southern Queensland NRM regional organisation area.

1.4 Maranoa and Balonne Rivers region

The Maranoa and Balonne River covers approximately 63,400 square kilometres. The major towns in the region include Roma, St George, Mitchell and Surat. The local government areas that intersect the plan area are Balonne Shire Council, Central Highlands Regional Council, Maranoa Regional Council, and Western Downs Regional Council (WetlandInfo, 2018a). The National Parks in the region include Carnarvon National Park, Chesterson Range National Park, Culgoa Floodplain National Park, Erringibba National Park, Narkoola National Park, Thrushton National Park and Tregole National Park.

The dominant land use in the region is open grazing. Forestry is concentrated in the upper Maranoa and irrigated cropping is concentrated in the lower Balonne streams. Southern Queensland NRM is the regional body for natural resource management in the plan area.

1.4.1 Climate

The Maranoa and Balonne River region has a summer dominant rainfall pattern. The mean annual rainfall is relatively consistent across the region, although a general trend of annual rainfall decreasing from east to west is experienced. Miles (east) receives 650mm rainfall annually, Roma (central) receives 580mm rainfall annually, Mitchell (north west) receives 570mm rainfall annually and St George (south west) receives 490mm rainfall annually. Summer rainfall is dominated by high intensity storms from October to December, which can often be localised.

1.4.2 Surface water

The Maranoa and Balonne River region comprises approximately 24% of the Queensland Murray-Darling Basin. The main channel in this basin begins in the headwaters of the Condamine River basin, near Warwick. The Condamine River flows through the Condamine River basin until becoming the Balonne River between the town of Condamine and Surat.

The Balonne River flows east to west until Surat where it turns south-west. Many tributaries flow into the Balonne including Undulla Creek, Dogwood Creek, Yuleba Creek, Bungil Creek and the Maranoa River. The Balonne flows into Lake Kajarabie (Beardmore Dam) near St George, before becoming a braided network of channels, waterholes and floodplains that form the Narran, Bokhara, Ballandool and Culgoa rivers, and Briarie Creek.

The Bokhara, Ballandool and Culgoa rivers and Brairie Creek cross the NSW-Qld border and flow in a southern direction before discharging into the Darling River (Briarie Creek forms Briarie River as it crosses the NSW border). The Narran River crosses the NSW-Qld border before discharging into Narran Lake. The Maranoa River is the largest tributary in the basin and begins in the Carnarvon National Park. The river flows south-east through the town of Mitchell before discharging into the Balonne River, upstream of Lake Kajarabie. The major water storage in the area is Beardmore Dam (capacity 82 gigalitres).

1.4.2.1 Wetlands

Queensland’s wetlands are important habitats and include rivers (riverine), lakes (lacustrine) and swamps (palustrine). Queensland’s wetlands support the state's native biodiversity, including migratory birds, frogs, fish and threatened species. They are important for our economy because they provide nurseries for fish, water for farming and other uses. Wetlands remove sediments and transform nutrients and pesticides—protecting other downstream habitats. Wetlands are also great places to enjoy Queensland’s natural wonders. Many of Queensland’s wetlands are internationally important habitat for migratory birds and other values (WetlandInfo, 2018b). Wetlands are a focus of ecological diversity and abundance, and are subject to booms and busts determined by seasonal and sometimes decadal conditions. The two nationally important wetlands (DIWA) in the plan area are Balonne River Floodplain and The Gums Lagoon. The internationally recognised Ramsar wetland, Narran Lake Nature Reserve, resides in NSW. The Narran River, which is a distributary of the Balonne River and begins in Queensland, discharges into Narran Lake Nature Reserve.

For an extensive range of information, tools and maps on wetlands in Queensland refer to the Wetland*Info* website.

1.4.2.2 AquaBAMM

AquaBAMM is the state endorsed method for the identifying and assessing wetlands in Queensland. AquaBAMM is a decision support tool that utilises existing information and expert input to assess conservation value in aquatic ecosystems. The output of the AquaBAMM method is an Aquatic Conservation Assessment (ACA) for a specified study area (WetlandInfo, 2013a).

The ACA for the wetlands of the Queensland Murray-Darling Basin was published in July 2011 (Fielder, Davidson, & Barratt, 2011). ACAs provide a source of baseline, wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered. The ACA for the wetlands of the Queensland Murray-Darling Basin was a source of information for the development of this report.

The ACAs assess riverine and non-riverine (palustrine and lacustrine) wetlands separately. A project area, such as the Queensland Murray-Darling Basin, is divided into smaller sub-catchment units for the assessment. The riverine or non-riverine wetlands within the sub-catchment units are then assigned an AquaScore based on an assessment of eight criteria. The criteria are naturalness aquatic, naturalness catchment, diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. The AquaScore represents the overall conservation value of a sub-catchment unit and varies from very low to very high.

Figure 4 and Figure 5 display the riverine and non-riverine AquaScores for the Queensland Murray-Darling basins. To highlight the significant wetland areas in the plan area, Figure 6 and Figure 7 present the riverine and non-riverine special features that were used in the development of the AquaScores. Special features are areas identified by flora, fauna and ecology expert panels. These features display characteristics which expert panels consider to be of the highest ecological importance. Special features include geomorphic features, unique ecological processes, presence of unique or distinct habitat, and presence of unique or special hydrological regimes e.g. spring-fed streams (WetlandInfo, 2013b).

1.4.2.3 Persistent waterholes

Persistent waterholes along the river systems in the plan area provide aquatic habitat during extended periods of low or no flow and, as a result, are referred to as ‘refugial waterholes’. They are critical components of a functioning ‘source and sink’ system for aquatic organisms in the semi-arid landscapes of the QMDB (Silcock, 2009).

Refugial waterholes experience variable patterns of connection and disconnection which is a fundamental driver of ecological processes in these riverine environments and is vital for dispersal and survival of diverse populations of biota. Persistent refugial waterholes require careful management, not as individual waterholes, but as an integrated system of waterholes along the length of rivers and channels.

Further research into the persistence of waterholes in the Maranoa and Balonne River basin is needed to enable adequate assessment of threats to waterholes in the basin. The persistent waterholes for the Maranoa and Balonne River basin are listed in Appendix 4— Persistent Waterholes in the Maranoa and Balonne.

1.4.2.4 Barriers to fish passage

Instream infrastructure, such as weirs, dams and road crossings, can limit the passage of aquatic fauna and affect their ability to migrate to new habitats for the purposes of food and spawning, and access to permanent waterholes. Some opportunities for fish passage are provided through barrier drown-out, where water depth downstream of the barrier increases during flooding to equal or exceed the height of the barrier. However, not all fish will be able to utilise these opportunities due to their size and speed. Note that barriers in the centre of a drainage basin impact inland fish more than barriers in lowland reaches, because barriers higher in the catchment typically drown-out less frequently (Kerr, Kimball, Prior, Ellaway, & Luke, 2015). Figure 8 displays the barriers to fish passage in the plan area based on best available information. Further work may identify additional barriers in the plan area. It is important to consider barriers to fish passage for the purposes of managing aquatic fauna in the plan area, particularly with respect to environmental flows/low flow levels and access to permanent waterholes during dry periods.

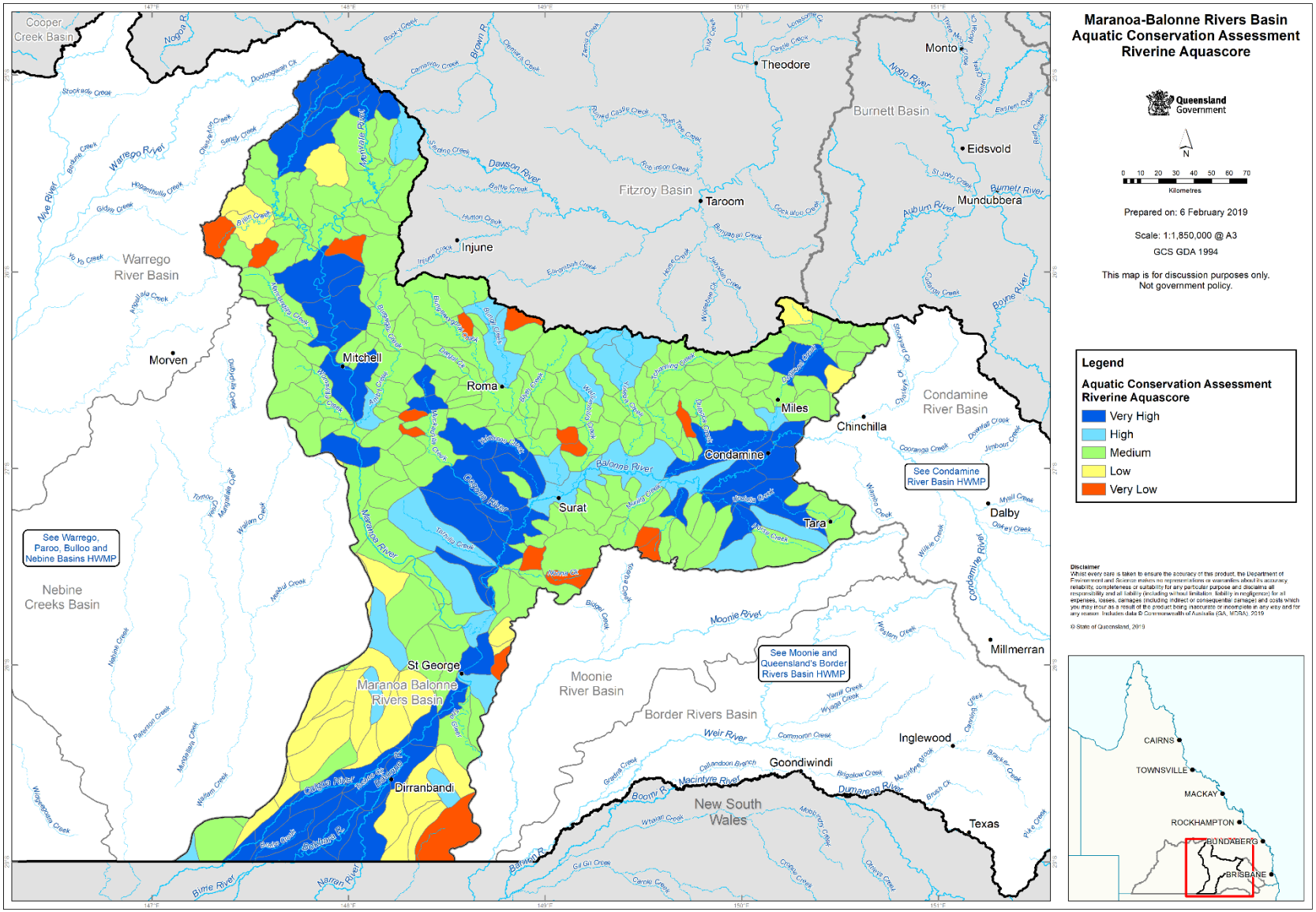

Figure 4: Riverine Aquatic Conservation Assessment AquaScores for the Maranoa and Balonne River basin

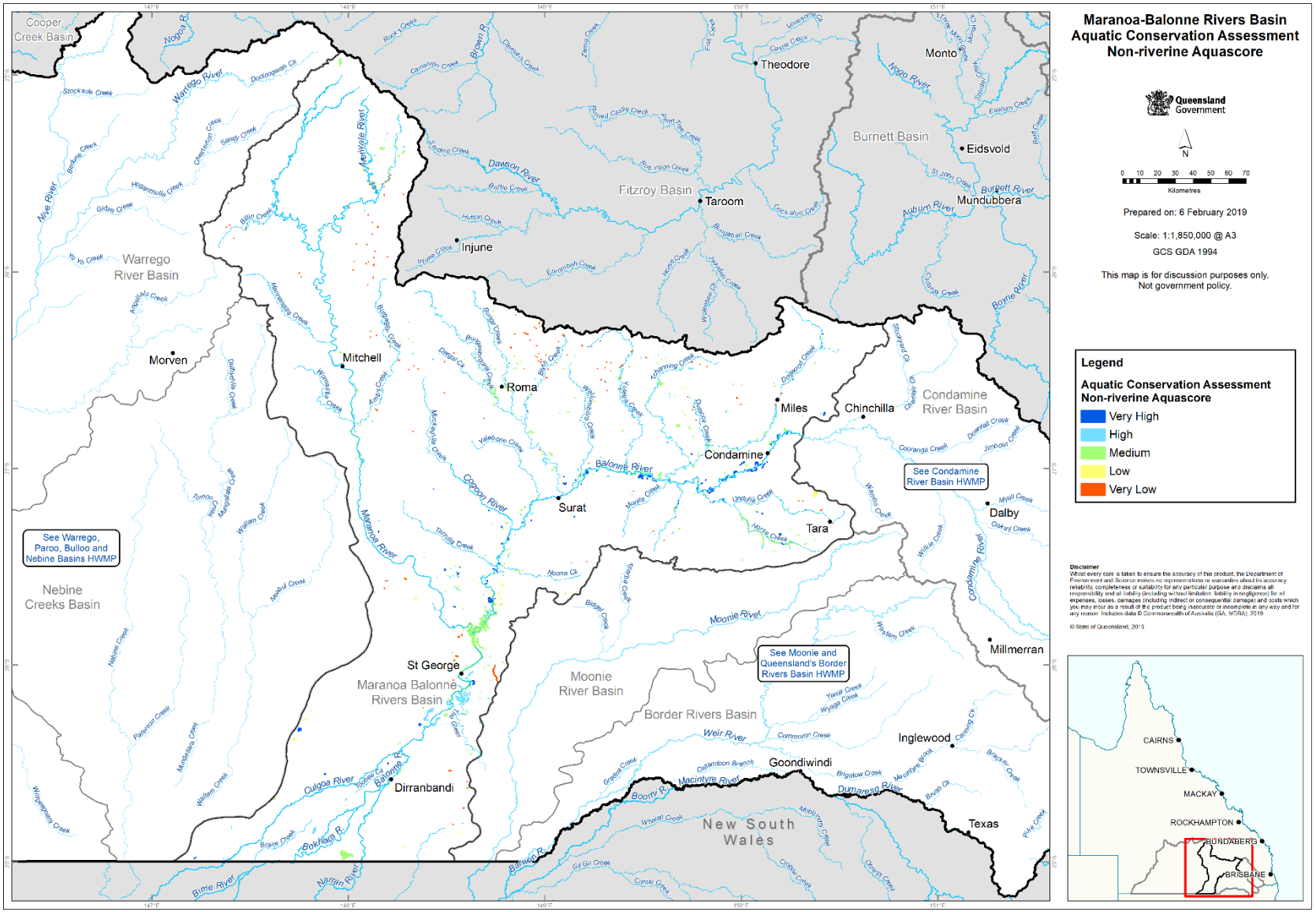

Figure 5: Non-Riverine Aquatic Conservation Assessment AquaScores for the Maranoa and Balonne River basin

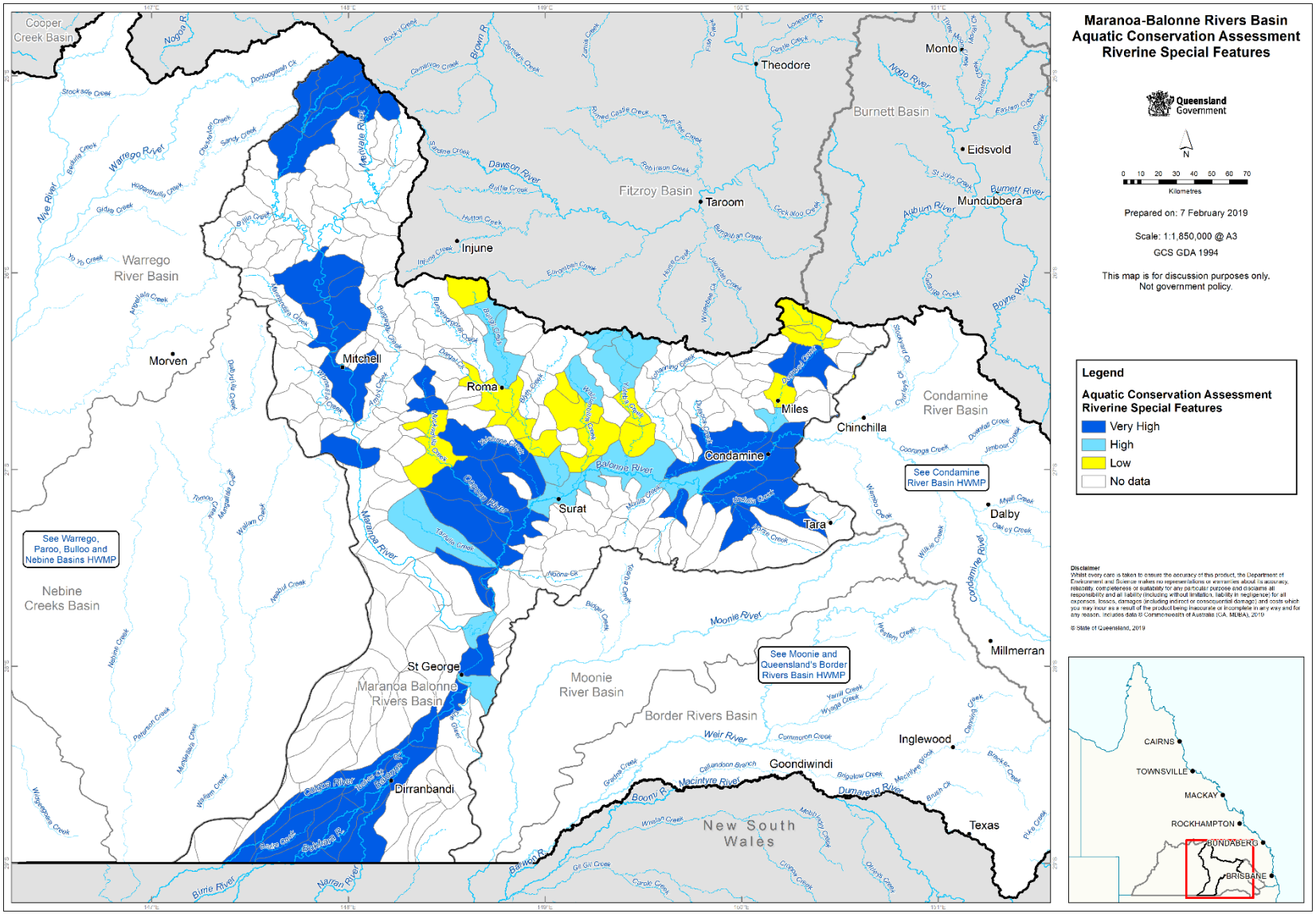

Figure 6: Riverine Special Features contributing to the Aquatic Conservation Assessment for the Maranoa and Balonne River basin

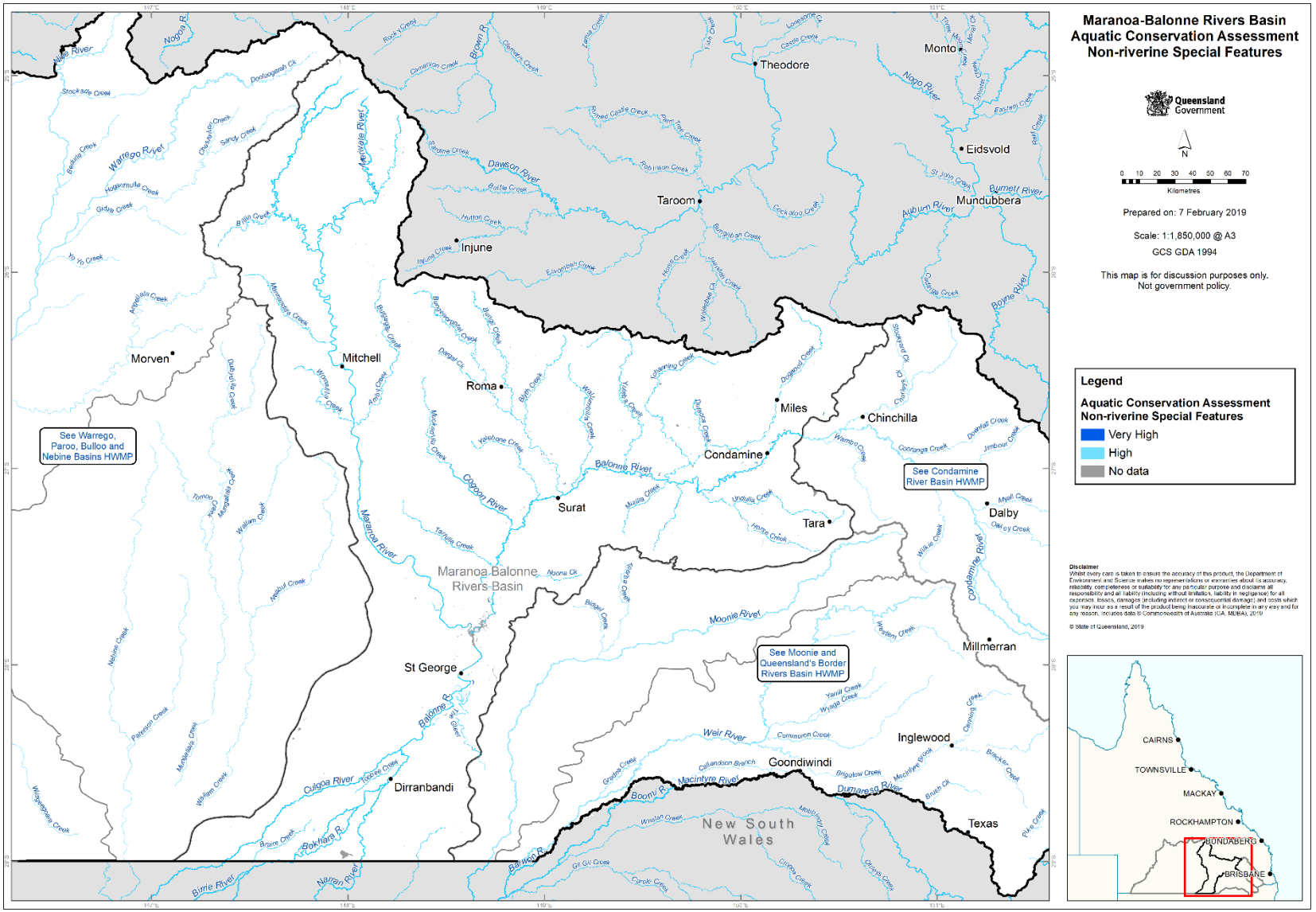

Figure 7: Non-Riverine Special Features contributing to the Aquatic Conservation Assessment for the Maranoa and Balonne River basin

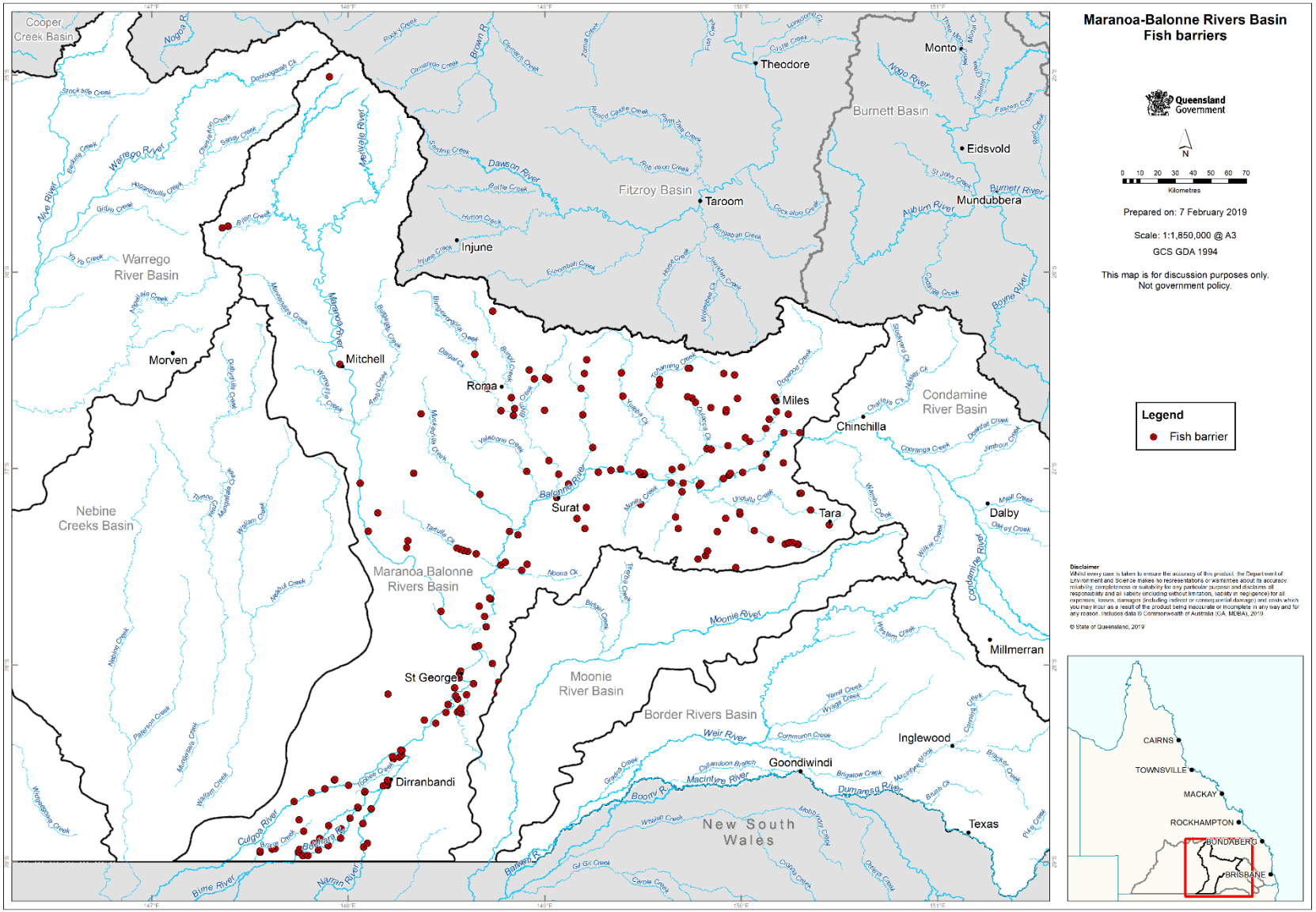

Figure 8: Barriers to fish passage, including weirs and road crossings, in the Maranoa and Balonne River basin (Kerr et al., 2018)

1.4.3 Groundwater

Groundwater is present in the region in shallow alluvial and sandstone aquifers, and within the deeper confined strata of the Great Artesian Basin. Due to the climate variability, recharge of the groundwater aquifers is strongly episodic and relies on periods of unusually high rainfall or wetter than average winter to increase deep drainage rates (McNeil, Raymond, Bennett, & McGregor, 2017). The Great Artesian Basin (GAB) is recharged from infiltration occurring on the north-west slopes of the Great Dividing Range.

The Basin Plan identified four groundwater Sustainable Diversion Limit (SDL) resource units for the plan area:

- Queensland MDB: deep (GS56);
- Sediments above the Great Artesian Basin: Condamine-Balonne (shallow) (GS58);
- St George Alluvium: Condamine-Balonne (shallow) (GS61);
- St George Alluvium: Condamine-Balonne (deep) (GS61); and
- Upper Condamine Alluvium (Tributaries) (GS64b).

The Basin Plan does not apply to groundwater of the GAB and as such, SDL resource units do not include GAB waters. However, for Queensland legislative and planning purposes, this HWMP includes waters of the GAB.

Refer to Figure 9 for a map of the groundwater SDL resource units that intersect the plan area.

1.4.3.1 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson, et al., 2011). Ecosystem dependency on groundwater may vary temporally (over time) and spatially (depending on its location in the landscape). GDEs can include aquifers, caves, lakes, palustrine wetlands, lacustrine wetlands, rivers and vegetation (WetlandInfo, 2017a). It is important to note that not all groundwater dependent ecosystems are associated with a spring. Some groundwater dependent ecosystems will access groundwater that does not express at the surface, such as the roots of vegetation (WetlandInfo, 2015).

Refer to Figure 10 for a map of the groundwater dependent ecosystems in the plan area. A basic requirement for managing groundwater and GDEs is to understand where and how groundwater moves through the landscape. Potential GDE aquifer mapping seeks to achieve this through identifying the extent and key characteristics of GDE aquifers in a landscape. Potential GDE aquifer mapping incorporates a range of criteria including, but not limited to, confinement, geology, porosity, groundwater flow system, salinity, pH and recharge processes (WetlandInfo, 2017b). Figure 11 displays the potential GDE aquifers across the plan area.

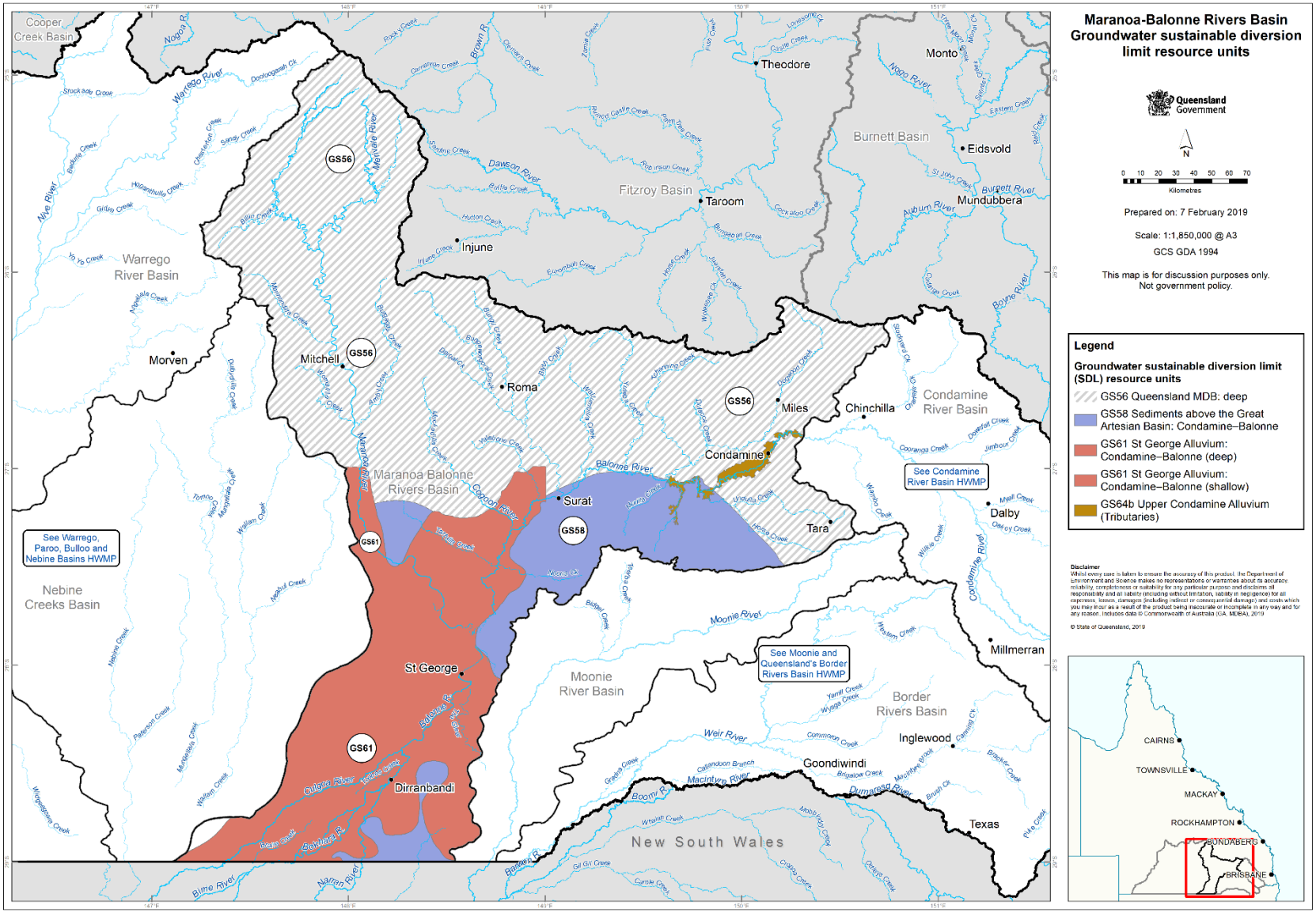

Figure 9: Groundwater Sustainable Diversion Limit resource units identified under the Basin Plan for the Maranoa and Balonne River basin (MDBA, 2018).

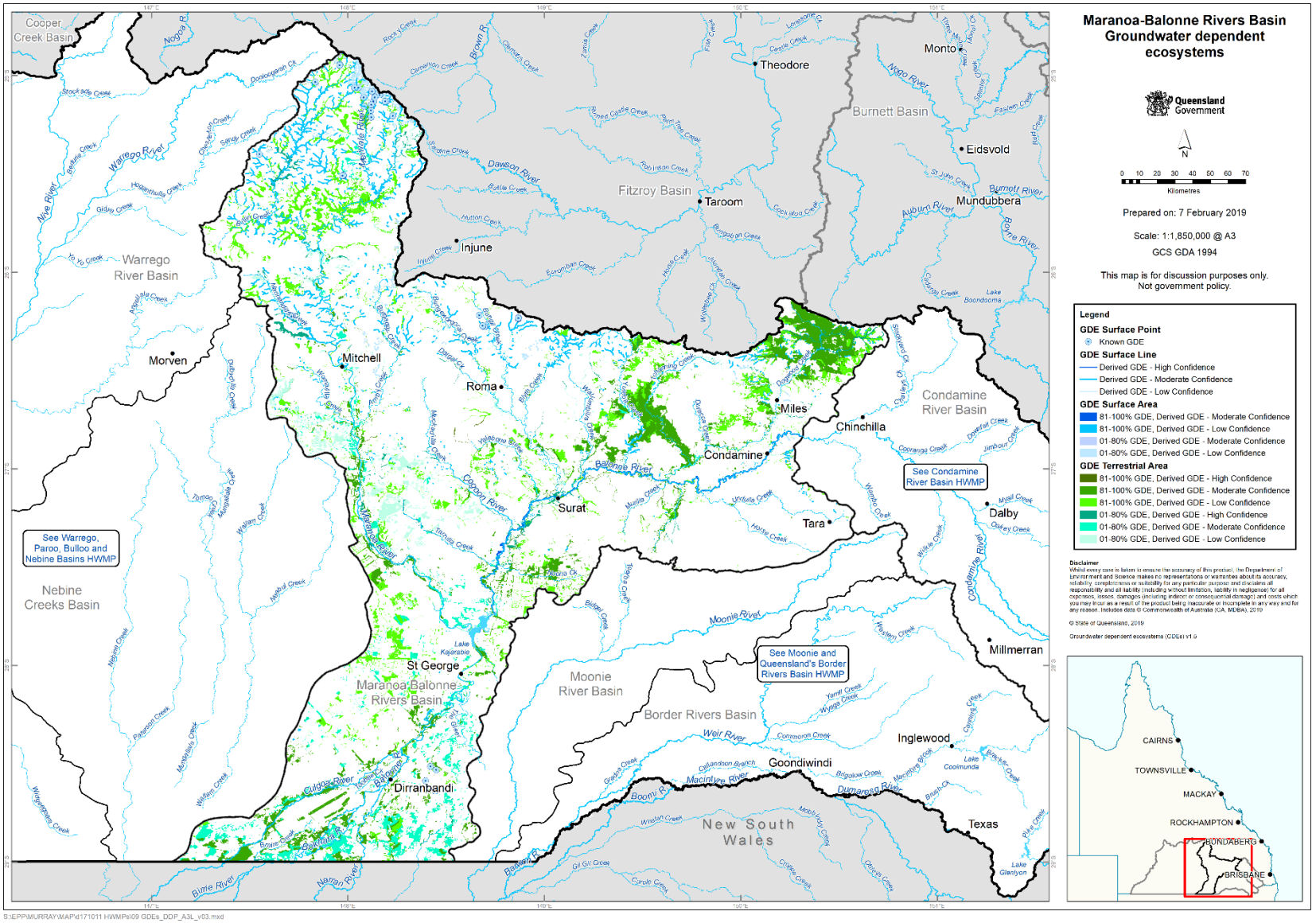

Figure 10: Groundwater Dependent Ecosystems in the Maranoa and Balonne River basin.

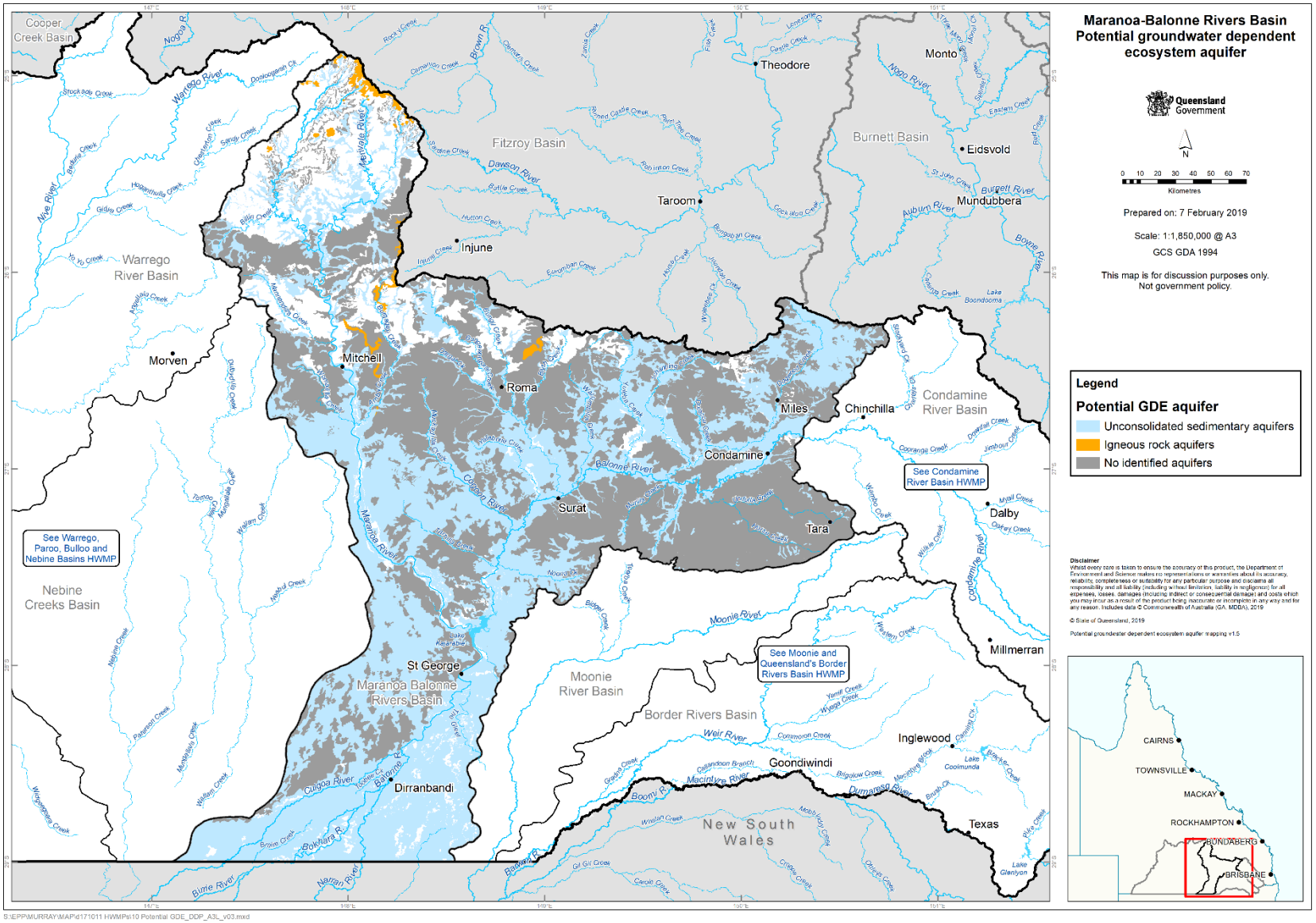

Figure 11: Potential Groundwater Dependent Ecosystems aquifer mapping within the Maranoa and Balonne River basin.

1.5 Queensland water resource planning

The allocation and sustainable management of water in Queensland is accomplished through the water planning process. This process involves the preparation of statutory water plans under the *Water Act 2000* (Qld) and accompanying water entitlement notices, water management protocols, resource operations licences, distribution operations licences and operation manuals. The statutory water plan for the area covered by this HWMP is the *Water Plan (Condamine and Balonne) 2019.* The water plan states the strategic outcomes, objectives and strategies for achieving a sustainable balance between water for industry, irrigators, town water supply, the community and environment. This includes the economic, social, cultural and ecological outcomes that apply to the plan area, as well as water allocation security objectives and environmental flow objectives.

The Basin Plan requires Commonwealth Water Resource Plans to be submitted to the Murray–Darling Basin Authority for accreditation by the Commonwealth Minister responsible for water. The Commonwealth Water Resource Plans are different from Queensland's existing statutory water plans. They will comprise a package of existing State instruments and other relevant documents that together meet the requirements of the Basin Plan. Key components of this package include the Queensland water planning instruments, as well as the healthy waters management plan and other relevant documents. Currently there are three Queensland water plans that intersect the Murray-Darling Basin—Warrego, Paroo, Bulloo[2] and Nebine; Condamine and Balonne; Border Rivers and Moonie.

1.5.1 Environmental flow objectives and ecological outcomes

The Water Plan (Condamine and Balonne) 2019 states the environmental flow objectives and ecological outcomes that apply to the plan area. Refer to the Department of Natural Resources, Mines and Energy water plan areas website to access a copy of the plan.

1.5.2 Great Artesian Basin

The Great Artesian Basin (GAB) underlies majority of the QMDB. The allocation and sustainable management of water from the GAB is managed separately under the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 and the Water Management Protocol for the Great Artesian Basin and Other Regional Aquifers 2017. The Great Artesian Basin management areas within the Maranoa and Balonne Basin plan area includes groundwater sub-basin Surat Basin.

1.5.3 Intergovernmental Agreements

The Dumaresq-Barwon Border Rivers Commission also applies to this plan area. The governments of Queensland and New South Wales agreed to share the waters of the rivers and streams which either form or intersect the boundary between the two states and the associated groundwater resources; and to investigate, construct and operate works to conserve and regulate those waters where considered desirable. The waters included under this interstate agreement include Glenlyon Dam, the Border Rivers (Dumaresq, Macintyre and Barwon Rivers) and the intersecting streams (Moonie, Bokhara, Narran, Culgoa, Ballandool, Warrego and Paroo Rivers).

Water quality monitoring data is collected under this agreement, from sites downstream of the Queensland border and throughout the Border Rivers and intersecting streams. This monitoring data was considered in developing the local water quality targets for fresh water-dependent ecosystems presented in Section 10.2 of this report.

1.6 State Planning Policy

The State Planning Policy (SPP) defines the Queensland Government's policies about matters of state interest in land use planning and development (a state interest is defined under the *Planning Act 2016*).

1.6.1.1 Regional plans

The Queensland Government prepares regional plans which are long term strategic plans in partnership with local authorities that support local growth and development while also protecting a region’s natural resources. At a regional and state level, regional plans guide overall growth patterns. At a local level, they are given effect by local government planning schemes, which are required to demonstrate they have appropriately integrated the relevant regional plan.

[2] Although the Bulloo drainage basin is not connected to the Murray-Darling Basin, it is included in the Queensland water plan area with the Warrego, Paroo and Nebine drainage basins for State planning purposes.

The Darling Downs Regional Plan was completed in October 2013. This plan covers a large proportion of the Queensland Murray-Darling Basin and describes environment and heritage matters but does not state strategic directions requiring statutory compliance by councils when preparing their planning schemes.

Current Regional Plans are available at the Queensland Planning System website at https://planning.dsdmip.qld.gov.au/planning/better-planning/state-planning/regional-plans.

1.6.1.2 Local planning schemes

Every local government has a planning scheme. These describe a council's plan for the future direction of a local government area and can span for 20 years or more. Depending on when the planning scheme was drafted, planning schemes may or may not align with the current SPP. More recent schemes (prepared after 2014) are likely to include mapping and codes which align with the current SPP and its water quality, biodiversity and heritage guidelines. The more recent planning schemes are likely to contain a biodiversity overlay (or equivalent) which maps the extent of land subject to matters of local environmental significance and codes which regulate development where matters of environmental significance are mapped. For more information on planning schemes, refer to Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) planning system webpage at https://planning.dsdmip.qld.gov.au/?jumpTo=map.

1.6.2 State Planning Policy: state interest—biodiversity

The State Planning Policy (SPP) lists biodiversity as a state interest and seeks to ensure that matters of national, state and local environmental significance are valued and protected and the health and resilience of biodiversity is maintained or enhanced to support ecological integrity. The SPP (and the accompanying SPP Guideline: Biodiversity) guides plan makers preparing or reviewing town planning schemes, regional plans or community infrastructure designations. The SPP and supporting guideline are available from the DSDMIP website.

1.6.3 State Planning Policy: state interest—cultural heritage

The State Planning Policy (SPP) lists cultural heritage is a state interest and seeks to ensure that 'the cultural heritage significance of heritage places and heritage areas, including places of Indigenous cultural heritage, is conserved for the benefit of the community and future generations'. It includes provisions to integrate the state interest—cultural heritage when making or amending a planning scheme and designating land for community infrastructure. This includes considering and integrating matters of Aboriginal cultural heritage and Torres Strait Islander cultural heritage to support the requirements of the *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Cultural Heritage Act 2003*[3]. World heritage properties, national heritage places and non-Indigenous cultural heritage places are additional considerations under the state interest—cultural heritage.

The SPP (state interest—cultural heritage) is supported by the State Planning Policy: state interest guideline—cultural heritage (April 2016 and as updated). The SPP and supporting guideline are available from the DSDMIP webpage.

1.6.4 State Planning Policy: state interest —water quality

The State Planning Policy (SPP, July 2017) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Policy elements and development benchmarks are specified in the SPP for the State Interest for Water Quality to ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The policy elements and benchmarks include the consideration of receiving waters and development in water resource catchments and water supply buffer areas.

The development benchmarks refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons. Therefore, these objectives currently apply to the city of Toowoomba in the QMDB region, as it classifies as a

[3] The *Aboriginal Cultural Heritage Act 2003* (ACHA) and *Torres Strait Islander Cultural Heritage Act 2003* (TSICHA) provide for the recognition, protection and conservation of Aboriginal and Torres Strait Islander cultural heritage and impose a duty of care in relation to the carrying out of activities. The requirements of the ACHA and TSICHA apply separately and in addition to the SPP.

population centre greater than 25,000 persons.

The SPP State Interest for Water Quality is supported by the State Planning Policy: state interest guideline—water quality (July, 2016).

The guideline includes a model code to guide Local Governments in specifying performance outcomes and acceptable solutions that can be incorporated into planning schemes. Environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009 are core concepts under this guideline. The SPP and supporting guideline are available from the DSDMIP website.

SECTION 2: EXISTING CONDITION AND EXTENT

2 Existing condition and extent

2.1 Condition

The Queensland Government Q-catchments Program assessed the threats to the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The basins assessed under this program were the Condamine, Balonne, Maranoa, Lower Balonne, Moonie and Border Rivers. Threats to the aquatic ecosystem were identified and prioritised for each basin, and are discussed below. The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, this section will report on the findings for the combined basins. Lower Balonne was assessed as a separate basin and will be reported on as such. The following priority threats were identified for the Condamine, Balonne and Maranoa basins:

1. Instream pest fauna – High priority threat
2. Climate change – High priority threat
3. Deposited sediment – High priority threat
4. Hydrology- sub-threat: Flow regime general – Medium priority threat
5. Riparian disturbance – Medium priority threat

The following priority threats were identified for the Lower Balonne basin:

1. Instream pest fauna – High priority threat
2. Hydrology- sub-threat: floodplain inundation – High priority threat
3. Hydrology- sub-threat: in-channel flow variability – High priority threat
4. Deposited sediment – Moderate priority threat
5. Climate change – Moderate priority threat
6. Hydrology- sub-threat: Flow regime general – Medium priority threat
7. Introduced riparian flora – Medium priority threat

The Q-catchments report notes that the identified list of priority threats will be used to support the selection and prioritisation of riverine condition indicators for application in future monitoring activities. This further assessment of the catchment condition informs the management of additional threats to water quality, as it is unlikely that ecological outcomes can be achieved through the management of flow regime alone. Due to the focus of the Q-catchment report on ecosystem condition related to flow regime, this HWMP includes additional sources of information to inform the existing condition of the Maranoa and Balonne River basin.

2.1.1 Instream pest fauna

The presence of instream pest fauna is often associated with a decline in the populations and communities of native flora and fauna (Negus, et al., 2015) particularly where native populations are already under stress from poor water quality or habitat degradation. This is due to the increased predation and competition with native species. Pest fish are introduced into the ecosystem in a number of ways including, dumping of unwanted fish to waterways, the use of pest fish as bait, and stocking of fish in dams and impoundments. Of the 12 species of instream pest fauna present in the Murray-Darling basin (Lintermans, 2007), four fish species and one amphibian are known to occur, and one fish species has a real potential to occur in the Condamine, Balonne, and Maranoa. Three fish species and one amphibian are known to occur, and two fish species have real potential to occur in the Lower Balonne basins (Table 1).

Table 1: Presence of instream pest fauna in the Condamine, Balonne, Maranoa and Lower Balonne basins (Negus, et al., 2015)

Species	Condamine, Balonne and Maranoa	Lower Balonne
European carp *(Cyprinus carpio)*	✓	✓
Eastern mosquitofish *(Gambusia holbrooki)*	✓	✓
Goldfish *(Carassius auratus)*	✓	✓
Mozambique tilapia *(Oreochromis mossambicus)*	× (at risk)	× (at risk)
Pearl cichlid *(Geophagus brasiliensis)*	✓	× (at risk)
Cane Toad *(Bufo marinus)*	✓	✓

2.1.2 In-channel flow variability

Many rivers in QMDB naturally cease to flow and resultantly, become disconnected during dry periods. Water storages and downstream releases in the eastern catchments of QMDB have resulted in an alteration to in-channel flow variability, by stabilising flows and reducing the magnitudes of flood flows. Reduced flow variability and increased seasonal stability can adversely impact native fish reproduction or migration, favour populations of exotic fish, and has been shown to influence aquatic macroinvertebrates, favouring taxa adapted to such conditions (Negus, et al., 2015).

2.1.3 Deposited sediment

Intermittently flowing river systems of the eastern catchments of QMDB are often characterised by a series of waterholes which vary in persistence. Waterholes offer critical refuges for aquatic biota, terrestrial plants and animals and other water users, including for social, cultural and economic purposes during periods of low or no-flow (Lobegeiger, 2010). Alterations to hydrology can threaten waterhole persistence due to changes to the frequency with which waterholes are filled and sediment is flushed through the system (DSITI, 2015).

Research conducted by the Queensland Government into the persistence of waterholes in the Lower Balonne (DSITI, 2015) found that the average persistence time of waterholes in the Culgoa River was 377 days and in the Narran River the average persistence time was 355 days. Further research is required to quantify the rate of sedimentation in these waterholes.

The eWater Source Water Quality Model for the Queensland Murray-Darling Basin (Davidson, 2018), provides information about the sources in the landscape contributing sediment to stream in Maranoa and Balonne River basin (Table 2). The model also indicates the proportion of sediment being contributed to stream from each land use in Maranoa and Balonne River basin (Table 3). This information is useful for determining where investment in land management will be most effective for reducing instream sedimentation rate.

Table 2: Proportion of total suspended solids contributed to stream by each source in the Maranoa and Balonne River basin (Davidson, 2018).

Source of sediment	Maranoa (%)	Balonne (%)
Channel remobilisation	2	1
Gully	60	53
Hillslope	13	7
Streambank	24	32
Undefined	0	7

Table 3: Contribution of total suspended solids from exported tonnes per hectare, to stream by land use in the Maranoa and Balonne River basin (Davidson, 2018).

Land use	Maranoa (%)	Balonne (%)
Conservation	1	7
Cropping	24	32
Grazing	36	12
Forestry	1	1
Horticulture	7	4
Intensive animal industry	13	2
Mining	8	3
Other	7	5
Rural residential	7	2
Urban	8	5
Waste treatment	7	4
Water	7	22

2.1.4 Flow regime and instream connectivity: barriers

The flow regime of the Maranoa and Balonne River basin has been altered from natural flows due to the presence of numerous dams and weirs, and the extraction of water by industry, irrigation and other land uses. Aquatic species have evolved or adapted in line with natural flow regimes, often relying on hydrologic cues for spawning, migration or recruitment. Alterations to natural flows can negatively impact or exclude aquatic species, particularly fish.

Barriers to fish passage, either due to infrastructure or periods of low flow, can prevent fish from migrating to access foraging or breeding areas, and vital drought refugia. For many species the timing of this is key to

reproductive success. Refer to Figure 8 for the barriers to fish passage in the Maranoa and Balonne River basin.

2.1.5 Riparian disturbance and riparian weeds

Riparian disturbance, including clearing, reduction and fragmentation of riparian vegetation, impacts the aquatic and terrestrial ecosystem significantly. Habitat removal, along with decreased bank stability, reduced interception of sediments and other pollutants, increased light penetration and increased abundance and prevalence of weed species, are associated impacts of riparian vegetation disturbance.

The loss of riparian vegetation from pre-European settlement to 2013 due to anthropogenic impacts was determined in the Riparian Forest and Ground Cover Levels report (Clark, Healy, & Tindall, 2015). Clark et al., found that 27% of pre-European riparian vegetation has been cleared in the Maranoa River (58,721 ha) and 46% in the Balonne River (162,257 ha). Further, the proportion of the riparian area that is endangered is approximately 2% in the Maranoa and approximately 1% in the Balonne. The proportion that is of concern is approximately 17% in the Maranoa and approximately 20% in the Balonne.

Refer to section 10.2.8 for further information on riparian levels and recommended targets to contribute to maintaining and improving ecosystem health.

Although introduced riparian flora was not identified as a priority threat by the Q-catchments program in the Condamine, Maranoa and Balonne River basin, riparian weeds, including Weeds of National Significance (WONS), have been detected. However, introduced riparian flora was identified as a priority threat specifically in the Lower Balonne region. Table 4 displays the riparian floral weed species identified in the Condamine, Maranoa and Balonne, and the Lower Balonne River basin.

Table 4: Riparian weeds identified in the Maranoa and Balonne River basin (Negus, et al., 2015) (derived from Maranoa Regional Council).

Species	Condamine, Maranoa and Balonne	Lower Balonne
African boxthorn (*Lycium ferocissimum*)*	✓	×
Annual ragweed (*Ambrosia artemisiifolia*)	✓	×
Blackberry (*Rubus fruticosus* sp. *aggregate*)*	✓	×
Bridal creeper (*Asparagus asparagoides*)*	✓	×
Chilean needle grass (*Nassella neesiana*)*	✓	×
Cholla Cactus – Devils Rope Pear (*Cylindropuntia imbricate*)	✓	×
Firethorn (*Pyracantha* spp.)	✓	×
Fireweed (*Senecio madagascariensis*)*	✓	✓
Groundsel (*Baccharis halimifolia*)	✓	×
Harrisia cactus (*Eriocereus* spp. inc. *E. martini*)	✓	✓
Honey locust tree (*Gleditsia triacanthos*)	✓	✓
Lantana (*Lantana camara*)*	✓	✓
Lippia (*Phyla canescens*)	✓	✓
Mexican poppy (*Argemone mexicana*)	✓	✓
Mother-of-millions (*Bryophyllum delagoense*	✓	×

Species	Condamine, Maranoa and Balonne	Lower Balonne
syn. *B tubiflorum*)		
Noogoora Burr (*Xanthium pungens*)	✓	✓
Parkinsonia (*Parkinsonia aculeate*)*	✓	✓
Parthenium (*Parthenium hysterophorus*)*	✓	✓
Prickly acacia (*A. nilotica* subspecies *indica*)*	✓	×
Prickly pear/Opuntioid cacti (*Opuntia* spp.)*.	✓	✓
Privets (*Ligustrum lucidum* & *L. sinense*)	✓	×
Saffron thistle (*Carthamus lanatus)*	✓	✓
Serrated tussock (*N. trichotoma*)*, Mexican feather grass (*N. tenuissima*), weedy sporobolus or rat's tail grasses, Parramatta grass (*S. africanus*), giant Parramatta grass (*S. fertilis*), giant rat's tail grass (*S.pyramidalis* and *S. natalensis*)	✓	✓
St John's wort (*Hypericum perforatum*)	✓	×
Thornapples (*Datura* spp.)	✓	×
Tiger pear (*O. aurantiaca*)	✓	×
Velvet tree pear (*O. tomentose*)	✓	✓
Willows (*Salix* spp.)*	✓	×

*Weeds of National Significance (WONS).

2.1.6 Water Quality

2.1.6.1 Surface water

The surface water quality of the Maranoa and Balonne River basin was assessed during the development of water quality targets for these basins (Refer to Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions). A comparison of surface water quality across the Maranoa, Balonne and Lower Balonne[4] is displayed in the below figures.

Figure 12 shows the average concentration of total nitrogen and total phosphorus across the three river basins. Balonne River has the greatest average concentration of nitrogen (1492µg/L), followed by the Lower Balonne (1237µg/L) and Maranoa (1097µg/L).

Figure 13 shows the average turbidity (NTU) across the three river basins. The Lower Balonne has the highest turbidity levels (407NTU), followed by the Balonne (367NTU) and the Maranoa (285NTU).

Figure 14 displays the average electrical conductivity (µS/cm) across the three river basins. The Maranoa has the greatest electrical conductivity (368µS/cm), followed by the Balonne (277µS/cm) and the Lower Balonne (226µS/cm). At present, in-stream salinity is not considered high compared to other areas of the Murray-Darling Basin. However, it has the potential to become a water quality issue if land uses and management practices that result in elevated salinity levels are not managed appropriately into the future.

[4] The three water quality zones are an amalgamation of several water types (refer to Figure 30) as such: Maranoa (Upper Maranoa, Lower Maranoa and Maranoa Fan); Balonne (Dogwood Creek, Undulla Creek, Lower Condamine Floodplain, Balonne River, Yuleba Creek and Bungil Creek); and Lower Balonne (Lower Balonne Streams, St George Floodplain, Briarie Creek and Lower Balonne Floodplain).

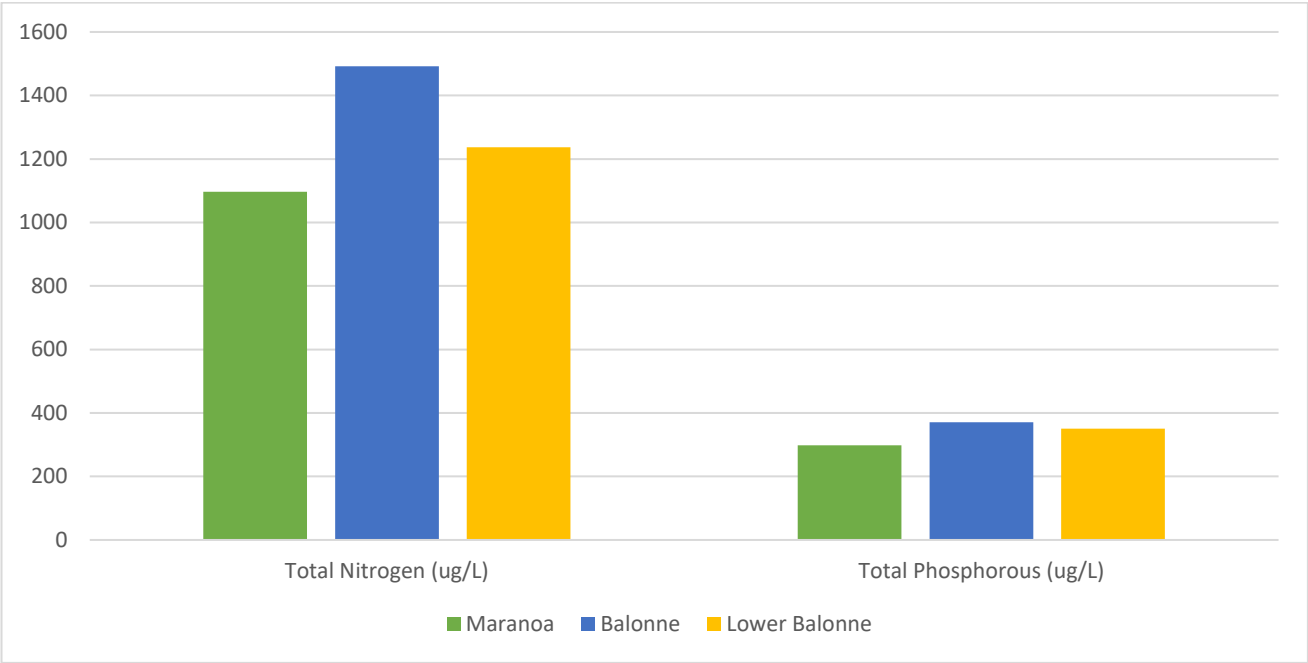

Figure 12: Comparison of average total nitrogen and total phosphorus concentrations (µg/L) in the Maranoa, Balonne and Lower Balonne River basins.

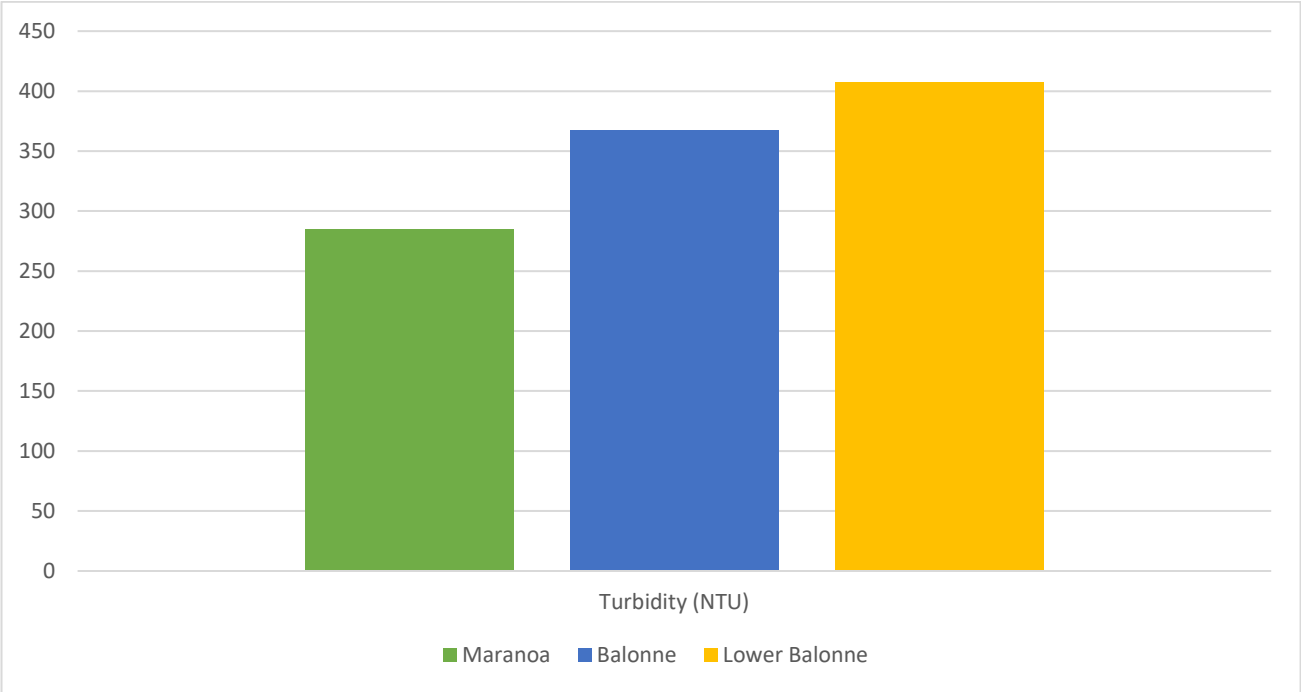

Figure 13: Comparison of average turbidity (NTU) in the Maranoa, Balonne and Lower Balonne River basins.

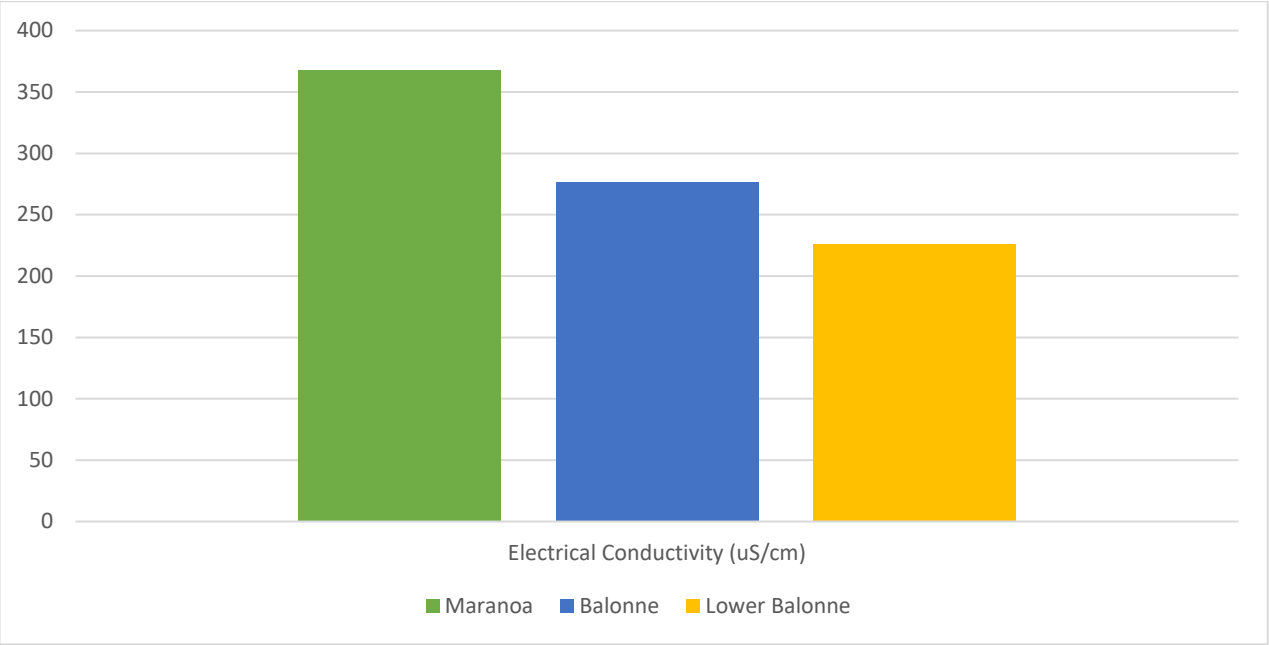

Figure 14: Comparison of average electrical conductivity concentration (µS/cm) in the Maranoa, Balonne and Lower Balonne River basins.

Further, the eWater Source Water Quality Model for the Queensland Murray-Darling Basin (Davidson, 2018) shows the proportion of total nitrogen and total phosphorus being contributed to stream from each land use in the Maranoa and Balonne River basin (Table 5). This information is useful for determining where investment in land management will be most effective in reducing nutrient export to stream.

Table 5: Proportion of total nitrogen and total phosphorus from exported tonnes per hectare contributed to stream by land use in the Maranoa and Balonne River basin (Davidson, 2018).

Land use	Maranoa		Balonne	
	TN (%)	TP (%)	TN (%)	TP (%)
Conservation	5	6	7	8
Cropping	20	24	25	30
Grazing	11	11	16	15
Forestry	3	3	3	2
Horticulture	7	8	5	5
Intensive animal industry	11	14	6	5
Mining	6	6	4	3
Other	7	8	6	5
Rural residential	11	6	5	2
Urban	11	4	7	4
Waste treatment	4	5	3	4
Water	4	6	12	18

2.1.6.2 Groundwater

Groundwater quality was analysed during the development of water quality targets for the groundwaters of QMDB. For further information on methods, refer to Regional groundwater chemistry zones: Queensland Murray-Darling Basin (McNeil, Raymond, Bennett, & McGregor, 2017).

McNeil et.al. (2017) found that surface and groundwater interactions are limited over the Maranoa-Balonne region, as indicated by chemically distinct ground and surface waters. The sub-artesian waters are highly varied across the region but they can be separated into moderately saline (sodium bicarbonate type) and highly saline (sodium chloride type) waters. These waters are also present in the artesian system with the sodium bicarbonate being more common at shallower depths and the sodium chloride type becoming more common with depth. These groundwaters are common in flatter areas with dry climates as the salts deposited by rainfall accumulate as water is lost to evaporation. The salts are then leached towards the water table during recharge events. High sulphate concentrations are common in the Maranoa region (excluding the headwaters of the Maranoa River) and are most likely related to the presence of gypsum in the landscape. The artesian groundwater in the area of the Maranoa River headwaters are uncommonly low in salinity in comparison to other artesian bores in QMDB. The low salinity and similar chemistry to surface waters suggests that this is a recharge area.

Refer to section 7 for further information about potential risks to water quality over the life of the plan in the Maranoa and Balonne River basin. Refer to section 8 for information on management responses to address risks to water quality in the Maranoa and Balonne River basin.

2.1.7 Climate change

A changing climate is likely to impact the water resources and freshwater ecosystems of the QMDB (Negus, et al., 2015). Rainfall variability is likely to increase with current climate modelling predicting that rainfall during winter and spring will decrease and the frequency of intense downpours will increase (The State of Queensland, 2017). It is likely that this will be associated with changes to river flows and to the frequency and extremity of droughts and floods.

Climate change is predicted to impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011). Reductions to flood frequency and duration may impact vegetation (river red gums - *Eucalyptus camaldulensis* for example), reducing river shading and reducing the contribution of organic matter to stream. This will impact fish species as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster under current climate predictions due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).

Refer to the Queensland Government webpage for more information about climate change predictions, and adaptation and mitigation strategies https://www.qld.gov.au/environment/climate/climate-change. Refer to section 8 for information on management responses to address risks of climate change in the Maranoa and Balonne River basin.

2.1.8 State of the Environment

The Queensland Government is responsible for reporting on the environmental performance of the State of Queensland. This reporting occurs on a biennial frequency with the report structured around four themes – biodiversity, heritage, pollution and climate (The State of Queensland, 2015).

Refer to the Queensland Government webpage for more information about the State of the Environment reporting https://www.stateoftheenvironment.des.qld.gov.au/.

2.2 Extent

The extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished. Different wetland systems provide different values to society. These values can vary throughout the State and can be affected by changes in extent.

Freshwater wetlands include:

Riverine wetlands: Systems that are contained within a channel (e.g. river, creek or waterway) and their associated streamside vegetation (WetlandInfo, 2013c).

Lacustrine wetlands (lakes): Systems that are dominated by open water. Although lakes may have fringing vegetation, the majority of the wetland area is open water. Lacustrine systems in Queensland, particularly in arid and semi-arid areas, are highly variable. Some are known to dry out and to support species adapted to these conditions, while others stay wet for long periods and provide a refuge for many species during dry times (WetlandInfo, 2013d).

Palustrine wetlands: Systems traditionally considered as a wetland. They are vegetated, non-riverine or non-channel systems and include billabongs, swamps, bogs, springs, soaks etc. Palustrine wetlands have more than 30% emergent vegetation and are an important part of the landscape, providing habitat and breeding areas for a wide variety of species (WetlandInfo, 2013e).

The tables below specify the area of freshwater wetlands (by system) in the plan area as a whole, as well as within each individual drainage basin.

Table 6: Wetland area by system (2013): Whole of plan area

System	Area (km^2)	Wetlands area (%)	Total area (%)
Artificial and highly modified	473.7	50.1	0.8
Lacustrine	25.5	2.7	0.0
Palustrine	109.2	11.5	0.2
Riverine	337.8	35.7	0.6
Total	**946.2**	**100**	**1.6**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table. Refer to Wetland*Info* – Balonne drainage sub-basin for boundary layers.

Source: Drainage sub-basin 2013 wetland system extents, WetlandInfo, Department of Environment and Science, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/statistics/wetland-extent/sub-basin.html>.

Table 7: Wetland area by system (2013): Balonne and Maranoa River basin

System	Area (km^2)	Wetlands area (%)	Total area (%)
Balonne			
Artificial and highly modified	455.7	52.8	1.2
Lacustrine	25.5	3.0	0.1
Palustrine	94.9	11.0	0.2
Riverine	286.6	33.2	0.7
Total	**862.7**	**100.0**	**2.2**
Maranoa			
Artificial and highly modified	18.0	21.5	0.1
Palustrine	14.3	17.1	0.1
Riverine	51.2	61.3	0.3
Total	**83.4**	**100.0**	**0.4**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table. Refer to Wetland*Info* – Balonne drainage sub-basin for boundary layers.

Source: Balonne River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-balonne-river/>.

Maranoa River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 11 October 2017, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-maranoa-river/>.

Wetlands can also be described by type of habitat that occurs within the system. The tables below specify the wetland area by habitat for the plan area. Refer to the Queensland WetlandInfo website for conceptual models that describe each habitat type in terms of its hydrology, geomorphology, fauna and flora.

Table 8: Wetland area by habitat (2013): Balonne River basin

Habitat	Area (km^2)	Wetlands area %	Total area (%)
Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	2.7	0.3	0.0
Coastal and sub-coastal non-floodplain grass sedge and herb swamp	0.0	0.0	0.0
Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	31.2	3.6	0.1
Coastal and sub-coastal floodplain grass, sedge, herb swamp	26.1	3.0	0.1

Habitat	Area (km^2)	Wetlands area %	Total area (%)
Coastal and sub-coastal floodplain lake	24.5	2.8	0.1
Coastal and sub-coastal non-floodplain soil lake	0.0	0.0	0.0
Arid and semi-arid tree swamp (floodplain)	2.9	0.3	0.0
Arid and semi-arid lignum swamp (floodplain)	3.3	0.4	0.0
Arid and semi-arid grass, sedge and herb swamp (floodplain)	0.2	0.0	0.0
Arid and semi-arid tree swamp (non-floodplain)	25.0	2.9	0.1
Arid and semi-arid lignum swamp (non-floodplain)	3.1	0.4	0.0
Arid and semi-arid grass, sedge and herb swamp (non-floodplain)	0.4	0.0	0.0
Arid and semi-arid floodplain lake	0.6	0.1	0.0
Arid and semi-arid non-floodplain lake	0.4	0.0	0.0
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	440.8	51.1	1.1
(modified natural) Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	1.2	0.1	0.0
(modified natural) Coastal and sub-coastal non-floodplain grass sedge and herb swamp	0.2	0.0	0.0
(modified natural) Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	1.6	0.2	0.0
(modified natural) Coastal and sub-coastal floodplain lake	11.8	1.4	0.0
Riverine	286.6	33.2	0.7
Total	**862.7**	**100.0**	**2.2**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table. Refer to Wetland*Info* – Balonne drainage sub-basin for boundary layers.

Source: Balonne River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-balonne-river/>.

Table 9: Wetland area by habitat (2013): Maranoa River basin

Habitat	Area (km^2)	Wetlands area %	Total area (%)
Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	6.2	7.4	0.0
Coastal and sub-coastal floodplain grass, sedge, herb swamp	0.9	1.1	0.0
Arid and semi-arid tree swamp (floodplain)	3.1	3.7	0.0
Arid and semi-arid grass, sedge and herb swamp (floodplain)	2.4	2.9	0.0
Arid and semi-arid tree swamp (non-floodplain)	0.8	0.9	0.0
Arid and semi-arid lignum swamp (non-floodplain)	0.7	0.9	0.0
Arid and semi-arid grass, sedge and herb swamp (non-floodplain)	0.1	0.2	0.0
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	18.0	21.5	0.1
Riverine	51.2	61.3	0.3
Total	**5102.8**	**100.0**	**2.7**

Note: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Source: Maranoa River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 11 October 2017, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-maranoa-river/>.

The loss of wetland extent in Queensland is affected primarily by drainage, clearing or levelling in lowland parts of catchments due to intensive agriculture and urbanisation. Wetland extent can also be impacted by upland activities such as dam construction altering the hydrology of downstream wetlands. At a state-wide scale, an estimated 94% of pre-clear extent of freshwater wetland remains (DEHP, 2017). Estimated historical loss of wetlands is unevenly distributed across drainage divisions and catchments with:

- 84% remaining in the Queensland Murray-Darling division
- 50% remaining in the North East Coast (non-Great Barrier Reef (GBR)) division
- 80% remaining in the North East Coast—GBR division
- close to 100% remaining in the other divisions (including the Bulloo drainage basin).

Of the three freshwater wetland systems (lacustrine, palustrine, riverine) in Queensland, one of the greatest ongoing losses has occurred in palustrine and riverine systems in the Queensland Murray-Darling drainage division. Within this division, historical loss of freshwater wetland extent is unevenly distributed. The Macintyre, Weir and the Dumaresq have less than, or equal to, 50% remaining. Historical loss of palustrine wetlands in the Moonie, Macintyre and Weir catchments has resulted in less than 25% remaining (DEHP, 2017).

Net rate of loss of wetlands in the Queensland Murray-Darling drainage division over the 2001-05, 2005-09 and 2009-13 periods has decreased from a rate of over 1500 hectares (ha) to 291ha (2009-13)—a rate of 72ha per year. Most of this loss is due to broad acre land clearing of riverine and palustrine wetlands, primarily in the Warrego drainage basin (DEHP, 2017).

There are 40,901ha of freshwater wetlands within protected areas in the Queensland Murray-Darling drainage division.

This amounts to 9% of the total 432,603ha of freshwater wetlands in the division and 0.7% across the state. The majority (78%) of freshwater wetlands that are in protected areas are contained within national parks. The rest are mostly within nature refuges (19%). Both lacustrine and palustrine wetlands are reasonably well represented in protected areas, at 14% and 11% respectively, however only 1% of riverine wetlands are contained within protected areas (DEHP, 2017).

The tables below specify the change in wetland extent by system and habitat within the Balonne and Maranoa River basin.

Table 10: Wetland extent change by system: Balonne and Maranoa River basin

System	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)	2013/pre-clear (%)
Balonne					
Artificial and highly modified	455.7	453.6	452.3	445.4	n/a
Lacustrine	25.5	25.5	25.5	15.1	6.1
Palustrine	94.9	95.0	95.0	98.5	54.3
Riverine	286.6	286.7	287.3	288.7	78.8
Total	**862.7**	**860.8**	**860.1**	**847.7**	**79.3**
Maranoa					
Artificial and highly modified	18.0	18.0	15.1	13.4	n/a
Palustrine	14.3	14.3	14.3	14.3	95.5
Riverine	51.2	51.2	51.2	51.7	81.2
Total	**83.4**	**83.4**	**80.6**	**79.5**	**81.5**

Note: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table. Refer to Wetland*Info* – Balonne drainage sub-basin for boundary layers.

Source: Balonne River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-balonne-river/>.

Maranoa River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 11 October 2017, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-maranoa-river/>.

Table 11: Wetland extent change by habitat: Balonne River basin

Habitat	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)
Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	2.7	2.7	2.7	2.7
Coastal and sub-coastal non-floodplain grass sedge and herb swamp	0.0	0.0	0.0	0.0
Coastal and sub-coastal floodplain tree swamp—Melaleuca spp. and *Eucalyptus* spp.	31.2	31.2	31.2	31.1

Habitat	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)
Coastal and sub-coastal floodplain grass, sedge, herb swamp	26.1	26.1	26.1	29.5
Coastal and sub-coastal floodplain lake	24.5	24.5	24.5	14.7
Coastal and sub-coastal non-floodplain soil lake	0.0	0.0	0.0	0.0
Arid and semi-arid tree swamp (floodplain)	2.9	2.9	2.9	2.9
Arid and semi-arid lignum swamp (floodplain)	3.3	3.3	3.4	3.4
Arid and semi-arid grass, sedge and herb swamp (floodplain)	0.2	0.2	0.2	0.4
Arid and semi-arid tree swamp (non-floodplain)	25.0	25.0	25.0	25.0
Arid and semi-arid lignum swamp (non-floodplain)	3.1	3.1	3.1	3.1
Arid and semi-arid grass, sedge and herb swamp (non-floodplain)	0.4	0.4	0.4	0.4
Arid and semi-arid floodplain lake	0.6	0.6	0.6	0.0
Arid and semi-arid non-floodplain lake	0.4	0.4	0.4	0.4
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	440.8	438.7	437.4	430.5
(modified natural) Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	1.2	1.2	1.2	1.2
(modified natural) Coastal and sub-coastal non-floodplain grass sedge and herb swamp	0.2	0.2	0.2	0.2
(modified natural) Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	1.6	1.6	1.6	1.6
(modified natural) Coastal and sub-coastal floodplain lake	11.8	11.8	11.8	11.8
Riverine	286.6	286.7	287.3	288.7
Total	**862.7**	**860.8**	**860.1**	**847.7**

Note 1: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. Thus, the figures presented above for the Balonne system is not representative of the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table.

Note 2: The drainage boundary for the Balonne River sub-basin varies slightly to the Balonne River spatial area covered in this plan. The HWMP for the Condamine River basin includes the proportion of wetland for the area of Balonne River systems not included in the above table. Refer to Wetland*Info* – Balonne drainage sub-basin for boundary layers.

Source: Balonne River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-balonne-river/>.

Table 12: Wetland extent change by habitat: Maranoa River basin

Habitat	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)
Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	6.2	6.2	6.2	6.2
Coastal and sub-coastal floodplain grass, sedge, herb swamp	0.9	0.9	0.9	0.9
Arid and semi-arid tree swamp (floodplain)	3.1	3.1	3.1	3.1
Arid and semi-arid grass, sedge and herb swamp (floodplain)	2.4	2.4	2.4	2.4
Arid and semi-arid tree swamp (non-floodplain)	0.8	0.8	0.8	0.8
Arid and semi-arid lignum swamp (non-floodplain)	0.7	0.7	0.7	0.7
Arid and semi-arid grass, sedge and herb swamp (non-floodplain)	0.1	0.1	0.1	0.1
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	18.0	18.0	15.1	13.4
Riverine	51.2	51.2	51.2	51.7
Total	**83.4**	**83.4**	**80.6**	**79.5**

Note: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Source: Maranoa River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Science, Queensland, viewed 11 October 2017, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-maranoa-river/>.

SECTION 3: OBJECTIVES AND OUTCOMES FOR WATER RESOURCES

3 Objectives and outcomes for water resources

The objectives and outcomes for water resources[5] are stated below. Specific objectives and outcomes apply to the waters of the Murray-Darling Basin as a whole and the waters of the Maranoa and Balonne River basins. The relevant section numbers are listed for objectives and outcomes derived from the Basin Plan.

3.1 Objectives and outcomes for Murray-Darling Basin water resources (whole system)

The following objectives and outcomes apply to the Maranoa and Balonne drainage basins due to their connectivity with the Murray-Darling Basin system.

3.1.1 Objectives and outcome to contribute to the achievement of the Murray-Darling Basin Plan

The relevant objectives for **water quality** are:

a. to give effect to relevant international agreements through the integrated management of Basin water resources
b. to establish a sustainable and long-term adaptive management framework for Basin water resources, that takes into account the broader management of natural resources in the Murray-Darling Basin
c. to optimise social, economic and environmental outcomes arising from the use of water resources.

(Reflects Basin Plan Section 5.02, 1a-c)

The outcome for the Basin Plan as a whole is a healthy and working Murray-Darling Basin that includes:

a. communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use
b. productive and resilient water-dependent industries, and communities with confidence in their long-term future
c. healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and ultimately, the ocean.

(Reflects Basin Plan Section 5.02, 2a-c)

3.1.2 Objectives and outcome in relation to environmental outcomes

The objectives in relation to environmental outcomes are, within the context of a working Murray-Darling Basin:

a. to protect and restore water-dependent ecosystems of the Murray-Darling Basin
b. to protect and restore the ecosystem functions of water-dependent ecosystems
c. to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats.

(Reflects Basin Plan Section 5.03, 1a-c)

The outcome in relation to objectives (a) to (c) is the restoration and protection of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin with strengthened resilience to a changing climate.

(Reflects Basin Plan Section 5.03, 2)

[5] Reflects the terminology used in the Basin Plan. 'Objectives and outcomes for water resources' are equivalent to 'Management Goals' under the National Water Quality Management Strategy. The EPP Water provides for the development of Management Goals that are long-term management objectives used to assess whether corresponding Environmental Values are being maintained. Management Goals for aquatic ecosystems reflect the management intent described in Section 14 of the EPP Water.

3.1.3 Objective and outcome in relation to water quality and salinity

The objective in relation to water quality and salinity is to maintain appropriate water quality, including salinity levels, for environmental, social, cultural and economic activity in the Maranoa and Balonne River basin.

The outcome in relation to water quality and salinity is that water resources in the Maranoa and Balonne River basin remain fit for purpose.

(Reflects Basin Plan Section 5.04, 1-2)

3.2 Objectives and outcomes for the Maranoa and Balonne River basins

The following objectives and outcomes apply to the Maranoa and Balonne River basin.

3.2.1 Objective to maintain good levels of water quality

If the value of a water quality indicator (for example, salinity, nutrients, pH, turbidity etc.) is at a level that is better than the target value for water quality (set out in section 10 of this report), the objective is to maintain that level.

(Reflects Basin Plan Section 9.08)

3.2.2 Objective to maintain the extent of natural wetlands and riparian forested areas

The objective is to maintain and, where possible, enhance the extent of natural wetlands (palustrine, lacustrine and riverine) and riparian forested areas across the Maranoa and Balonne River basin.

3.2.3 Objective for declared Ramsar wetlands aquatic ecosystems

The Maranoa and Balonne River basin does not contain any Ramsar wetlands at time of print.

If wetlands of international significance are declared in the future, the objective is that the quality of water is sufficient to maintain the ecological character of the wetlands.

(Reflects Basin Plan Section 9.04, 1)

3.2.4 Objective for aquatic ecosystems other than declared Ramsar wetlands

The objective is that the quality of water is sufficient:

a. to protect and restore the ecosystems, and
b. to protect and restore the ecosystem functions of the ecosystems, and
c. to ensure that the ecosystems are resilient to climate change and other risks and threats.

(Reflects Basin Plan Section 9.04, 2a-c)

3.2.5 Objective and outcome for Aboriginal cultural, spiritual and ceremonial values and uses of water

The objective is to ensure the suitability of water to support the identified cultural, ceremonial and spiritual values and uses of waters across the Queensland Murray-Darling Basin.

The outcome is that Queensland Murray-Darling Basin water resources remain fit for purpose in relation to cultural, spiritual and ceremonial values and uses of water.

(Reflects Basin Plan Section 10.52, 1a-b)

3.2.6 Objectives for raw water for treatment for human consumption

The objectives for raw water treatment for human consumption are:

a. to minimise the risk that the quality of raw water taken for treatment for human consumption results in adverse human health effects; and
b. to maintain the palatability rating of water taken for treatment for human consumption at the level of good as set out in the Australian Drinking Water Guidelines; and
c. to minimise the risk that the quality of raw water taken for treatment for human consumption results in the odour of drinking water being offensive to consumers.

(Reflects Basin Plan Section 9.05, a-c)

3.2.7 Objective for irrigation water

The objective for irrigation water is that the quality of surface water, when used in accordance with the best irrigation and crop management practices and principles of ecologically sustainable development, does not result in crop yield loss or soil degradation.

Soil degradation means reduced permeability and soil structure breakdown caused by the level of sodium in the irrigation water, and is assessed using the sodium adsorption ratio[6].

(Reflects Basin Plan Section 9.06)

3.2.8 Objective for recreational water quality

The objective for recreational water quality is to achieve a low risk to human health from water quality threats posed by exposure through ingestion, inhalation or contact during recreational use of QMDB water resources.

(Reflects Basin Plan Section 9.07)

3.2.9 Objective for waters under the *Environmental Protection (Water) Policy 2009*

It is the management intent for waters[7] that the decision to release waste water or contaminants to the waters must ensure the following for:

- high ecological value (HEV) waters—the measures for the indicators for all EVs are maintained
- slightly disturbed (SD) waters—the measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives (targets) for HEV waters
- moderately disturbed (MD) waters, if the measures for indicators of the EVs:
  - achieve the water quality objectives— the measures for the indicators are maintained at levels that achieve the water quality objectives (targets) for the water
  - do not achieve the water quality objectives (targets) for the water—the measures for indicators of the EVs are improved to achieve the water quality objectives (targets) for the water.

Refer to Section 6 of this plan for further details.

[6] See Chapter 11 – Salinity Management Handbook (DNR, 1997); or Figure 4.2.1 of Chapter 4 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

[7] Refer to Section 14 of the EPP Water.

SECTION 4: CONSULTATION AND ENGAGEMENT

4 Consultation and engagement

Consultation requirements for the WQM Plan are specified under section 10.32(4)(d) and 10.35 of the Basin Plan and relate to the connectivity of water resources with New South Wales. Section 4 provides information in support of these consultation requirements.

The development of the HWMP for the Maranoa and Balonne basin involved ongoing consultation in accordance with the requirements of the EPP Water and the Basin Plan. Consultation on the technical of this draft HWMP occurred throughout 2016 and 2017 and is detailed below. Following this, a draft version of the HWMP was released online for community and stakeholder consultation from April 2018 to June 2018.

Engagement with stakeholders and the community was encouraged through a range of mediums, including local print media, mail-outs, emails, natural resource management websites, meetings and workshops. The consultation was open to all interested stakeholders, including community members, participants from local, state and federal governments, natural resource management groups, local Aboriginal Nations, industry groups and environmental groups.

The stakeholder and community-based discussions indicated that water is a key regional asset, whether above or below ground. The major variances in discussion amongst the groups were the different uses and outcomes, the allocations to various sectors and the potential threats to the quantity and quality of both above ground or underground water supplies.

4.1 Water Quality Technical Panel

Throughout the development of the HWMP for the Maranoa and Balonne basin, the Water Quality Technical Panel was consulted on matters where skilled expertise or technical input was required. The panel was comprised of technical staff from Queensland Government departments, former-Queensland Murray-Darling Basin Committee and external water quality experts, and utilised a range of State and Commonwealth information resources.

The Water Quality Technical Panel initially met to divide the Maranoa and Balonne basin into sub-regions through GIS mapping, to enable more targeted discussions and establishment of environmental values at stakeholder and community workshops. The Water Quality Technical Panel further met to discuss the development of water quality targets based on local data to protect environmental values.

The panel was also consulted during the initial risk assessment for QMDB conducted in 2013 and again in 2016-17 when the risk assessment for the Maranoa and Balonne basin was refined.

4.2 Consultation – Environmental values

Environmental values (EVs) for the Maranoa and Balonne River basin were established through a consultative process conducted by various agencies between early 2000 and 2017.

In 2002, the Condamine Balonne Water Committee began the process of identifying EVs for the waters of the Maranoa and Balonne River basin, and found that "*most respondents want water quality that supports all environmental values in all catchments"* (CBWC, 2002).

In 2012, the former-Queensland Murray Darling Committee (QMDC) re-established this work to support the development of the Healthy Waters Management Plans for the Maranoa and Balonne River basin and for the Border Rivers and Moonie River basins. QMDC collected the stakeholder values and uses of water in the Maranoa, Balonne, Border Rivers and Moonie basins by conducting a survey (Queensland Murray-Darling Committee , 2017). Feedback was received from 50 stakeholders or stakeholder groups, including local governments, catchment management authorities, Traditional Owner groups, irrigation industry, Queensland Government and the mining industry. During this process, the Water Quality Technical Panel divided the Maranoa, Balonne, Border Rivers and Moonie basins into sub-regions, to enable more targeted discussions around how stakeholders value and use water in these sub-regions. The EVs identified during the process employed by QMDC have been considered, and are included in this HWMP.

In 2016, the Queensland Government further refined the EVs work for groundwater. Groundwater aquifer zones were established to allow for the development of locally relevant water quality objectives. This process included identifying EVs for each groundwater aquifer using bore records. The Water Quality Technical Panel were consulted to ensure the approach taken to identify groundwater EVs was accurate and representative.

Feedback from Aboriginal Nations during the refinement of the groundwater EV method confirmed that the Cultural, Spiritual and Ceremonial EV should be identified for all groundwater aquifers.

In March 2017, the draft EVs were released for a three month public consultation period via print media, email, and website. The material was made available, and in many cases presented, to 51 stakeholder groups, including Local State and Federal governments, Northern Basin Aboriginal Nations, SunWater, Arrow Energy, QMDC and Condamine Balonne Water Committee. Submissions received during the consultation period included the following common suggestions:

- *Include an appendix in the guidelines with location details of identified High Ecological Value and Slightly Disturbed Aquatic Ecosystems*
    - An appendix is included in this HWMP with locations of the persistent waterholes which are High Ecological Value. Spatial information on High Ecological Value and Slightly Disturbed Aquatic Ecosystems will be available via QSpatial, as per below.
- *Spatial information layer on identified High Ecological Value and Slightly Disturbed Aquatic Ecosystems (and extent of Water Type Zone boundaries) be made available on Qld Globe and to NRM bodies*
    - This layer will be published on QSpatial once the EVs and WQOs have been recommended for inclusion in Schedule 1 of EPP Water.

In the April 2018 submissions period, additional feedback was received regarding the Environmental Values mapping included in the draft HWMPs. The feedback received during each consultation process has resulted in the final set of EVs presented in Table 13 and shown in Figure 16 to Figure 25 of this HWMP.

The economic and social impacts of protecting environmental values are considered through consultation, as well as through a socioeconomic report commissioned by the Queensland Government (Marsden Jacob Associates, 2017). At the completion of consultation and consideration of all submissions, finalised environmental values and water quality objectives (water quality target values) will be subsequently recommended for inclusion under Schedule 1 of the EPP Water[8]. Under the EPP Water, environmental values and associated water quality objectives (water quality target values) inform statutory and non-statutory water quality management planning and decision-making.

4.3 Consultation – Water quality objectives

Consultation with relevant local stakeholders occurred throughout the development of the water quality objectives[9] (WQOs) for the Maranoa and Balonne River basin. In March 2017, the draft WQOs were released for a three month public consultation period via print media, email, and publishing on the Queensland Government website. The material was made available, and in many cases presented, to 51 stakeholder groups, including local, state and federal governments, Northern Basin Aboriginal Nations, SunWater, Arrow Energy, QMDC and Condamine Balonne Water Committee. This consultation period allowed stakeholders to comment on the draft local water quality objectives which are developed to protect the draft environmental values for each sub-catchment, as well as levels of aquatic ecosystem protection and sub-regional mapping. It also provided the community with an update of progress towards the Maranoa and Balonne River basin HWMP.

Following the consultation period, communication was maintained with several stakeholder groups who indicated they possessed additional water quality data that would assist the department to further refine the WQOs and increase the relevance of the values to their local area. Submissions were received on the draft WQO material during and after the consultation period, and common feedback included:

- *Implement event monitoring programs including end of system monitoring and a number of nested monitoring sequences to improve understanding of pollutant sources and sinks through the catchment systems*
- *Maintain existing ambient monitoring programs*
- *Consideration should be given to coupling WQ guidelines and associated monitoring and modelling with broader environmental accounts and socioeconomic indicators.*

This consultation also provided the community with an update of progress towards the Maranoa and Balonne River Basin HWMP and an opportunity to provide feedback on the draft environmental values, levels of aquatic ecosystem protection and sub-regional mapping.

In April 2018, the department invited submissions on the draft HWMP for the plan area, which contained the environmental values and water quality objectives. The department encouraged any additional data to be submitted by stakeholders in a format that would enable the refinement of the WQOs.

[8] If the environmental values and associated water quality objectives are not listed in schedule 1 of the EPP Water, the environmental values are stated under section 6 (2) of the EPP Water and the water quality objectives are the set of water quality guidelines for all indicators that protect all the environmental values for the water.

[9] This terminology is sourced from EPP Water. Under Basin Plan, water quality objectives are termed ‘water quality targets’.

4.4 Consultation – Risk assessment

An initial risk assessment workshop to assess the risk of water quality degradation in the Maranoa and Balonne River basin was conducted in March 2013. The workshop included the Water Quality Technical Panel and local on-ground expertise from the former-Department of Natural Resources and Mines (DNRM) and staff from former-Queensland Murray-Darling Committee (QMDC).

The scores from the initial risk assessment were revisited in October 2016 and an additional workshop was held with the Water Quality Technical Panel to update the risk scores. Following update to the risk scores, further consultation occurred between staff from the Queensland Government as well as between DES and former-QMDC. The following feedback is an example of what was received from this consultation:

- *Risks identified and risk scores look to be accurate, noting that localised risks could occur but due to the spatial scale of the assessment units, these risks could be overlooked.*
    - This was addressed by identifying hotspots within each assessment area.

Following the internal workshops, joint external workshops were held with representatives from former-DNRM to present the draft risk assessment material to key stakeholders. The joint external workshop for the Maranoa and Balonne risk assessment was held in St George on 30 November 2016. Eleven participants attended the workshop, which included irrigators, environmental groups, and representatives from SunWater and Balonne Shire council.

The risk assessment contributes to the requirements of a Water Quality Management Plan under Chapter 10, Part 7 of the Basin Plan and will be included in the Commonwealth Water Resource Plan package to be submitted to the Murray-Darling Basin Authority for accreditation under the Basin Plan.

4.5 Consultation – Aboriginal Nations

The Department of Environment and Science would like to acknowledge and pay respect to the past and present Traditional Owners of the region and their Nations, and thank the representatives of the Aboriginal communities, including the Elders, who provided their knowledge of natural resource management throughout the consultation process. It is recognised that there are values and protocols of men's and women's business that relate to water which are culturally sensitive and were not discussed openly through consultation. It is acknowledged that only the commonly known places and stories can be discussed openly. It is also understood that places and stories can hold different cultural values and significance between each Aboriginal Nation.

Consideration of Aboriginal social, cultural and economic values and uses has been a key part of the consultation process for the development of the HWMP. The term 'Aboriginal water values' is used to describe the relationship between Aboriginal and Torres Strait Islander peoples and water and the importance of water and water dependent resources. Their relationship with water is intrinsic in nature, with water not only being fundamental for survival, but an indivisible, interwoven and central element of cultural and spiritual life (Constable & Love, 2015).

The consultation process, and how the consultation process fits into water planning, is described in detail in the Water Connections Report (DNRME, 2019) – but has been summarised below for the purposes of the HWMP. The Queensland Government aimed to consult with as many Traditional Owners as possible from Aboriginal Nations in the Border Rivers, Moonie, Condamine and Maranoa-Balonne river basins. The Department of Environment and Science worked closely with the Department of Natural Resources, Mines and Energy to align the consultation process for the development of the water plans and HWMPs for Queensland Murray-Darling Basin catchments.

It is important to note that Aboriginal Nation areas do not align with water plan areas or state borders and there are multiple Aboriginal Nations within the Maranoa and Balonne River basin. Aboriginal Nations of the Murray–Darling Basin (for both surface water and groundwater) are listed on maps produced by the Murray–Darling Basin Authority and representatives of the Aboriginal Nations (MDBA, 2018a & MDBA, 2018b). The Aboriginal Nations involved in the consultation process included:

- Barunggam
- Bidjara
- Bigambul
- Euahlayi
- Giabel
- Githabul
- Gomeroi (Kamilaroi)
- Gunggari
- Guwamu (Kooma)
- Jarowair

- Kambuwal
- Mandandanji
- Wakka Wakka.

Note: Murrawarri Nation representatives have indicated to the Queensland Government that their traditional lands do not extend far into Queensland, and therefore they do not need to be part of the engagement.

The consultation process started in August 2016 with a joint workshop held in Boggabilla between the Northern Basin Aboriginal Nations Delegates from the Nations in the catchment areas. The workshop outlined options for the Aboriginal Nation Delegates to consider how they wished to be engaged. From August 2016 to August 2017, people from the Aboriginal Nations across the plan area were engaged through a series of workshops on a Nation by Nation basis. In addition to the Nation workshops, individual Traditional Owners from each basin area were also consulted and input sought.

The consultation process aimed to identify values and uses of water, risks to the values and uses of water, objectives and outcomes desired for the water, and opportunities to strengthen the protection of Aboriginal values and uses, for consideration in both the Maranoa and Balonne River Basin HWMP and Queensland Water Plan for the Condamine-Balonne plan area. During consultation, careful consideration was given towards ensuring this information was documented in participant's own words.

Discussions with participants in the consultation workshops and meetings raised a number of risks related to:

- Aboriginal values and uses arising from the use and management of water resources; and
- that insufficient water is available, or water is not suitable, to maintain social, cultural, Aboriginal and other public benefit values.

The risks raised at the workshops and during discussions were largely consequential risks that have occurred as a result of insufficient water available for the environment, water being of a quality unsuitable for use or the poor health of water-dependent ecosystems. In the discussions, Aboriginal people often relayed the risks in the form of stories about impacts to important social, spiritual and cultural aspects related to land and water. Participants also drew comparisons between the current state of the river systems and how they remembered using and valuing the river systems when they were children or from stories passed on from earlier generations.

Following on from the consultation process described above, in April 2018 the draft version of the Healthy Waters Management Plan for the Maranoa and Balonne River basin was made available to Traditional Owners through the Department of Environment and Science website as well as through the former-QMDC website. People from Aboriginal Nations across the plan area were then met with again during May and June of 2018 to discuss the draft plans and review the way in which their values and uses of water were included. Overall, 180 submissions on the water plans and HWMPs were received from the Aboriginal community. The Department of Environment and Science reviewed submissions related to water quality that were received, to address through the HWMP where possible.

Section 9 of the HWMP presents Aboriginal people's values and uses addressed under a healthy waters management plan, which relates to water quality matters.

4.6 Consultation – Climate variability

The impacts of a changing climate are already being experienced in Queensland. These changes pose a threat to the state's economy, communities and environment. Due to this, climate change and the impacts of climate change on water quality have been considered in this HWMP.

In 2017, the former-Department of Environment and Heritage Protection (DEHP) prepared a response to ensure Queensland is equipped to understand, adapt and transition under a changing climate. The Queensland Climate Change Response outlines the commitments and actions the Queensland Government will take to transition to a low carbon, clean growth economy and adapt to the impacts of a changing climate. The Queensland Climate Change Response includes two key strategies: Queensland Climate Transition Strategy; and Queensland Climate Adaptation Strategy. The commitments and actions listed in these strategies inform the measures to address risks resultant of climate change. Further information about Queensland's approach to understand, adapt and transition under a changing climate can be found here: https://www.qld.gov.au/environment/climate/response.

4.7 Consultation – New South Wales Government

The southern section of the Maranoa and Balonne River basin is a cross-border river system that forms part of the 'Intersecting Streams' with New South Wales. Under the Basin Plan, consultation with the New South Wales Government on the WQM Plan (and accompanying HWMP) must be undertaken by the Queensland Department of Environment and Science to consider any cross-border impacts that may result from managing water quality in

these basins.

In particular, the following must be considered:

- the impact of Queensland proposed alternative water quality target values on the ability of New South Wales to meet water quality targets;
- the impact of Queensland measures on the ability of New South Wales to meet water quality targets; and
- any adverse impacts measures may have on New South Wales water resources.

Components of the draft HWMPs for the Queensland Border Rivers-Moonie and Maranoa and Balonne River basins were presented to water quality representatives from the New South Wales Department of Primary Industries (DPI) on 30 June 2017 and 23 January 2018. The department briefed DPI on the following components of the HWMP:

- 30 June 2017
    - A summary of risks to water quality identified by the department in the Border Rivers, Moonie River and Lower Balonne River basins. These risks were compared to the risks to water quality identified in the risk assessment conducted by DPI. Inconsistencies between the two risk assessments were highlighted and investigated.
- 23 January 2018
    - An updated summary of risks to water quality by the department in the Border Rivers, Moonie River and Lower Balonne River basins was provided to DPI for comparison to the risks to water quality identified by DPI.
    - The methods used to develop the proposed alternative water quality target values for surface and groundwater.

During the development of this HWMP, feedback provided to the department from DPI during the development of the Warrego, Paroo, Bulloo and Nebine Healthy Waters Management Plan (Department of Environment and Heritage Protection, 2016) has been considered to better meet cross-border outcomes, as the feedback is also applicable to the Maranoa and Balonne. The following suggestions have been incorporated into this HWMP:

- Include water quality data from NSW catchments in the development of proposed alternative water quality target values
- Include text boxes throughout the document to assist the reader to understand how the HWMP for the Maranoa and Balonne River basin contributes to meeting the requirements of a Water Quality Management Plan under the Basin Plan.

A final version of the HWMPs was provided to the New South Wales Government for their response following consideration of the Basin Plan requirements. On 12th February 2019, the New South Wales Department of Industry (Water) indicated their support for the Queensland Condamine-Balonne Water Quality Management Plan.

SECTION 5: SOCIAL, ECONOMIC, CULTURAL AND ENVIRONMENTAL VALUES AND USES

5 Social, economic, cultural and environmental values and uses

The social, economic, cultural and environmental values and uses of water for the Maranoa and Balonne River basin were established through the environmental values framework under the EPP Water. Environmental values (EVs) reflect the ways in which water is valued and used in a catchment area. Setting environmental values through community and stakeholder consultation reflects how a local region values and uses water. Under the EPP Water, and as depicted by Figure 15, EVs include:

- aquatic ecosystem[10]
- cultural and spiritual values (modified to 'cultural, spiritual and ceremonial values' for the purposes of this HWMP at the request of Traditional Owners)
- agriculture (including irrigation, stock and domestic)
- aquaculture
- human consumption of aquatic foods
- drinking water (suitable for treatment before supply as drinking water[11])
- industrial use; and
- recreation (primary, secondary and visual/aesthetic).

Initially, for the purpose of establishing environmental values for the surface waters of the Maranoa and Balonne River basin, sub-catchments were defined within each basin. The creation of sub-catchments enables locally relevant discussion around how water is valued and used by stakeholders and the community. The surface water sub-catchments were generated from Queensland Government, public domain information and community consultation and were developed on the basis of:

a. likely geological influences on soil type and water quality
b. recognition of existing defined sub-regional natural resource management planning areas.

The environmental values that apply to each surface water sub-catchment were determined through stakeholder and community consultation, and were further refined by technical input from Queensland Government staff (Refer to Section 4). To simplify the final EVs mapping, the sub-catchments were aligned, where possible, with the water types which were developed through the water quality objective development. A description of water types in the Maranoa and Balonne River basin is provided in Appendix 2—Description of water types in the Maranoa and Balonne basins.

To enable the accurate and comprehensive depiction of environmental values that apply to groundwater, groundwater aquifer units and sub-aquifer chemistry zones were defined for QMDB (McNeil, Raymond, Bennett, & McGregor, 2017). Groundwater chemistry data was analysed to identify zones of similar water chemistry. The EVs for each zone of similar water chemistry (sub-aquifer chemistry zones) were initially determined by reviewing the bore installation records, which are held within the Queensland Government Water Entitlements Registration Database. The bore installation records detail how the groundwater for each bore will be used, thus informing how the water is valued. Consultation with the Water Quality Technical Panel was conducted to ensure the approach taken to identify groundwater EVs is accurate and representative (Refer to Section 4).

At the completion of consultation and consideration of all submissions, finalised environmental values and water quality objectives (water quality target values) will be subsequently recommended for inclusion under Schedule 1 of the EPP Water[12]. Under the EPP Water, environmental values and associated water quality objectives (water quality target values) inform statutory and non-statutory water quality management planning and decision-making.

The environmental values that apply to the surface and groundwaters of the Maranoa and Balonne River basin are presented in Table 13 and mapped for each surface water sub-catchment and groundwater sub-aquifer chemistry zone in Figure 16 to Figure 25.

[10] The Australian and New Zealand Water Quality Guidelines (ANZECC/ARMCANZ) and the EPP Water outline how aquatic ecosystems can be subdivided into different levels of protection, depending on condition. The EPP Water recognises four possible levels of ecosystem condition and corresponding management intent; namely high ecological value (effectively unmodified) systems; slightly disturbed, moderately disturbed and highly disturbed systems. Section 14 of the EPP Water states the management intent for waters subject to an activity that involves the release of wastewater or contaminants to waters.

[11] For drinking water guidelines that apply to water after it has been treated or is to be used for drinking—see the Australian Drinking Water Guidelines developed by the National Health and Medical Research Council.

[12] If the environmental values and associated water quality objectives are not listed in schedule 1 of the EPP Water, the environmental values are stated under section 6 (2) of the EPP Water and the water quality objectives are the set of water quality guidelines for all indicators that protect all the environmental values for the water.

Aquatic ecosystem
- The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways, waterholes and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, yellowbelly, cod and yabbies) and their habitat, food and drinking water.

Irrigation
- Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.

Farm water supply/use
- Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.

Stock watering
- Suitability of water supply for production of healthy livestock.

Aquaculture
- Health of aquaculture species and humans consuming aquatic foods (such as fish and prawns) from commercial ventures.

Human consumers of aquatic foods
- Health of humans consuming aquatic foods, such as fish and prawns, from natural waterways.

Primary recreation
- Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, diving and water-skiing.

Secondary recreation
- Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing.

Visual recreation
- Amenity of waterways for recreation which does not involve contact with water. For example, walking and picnicking adjacent to a waterway.

Drinking water supply
- Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection.

Industrial use
- Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.

Cultural, spiritual and ceremonial values
- Cultural, spiritual and ceremonial values of water means its aesthetic, historical, scientific, social or other significance, to the past, present or future generations.

Figure 15: Environmental values icons and definitions under EPP Water (used in Figure 16 to Figure 25).

5.1 Socioeconomic assessment for the protection of environmental values

EPP Water s12(b), states that the economic and social impacts of protecting environmental values must be considered prior to recommending the environmental values for inclusion in schedule 1 of EPP Water. The former Department of Environment and Heritage Protection commissioned Marsden Jacob Associates to assess the value of protecting and enhancing environmental values and water quality in QMDB. This work forms the socioeconomic report for the protection of environmental values in the Queensland Murray-Darling and Bulloo Basins (Marsden Jacob Associates, 2017).

> **"When the condition of the aquatic ecosystem declines, important ecosystem functions and services also decline, affecting key sectors such as tourism, agriculture, fishing and recreation and threatening critical assets such as the unique wetlands of the region."** (Marsden Jacob Associates, 2017)

Benefits to the community, region and State from maintaining environmental values and water quality objectives in the QMDB as a whole, and in the Maranoa and Balonne River basin more specifically, were identified in the socioeconomic assessment. Key findings were that the aquatic ecosystem, ecosystem functions and services in QMDB directly contribute to the social and economic wellbeing of the community, region and State. Benefits from maintaining environmental values and water quality objectives include:

- maintaining a regionally significant and developing tourism sector in QMDB which generates $952 million per annum
    - Water quality of rivers, streams and wetlands underpins the tourism sector and outdoor recreation opportunities for all residents and visitors.
- providing recreation, boating and other aesthetic benefits to the community
    - Water based recreational activities in QMDB is valued at approximately $128 million per annum.
- ensuring a sustainable recreational fishing sector
    - Valued at $104 million per annum and further enhances recreational and eco-tourism opportunities.
- providing biological support and physical protection for biodiversity, fisheries and ecosystems
    - Community willingness to pay to protect the 1.3 million hectares of wetlands in QMDB is estimated to be $1.9 billion.
- ensuring the agricultural sector is sustainable
    - Land and water resources of suitable quality are critical to a sustainable agriculture sector
    - Agriculture production in Maranoa and Balonne River basin was worth approximately $512 million in 2011
    - In QMDB as a whole, agricultural production is worth $3,162 million.

The full socioeconomic report can be viewed on the Queensland Government website: https://environment.des.qld.gov.au/water/policy/pdf/qmdb-socioeconomic-report.pdf.

5.2 Environmental values for the Maranoa and Balonne River basin

Table 13: Environmental values for the Maranoa and Balonne River basin surface waters and groundwaters.

Notes:

1. Refer to the accompanying maps (Figure 16 to Figure 25), as indicated in the table, for the sub-catchments and sub-aquifers where environmental values apply.
2. ✓ means the environmental value is selected for protection. Blank indicates that the environmental value is not selected for protection.
3. Refer to Section 10 for the water quality target values that apply to protect the environmental values in **Table 13**.

Maranoa and Balonne River Basin	**Environmental Values**[1–3]											
	Aquatic ecosystem	**Irrigation**	**Farm supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Primary recreation**	**Secondary recreation**	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural, spiritual and ceremonial values**
Water												
SURFACE FRESH WATERS (rivers, creeks, streams) (Figure 16)												
Balonne River	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Lake Beardmore	✓	✓	✓	✓		✓	✓	✓	✓			✓
Bungil and Murilla Creeks	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Carnarvon Sandstones	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Dogwood Creek	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
Lower Balonne Floodplain	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Maranoa and Balonne River Basin	Environmental Values[1–3]											
	Aquatic ecosystem	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Lower Condamine Floodplain	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Lower Maranoa	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Undulla Creek	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Yuleba Creek	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
GROUNDWATERS												
Alluvial Zones (Figure 17)												
Lower Balonne	✓	✓	✓	✓						✓	✓	✓
Lower Condamine	✓	✓	✓	✓	✓					✓		✓
Lower Maranoa	✓		✓	✓						✓		✓
Moonie	✓		✓	✓								✓
Upper Balonne	✓		✓	✓						✓		✓

Maranoa and Balonne River Basin	Environmental Values[1–3]											
	Aquatic ecosystem	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Upper Maranoa	✓		✓	✓						✓		✓
Wallam	✓		✓	✓								✓
Fractured Rock Zones (Figure 18)												
Eastern Basement With Basalt Remnants	✓	✓	✓	✓						✓	✓	✓
Main Range Volcanics	✓	✓	✓	✓	✓					✓	✓	✓
Sediments Overlying the GAB Zones (Figure 19)												
Tertiary sediments	✓		✓	✓								✓
Weathered alluvium	✓	✓	✓	✓	✓					✓	✓	✓
Upper GAB Zones (Figure 20)												
Central upper Cretaceous aquitard	✓	✓	✓	✓						✓	✓	✓
Winton Mackunda eastern	✓	✓	✓	✓						✓	✓	✓

Maranoa and Balonne River Basin	Environmental Values[1–3]											
	Aquatic ecosystem	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Main GAB Aquitard Zones (Figure 21)												
Central Surat mid Cretaceous	✓		✓	✓								✓
Eastern Wallumbilla Outcrop	✓		✓	✓						✓		✓
Wallumbilla Doncaster Outcrop	✓		✓	✓						✓		✓
Mid GAB Aquifer Zones (Figure 22)												
Central Mooga and Orallo Outcrops	✓		✓	✓						✓		✓
Eastern Cretaceous Outcrop	✓		✓	✓						✓	✓	✓
Hooray Northern Outcrop	✓		✓	✓						✓		✓
Lower Balonne Gubberamunda	✓	✓	✓	✓						✓	✓	✓
North Wallumbilla Bungil and Mooga	✓		✓	✓						✓		✓
Northern Central Outcrop area	✓		✓	✓						✓	✓	✓

Maranoa and Balonne River Basin	Environmental Values[1–3]											
	Aquatic ecosystem	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Northern Maranoa Bungils	✓		✓	✓						✓	✓	✓
Northern Surat thickest Bungil and Mooga	✓	✓	✓	✓						✓		✓
Southeast Kumbarilla	✓	✓	✓	✓	✓					✓		✓
Surat thicker Mooga saline area	✓		✓	✓						✓		✓
Western Hooray	✓		✓	✓						✓		✓
Lower GAB Zones (Figure 23)												
Central Surat Springbok area	✓	✓	✓	✓	✓					✓		✓
Eastern Springbok Outcrop	✓		✓	✓						✓		✓
Hutton Western Eromanga region	✓		✓	✓						✓		✓
North East Walloons	✓	✓	✓	✓	✓					✓	✓	✓
Northeastern Hutton Outcrop	✓	✓	✓	✓						✓		✓

Maranoa and Balonne River Basin	Environmental Values[1–3]											
	Aquatic ecosystem	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Northern Hutton Outcrop	✓		✓	✓						✓		✓
Northern Walloons	✓	✓	✓	✓	✓					✓	✓	✓
Basal GAB Zones (Figure 24)												
Eastern Central area	✓	✓	✓	✓						✓	✓	✓
Northeastern Evergreen Outcrop	✓	✓	✓	✓						✓		✓
Northwestern Evergreen Outcrop	✓		✓	✓						✓		✓
Precipice Outcrop	✓	✓	✓	✓						✓		✓
Western Evergreen only	✓		✓	✓						✓		✓
Earlier Basins Partially Underlying the GAB Zones (Figure 25)												
Bowen Basin	✓			✓								✓
Upper Bowen Basin	✓			✓								✓

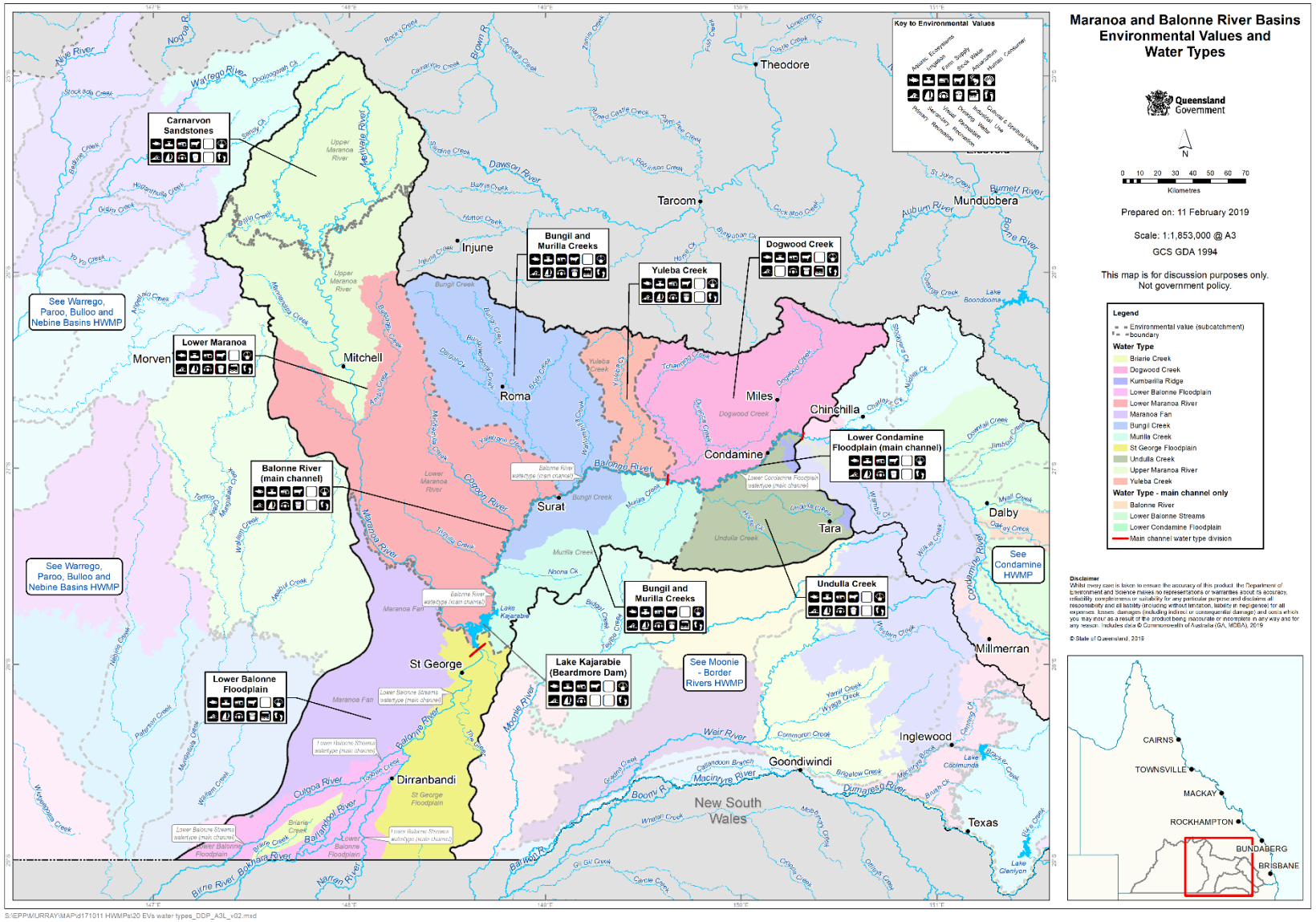

Figure 16: Environmental values and water types that apply to the surface water in each sub region within the Maranoa-Balonne River basin.

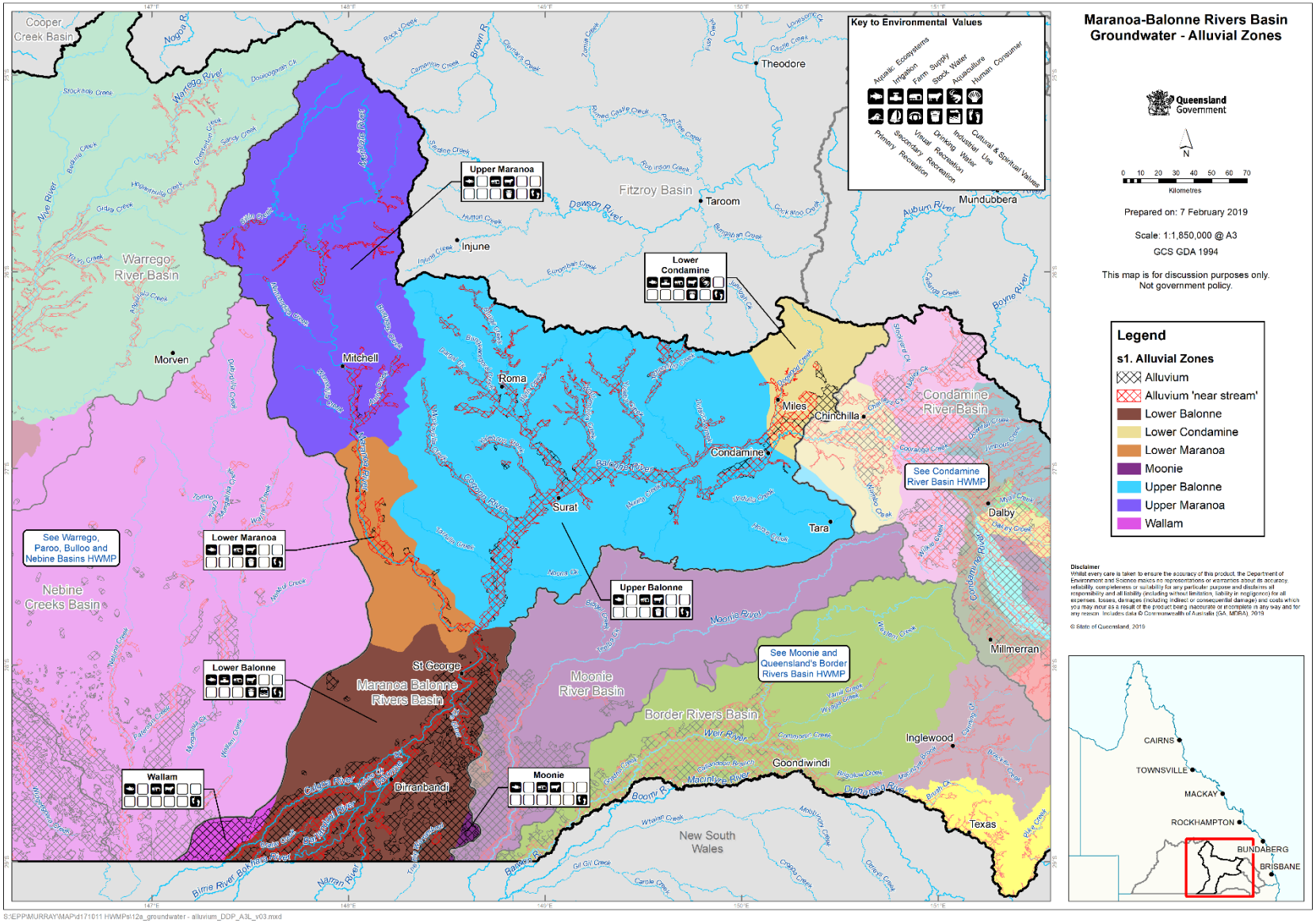

Figure 17: Environmental values that apply to the Alluvial aquifer zones within the groundwaters of Maranoa-Balonne River basin.

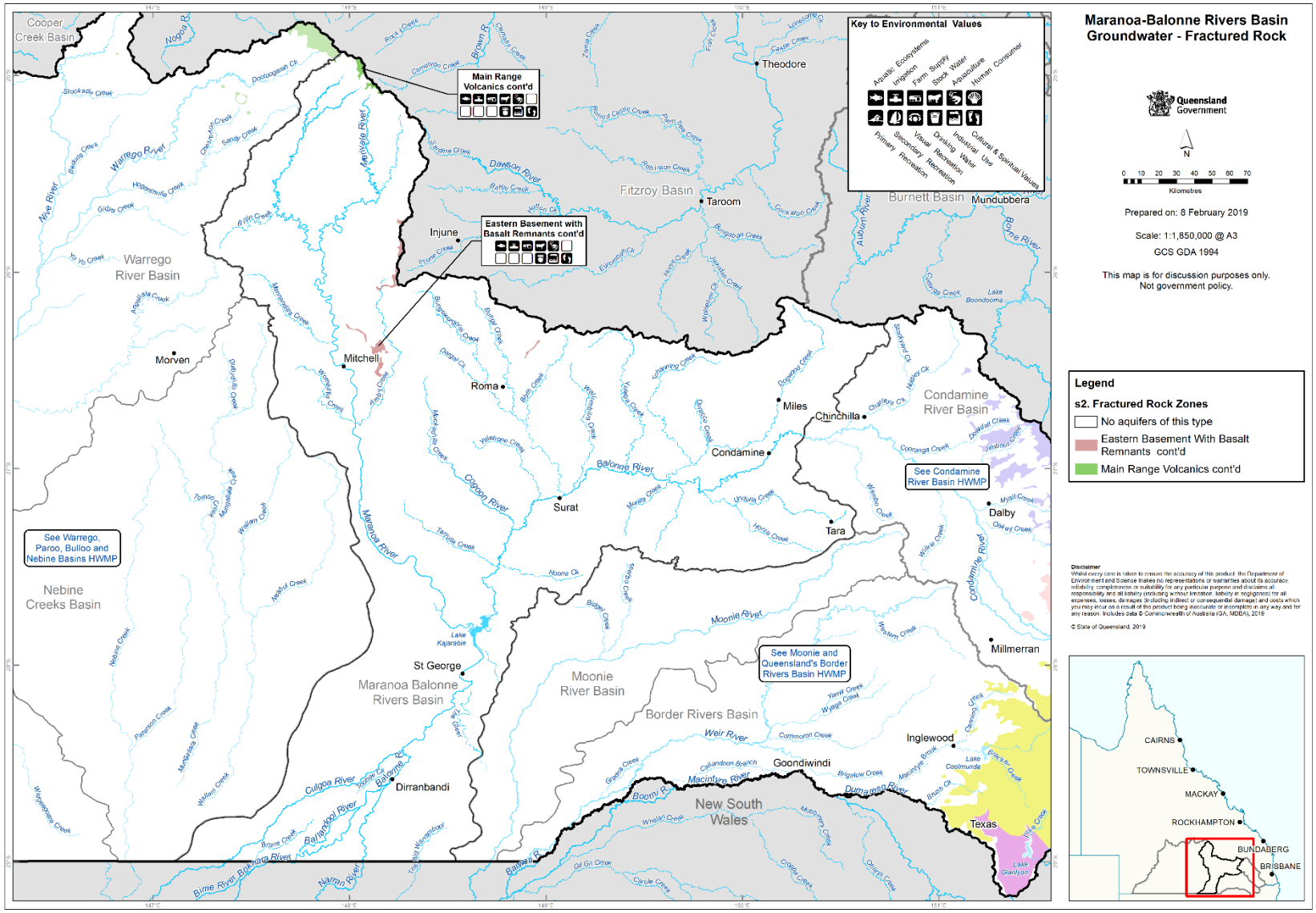

Figure 18: Environmental values that apply to the Fractured Rock aquifer zones within the groundwaters of Maranoa-Balonne River basin.

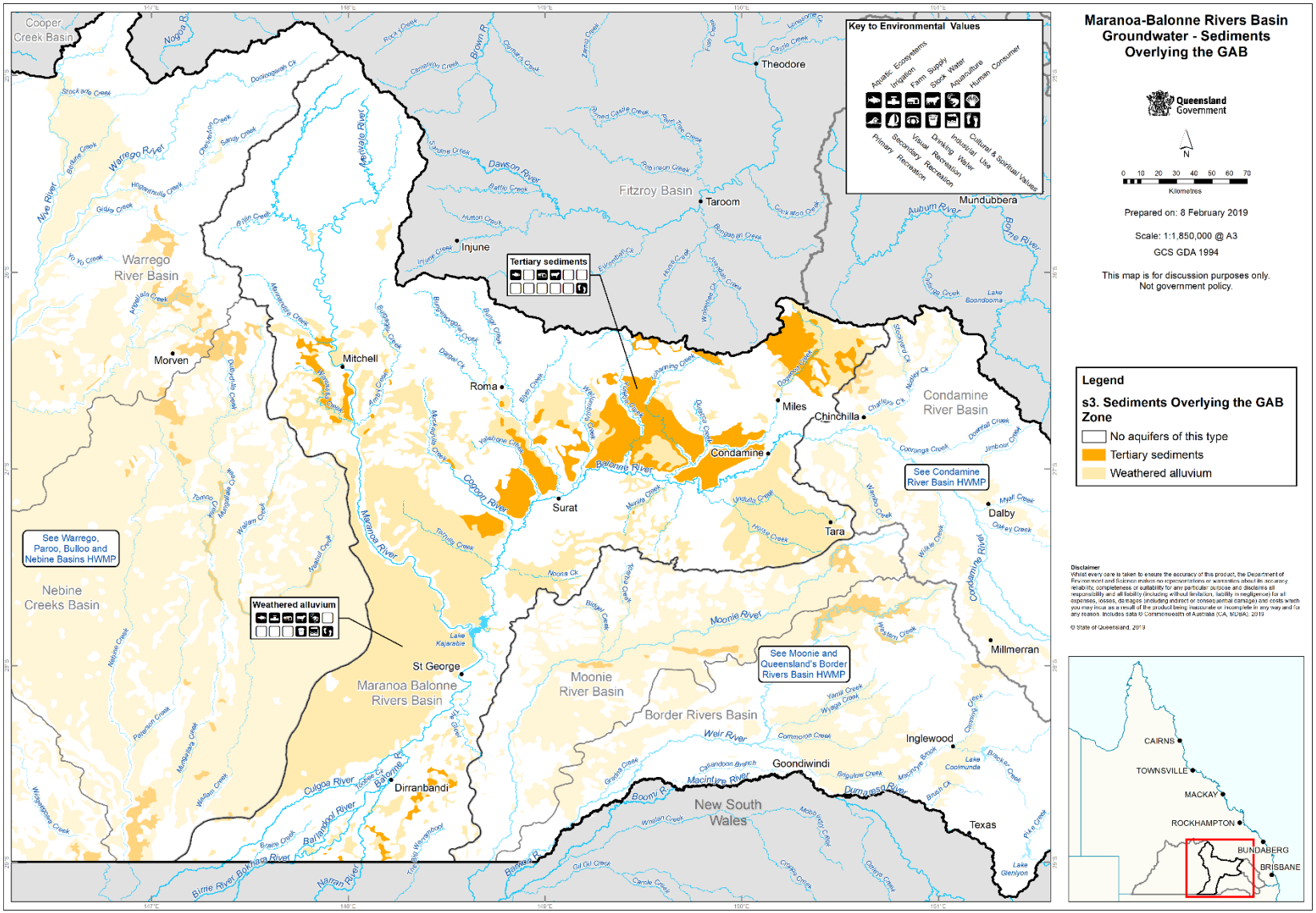

Figure 19: Environmental Values that apply to the Sediments Overlying the GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

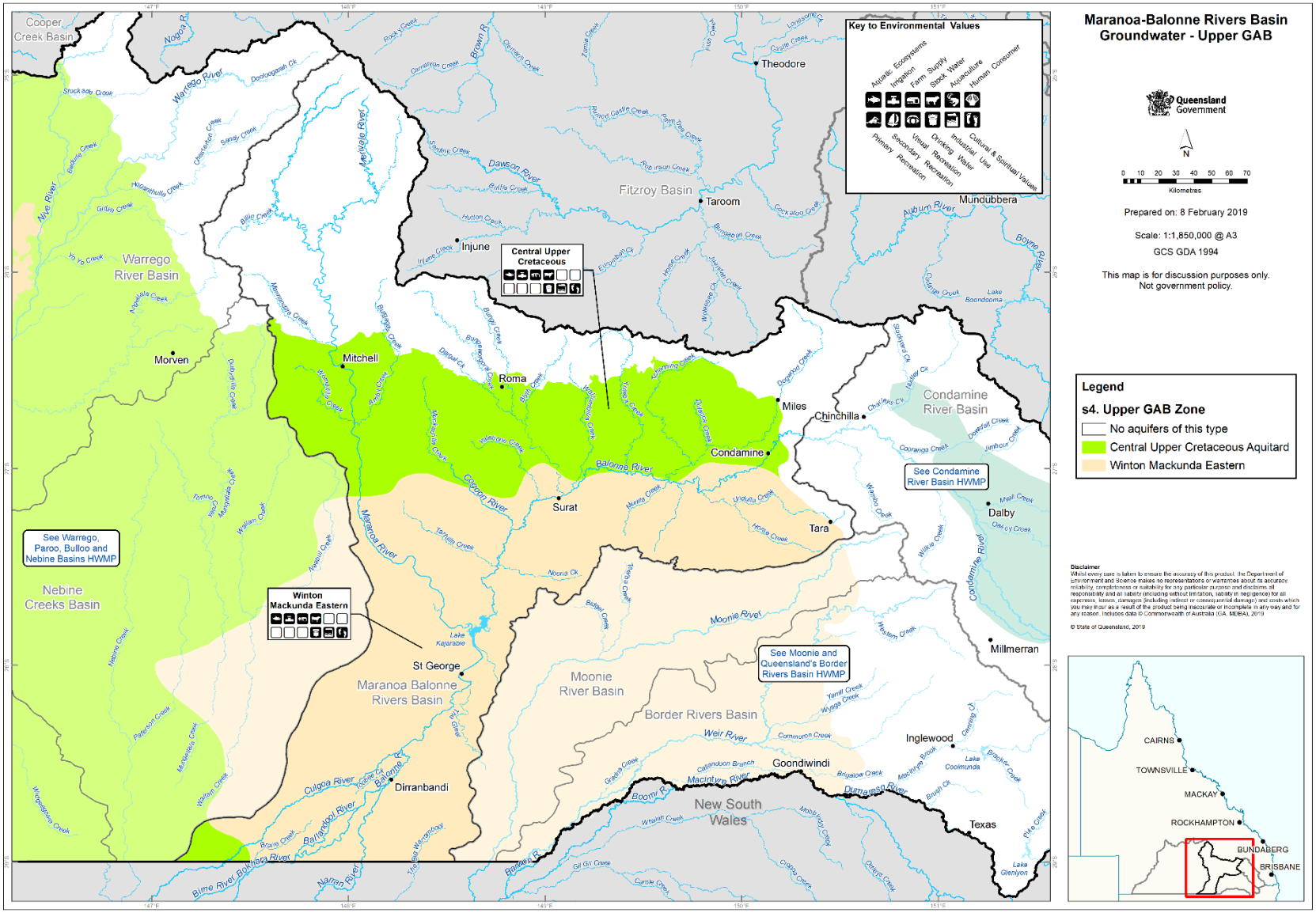

Figure 20: Environmental values that apply to the Upper GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

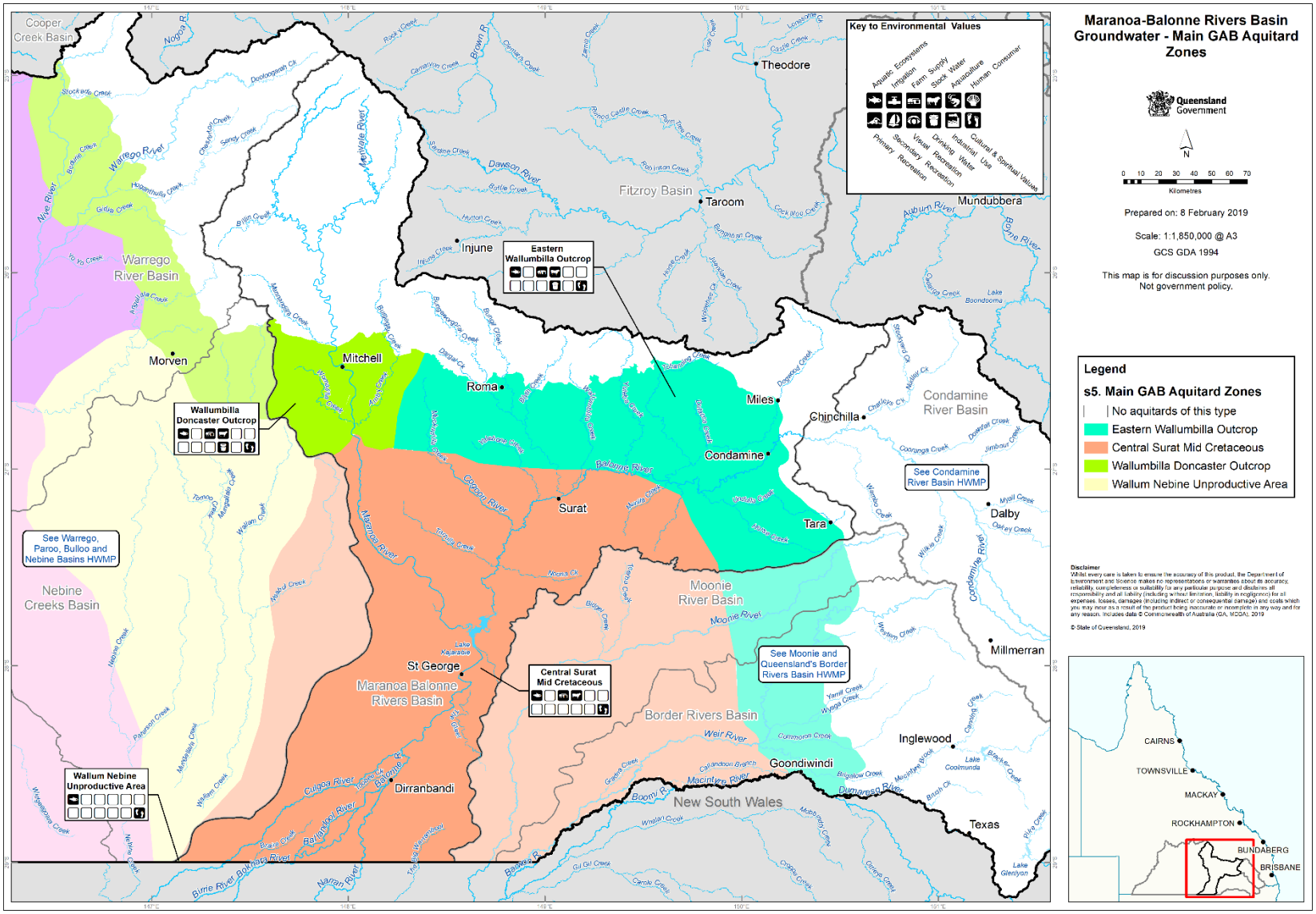

Figure 21: Environmental values that apply to the Main GAB Aquitard zones within the groundwaters of Maranoa-Balonne River basin.

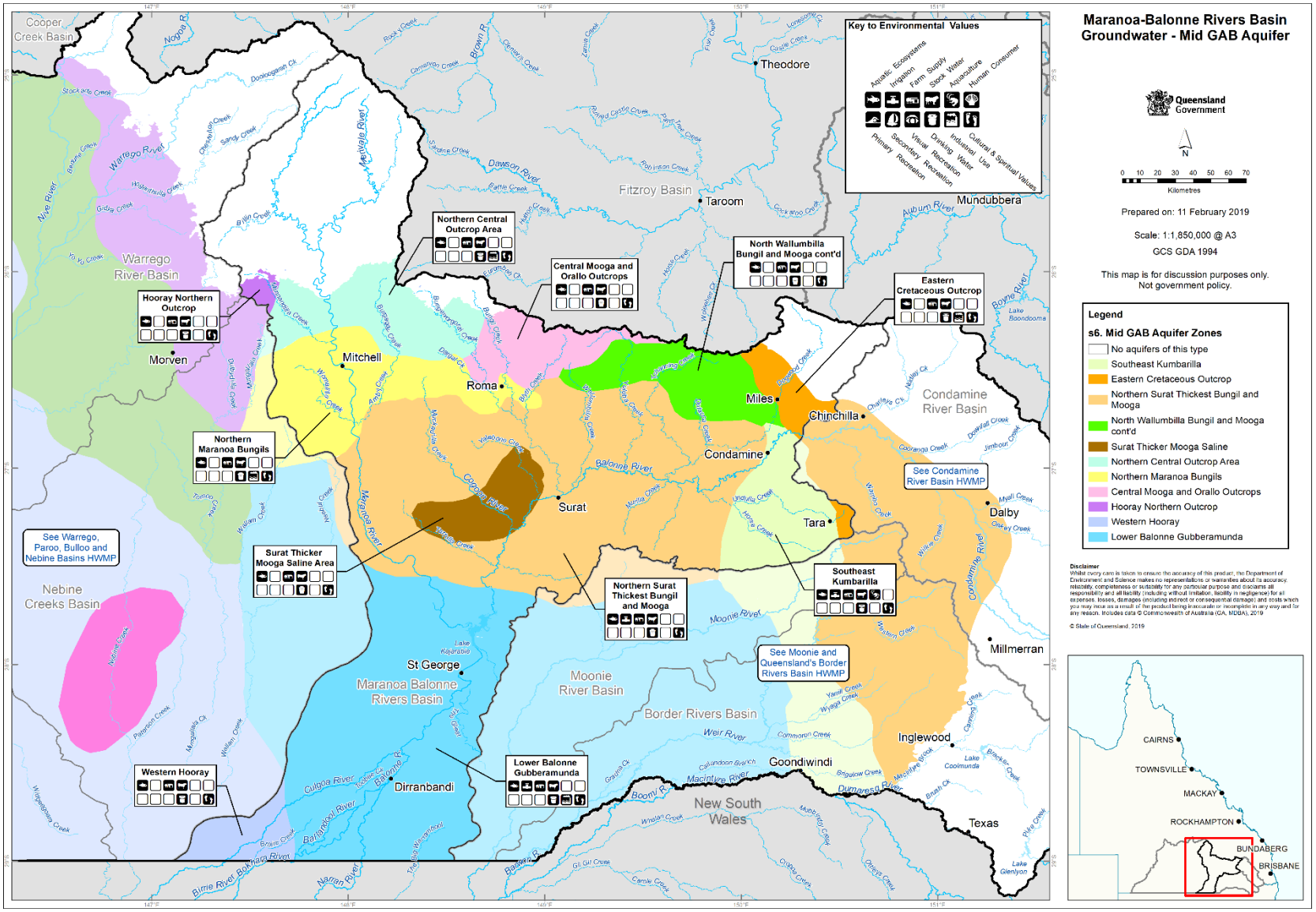

Figure 22: Environmental values that apply to the Mid GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

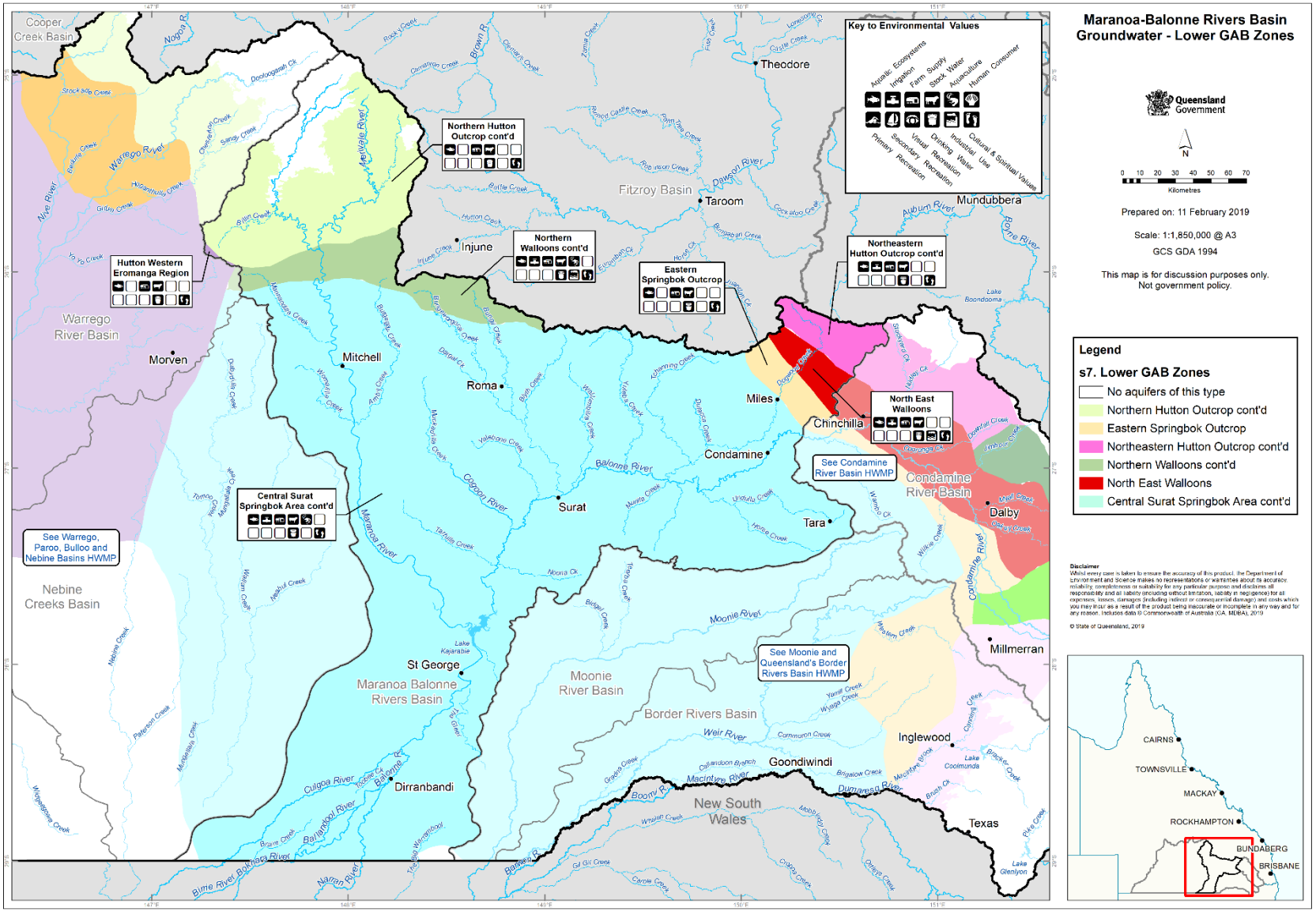

Figure 23: Environmental values that apply to the Lower GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

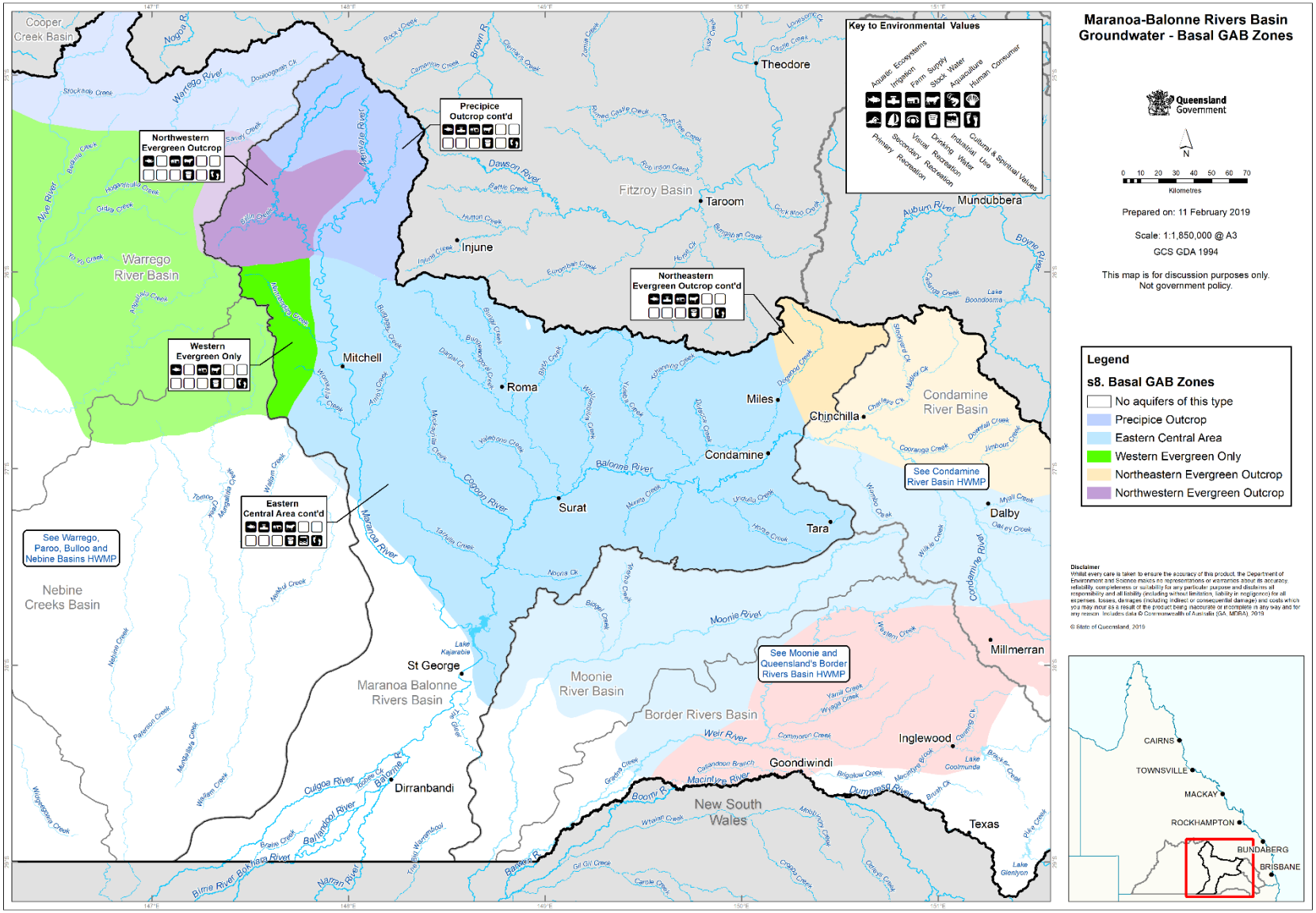

Figure 24: Environmental values that apply to the Basal GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

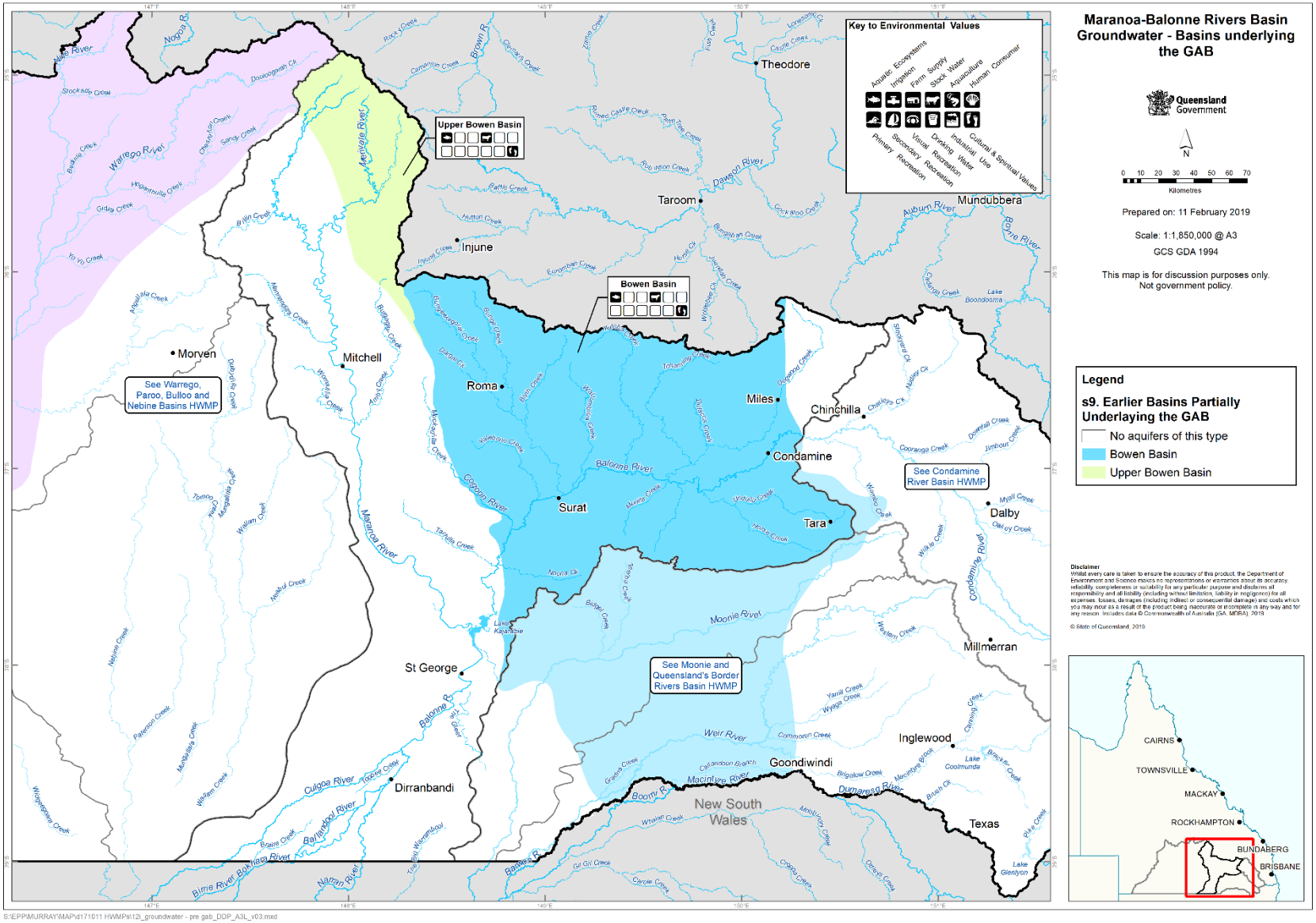

Figure 25: Environmental values that apply to the Earlier Basins Partially Underlying the GAB aquifer zones within the groundwaters of Maranoa-Balonne River basin.

SECTION 6: LEVELS OF AQUATIC ECOSYSTEM PROTECTION

6 Levels of aquatic ecosystem protection

For the aquatic ecosystem environmental value, the EPP Water identifies four levels of protection according to the current condition of waters. The four levels of protection are high ecological value, slightly disturbed, moderately disturbed and highly disturbed (Table 14). Each level of protection is assigned a specific management intent under the EPP Water, as described in Section 6.4 of this report.

Table 14: Levels of aquatic ecosystem protection

Ecosystem condition	Definition
Level 1 High Ecological Value (HEV) ecosystems	Waters in which the biological integrity of the water is effectively unmodified or highly valued.
Level 2 Slightly Disturbed ecosystems	Waters that have the biological integrity of high ecological value waters with slightly modified physical or chemical indicators but effectively unmodified biological indicators.
Level 3 Moderately Disturbed ecosystems	Waters in which the biological integrity of the water is adversely affected by human activity to a relatively small but measurable degree.
Level 4 Highly Disturbed ecosystems	Waters that are significantly degraded by human activity and have lower ecological value than high ecological value waters or slightly or moderately disturbed waters.

Source: EPP Water, Schedule 2.

The designation of levels of aquatic ecosystem condition and the subsequent management intent for waters across Queensland is initially determined by a rules-based approach. This is described in Environmental Protection Policy (Water) Mapping procedural guide (Department of Environment and Science, 2018). This approach is used to develop draft for consultation mapping, which is then refined to consider local water quality data, regional studies and local consultation information. Priority aquatic ecosystems are assigned as either High Ecological Value aquatic ecosystems or Slightly Disturbed aquatic ecosystems based on their condition.

6.1 High Ecological Value and Slightly Disturbed Aquatic Ecosystems

High Ecological Value and Slightly Disturbed Aquatic Ecosystems are presented in Figure 26. The High Ecological Value and Slightly Disturbed waters designations apply only to the waters within the identified boundaries.

The information and datasets considered in the identification and mapping of High Ecological Value waters included:

- protected estates (primarily national parks);
- Wetlands of High Ecological Significance;
- the list of persistent waterholes considered as critical refugia, tabulated at Appendix 4— Persistent Waterholes in the Maranoa and Balonne (Department of Science, Information Technology and Innovation, 2017);
- Great artesian basin (GAB) springs in the ground dependent ecosystems (GDE) register of the QLD GAB and Other Regional Aquifers water management protocol;
- Matters of National Environmental Significance;
- Matters of State Environmental Significance;
- NRM supporting documents (QMDC); and
- stakeholder consultation and expert opinion through the Water Quality Technical Panel.

The information and datasets for the Slightly Disturbed waters mapping included:

- nature refuges and state forests;
- conservation parks;
- Coordinated Conservation Areas; and
- stakeholder consultation and expert opinion through the Water Quality Technical Panel.

6.2 Moderately Disturbed Aquatic Ecosystems

All other areas of the Maranoa and Balonne River basin that are not identified as High Ecological Value, Slightly Disturbed or Highly Disturbed Aquatic Ecosystems are classed as Moderately Disturbed waters. This is the most common level of protection.

6.3 Highly Disturbed Aquatic Ecosystems

Areas classed as Highly Disturbed are not typically assigned until after local water quality data, regional studies and local information have been considered and clearly identify a more heavily degraded condition for particular waters.

Highly Disturbed waters have not been identified in the Maranoa and Balonne River basin.

6.4 Management intent under the EPP Water

Section 14 of the EPP Water states how waters in the different levels of protection described above should be managed. These matters must be considered when decisions are being made about the release of waste water into receiving waters.

For the matters to be complied with for environmental management decisions, including consideration of the management intent, refer to the Environmental Protection Regulation 2008 (as updated), section 51.

Table 15: Management intent under the EPP Water for levels of aquatic ecosystem protection

Level of protection	Management intent
High Ecological Value (HEV) waters	The measures for the indicators for all environmental values are maintained i.e. maintain water quality objectives (target values) for HEV waters.
Slightly Disturbed waters	The measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives (target values) for HEV waters.
Moderately Disturbed waters	If the measures for indicators of the environmental values achieve the water quality objectives (target values) for the water—the measures for the indicators are maintained at levels that achieve the water quality objectives (target values) for the water, or If the measures for indicators of the environmental values do not achieve the water quality objectives (target values) for the water—the measures for indicators of the environmental values are improved to achieve the water quality objectives (target values) for the water.
Highly Disturbed waters	The measures for the indicators of all environmental values are progressively improved to achieve the water quality objectives (target values) for the water.

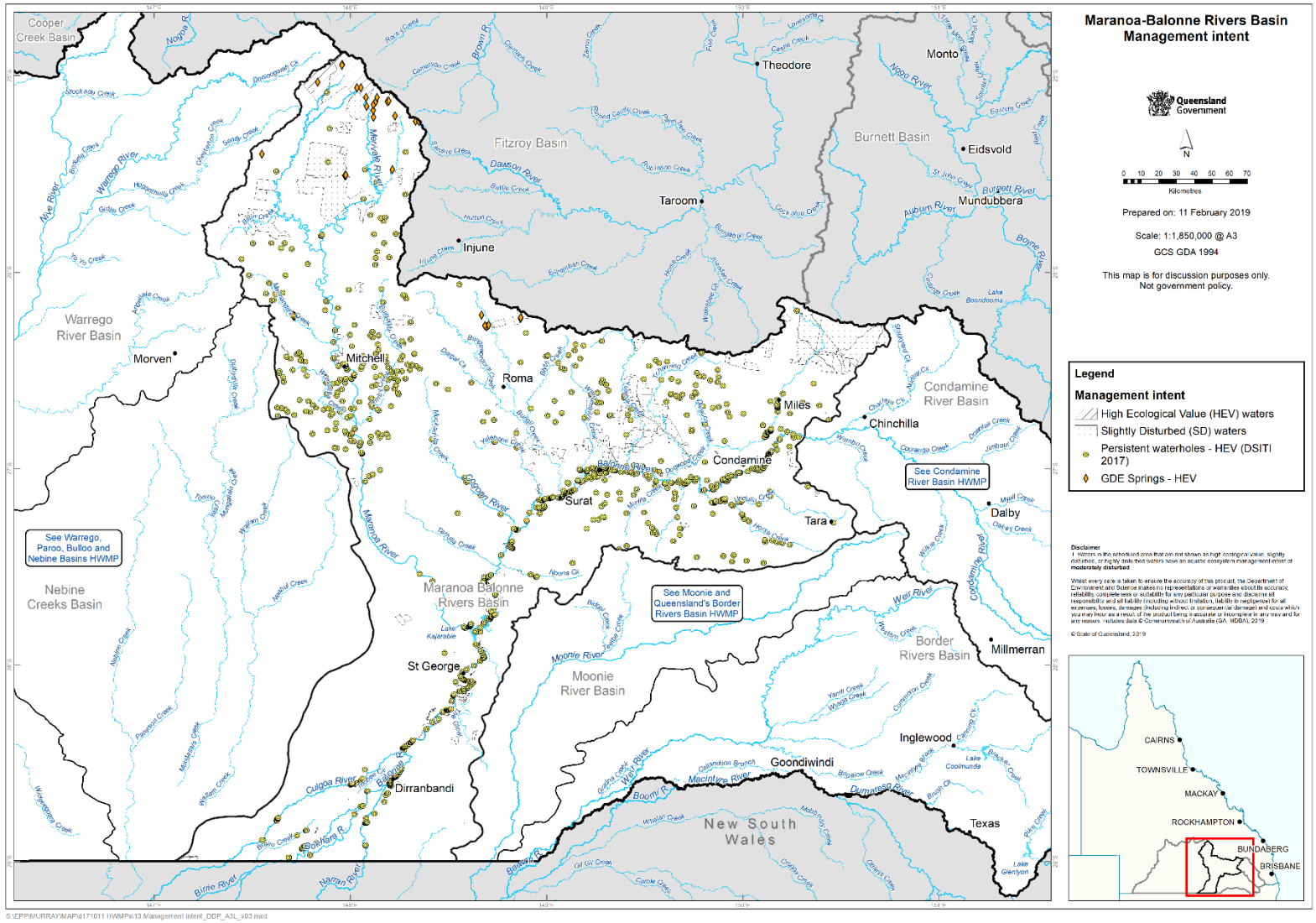

Figure 26: High Ecological Value and Slightly Disturbed waters. The persistent waterholes shown are High Ecological Value waters. A list of the waterholes in the basin area is provided in Appendix 4.

SECTION 7: KEY CAUSES OF WATER QUALITY DEGRADATION AND RISK ASSESSMENT OF WATER BEING OF A QUALITY UNSUITABLE FOR USE

7 Key causes, or likely causes, of water quality degradation and risk assessment of water being of a quality unsuitable for use

The Basin Plan specifies that a WQM Plan must identify the causes, or likely causes, of water quality degradation in the water resource plan area having regard to the key causes of water quality degradation identified in the Basin Plan (Part 2 of Chapter 9 and Schedule 10) under Section 10.30 for surface waters and Section 10.35A for groundwater.

Section 10.41 of the Basin Plan specifies that a water resource plan must be prepared having regard to current and future risks to the condition and continued availability of the water resources of the water resource plan area. Risks include those arising from elevated levels of salinity or other types of water quality degradation.

The key causes, or likely causes, of water quality degradation specific to the Maranoa and Balonne River basin, have been identified through assessment of the current and future risks to the water quality of Basin water resources.

Table 16 presents the key causes, or likely causes, of water quality degradation and the risk of each cause occurring in the Maranoa and Balonne River basin.

For details of the likelihood and consequence of the key causes, or likely causes, of water quality degradation impacting on water resources in the plan area, refer to the Water Quality Risk Assessment spreadsheet on the following website: https://environment.des.qld.gov.au/water/policy/murray-darling-bulloo-evs.html.

A water quality risk assessment was completed in accordance with the requirements of section 10.41 of the Basin Plan. The risk assessment assessed the current and future risks to the condition, or continued availability, of Basin water resources as a result of water being of a quality unsuitable for use. For the purposes of the risk assessment, 'use' included:

- cultural, spiritual and ceremonial
- aquatic ecosystem
- agriculture (including irrigation, stock and domestic)
- consumption of aquatic food (aquaculture and human consumption of aquatic foods)
- drinking water
- industrial use
- recreation (primary, secondary and visual/aesthetic)

The risk assessment was based on the 'Key causes of water quality degradation' derived from Schedule 10 of the Basin Plan and identified for the Maranoa and Balonne River basin surface waters and groundwater (see Table 16). During consultation, it was considered necessary to include in the risk assessment issues of local significance that indirectly impact water quality, including pest flora and fauna and climate change. These risks were informed by the Queensland Government Q-catchments Program (Negus, et al., 2015) and other sources as listed in Table 16. Risks to Aboriginal values and uses are displayed and discussed in Section 9 of the HWMP.

7.1 Risk assessment process

The environmental values and water quality targets at Section 5 and Section 10 of this HWMP take precedent to ANZG 2018 (previously ANZECC) guidelines, with exception of pesticides, heavy metals and other toxicant contaminants where ANZG 2018 guidelines continue to apply.

The risk assessment methodology is detailed in Appendix 3— Condamine-Balonne, Moonie and Queensland Border Rivers Water Quality Risk Assessment Methodology of this report, and is consistent with the AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines. It is also consistent with the National Water Initiative Policy Guidelines for Water Planning and Management—Risk Assessment Module developed by the Department of Sustainability, Environment, Water, Population and Communities.

The spatial scale of the surface water assessment was based on grouping several water type zones. The surface water risk assessment units for Maranoa and Balonne River basin include, Upper Balonne, Maranoa and Lower Balonne (Figure 27).

The spatial scale of the groundwater assessment was based on the groundwater Sustainable Diversion Limit (SDL)

resource units identified by the Murray-Darling Basin Authority. Refer to the Murray-Darling Basin Authority website for further information on Sustainable Diversion Limit resource units in the Murray-Darling Basin.

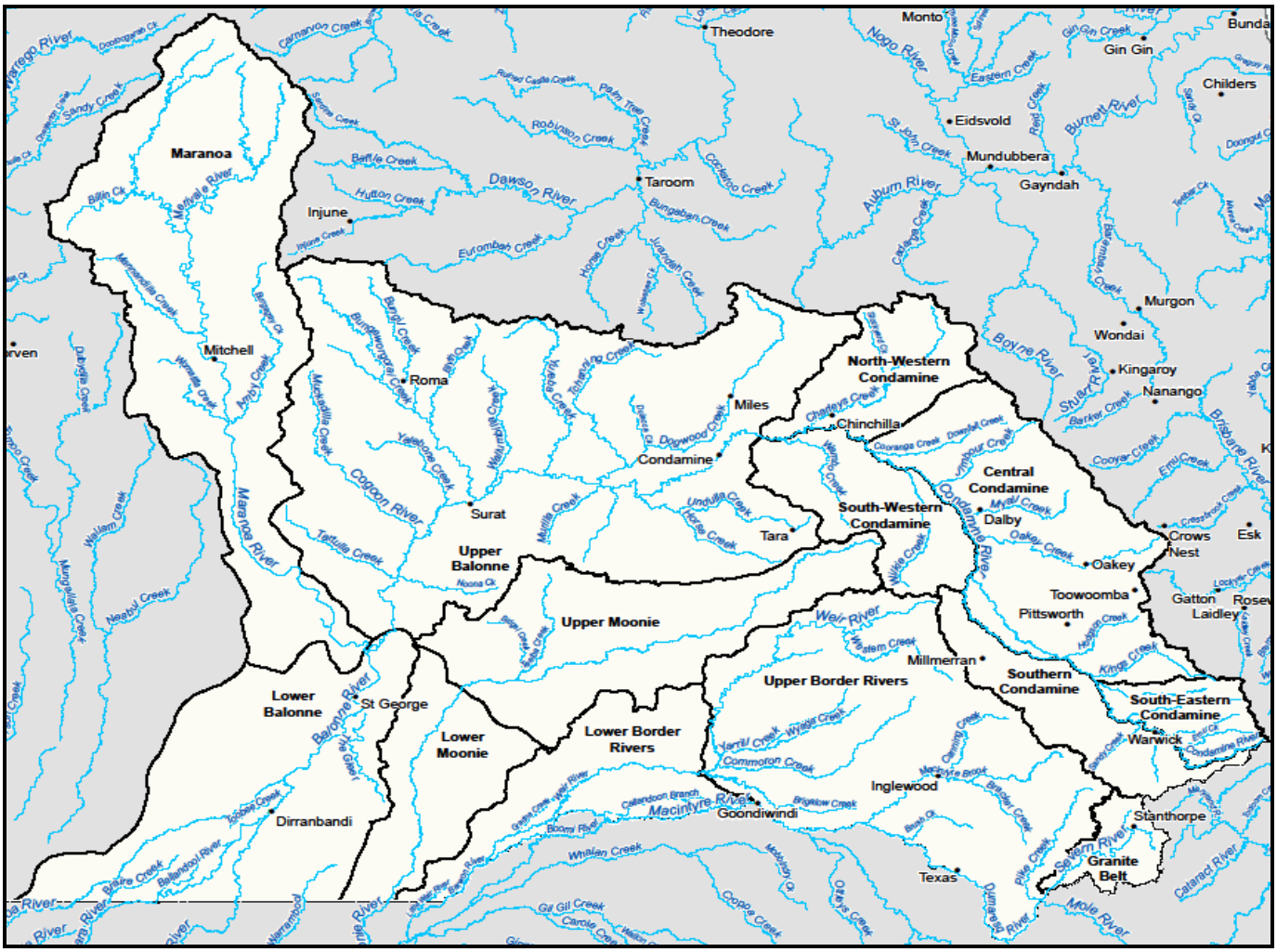

Figure 27: Surface water risk assessment units for the assessment of risks to water quality.

7.2 Risk assessment workshops

The initial risk assessment workshop for the Maranoa, Balonne, Queensland Border Rivers and Moonie regions was conducted in March 2013. The workshop was comprised of the Water Quality Technical Panel (Refer to Section 4.1) and included local on-ground expertise from the former-Department of Natural Resources and Mines (DNRM) and staff from the former-Queensland Murray-Darling Committee (QMDC). The scores from the initial risk assessment were revisited in October 2016 and an additional workshop was held with the Water Quality Technical Panel to update the risk scores. Following the internal workshops, joint external workshops were held with former-DNRM to present the draft risk assessment material to key stakeholders. For more information refer to section 4.4 which details the risk assessment consultation.

7.3 Risk assessment results

A water quality risk assessment was conducted to identify the potential key types of water quality degradation that could occur in the Maranoa and Balonne River basin. It is important to note that just because a risk was highlighted through the assessment, does not mean the set of circumstances is currently present for the risk to materialise. The factors contributing to the potential risks are summarised in Table 16. The risks that were identified included:

- elevated levels of salinity as a potential medium risk in surface waters of the Upper Balonne at Miles and in the groundwaters of the St George Alluvium: Condamine-Balonne (Deep) (GS61);
- elevated levels of suspended matter as a potential medium risk to aquaculture in Lower Balonne and Upper Balonne;
- elevated levels of nutrients as a potential medium risk in the surface waters of the Upper and Lower Balonne;
- elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds as a potential

medium risk in the surface waters of Upper and Lower Balonne;

- water temperature outside natural ranges as a potential high risk in the surface waters of Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir, if stratification of the storages occurs.
- a potential medium risk at Yuleba Creek due to connectivity with Great Artesian Basin waters;
- dissolved oxygen outside natural (ambient) ranges as a potential high risk in the surface waters of the Upper Balonne for Yuleba Creek as natural blackwater events have occurred here previously, as well as for the Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir, if stratification of the storages occurs;
- elevated levels of pesticides and other contaminants as a potential medium risk in the surface waters of the Upper Balonne between Dalby and Condamine;
- pH outside natural ranges as a potential medium risk in the surface waters of the Lower Balonne associated with acid sulfate soils;
- degradation of aquatic habitat connectivity and condition within and between water-dependent ecosystems and the degradation of riparian extent, connectivity and condition as medium risk in the Upper and Lower Balonne;
- climate change as high risk in the Condamine, Balonne and Maranoa and as medium risk in Lower Balonne;
- pest fauna (aquatic) as high risk in the Condamine, Balonne and Maranoa and Lower Balonne; and
- pest flora (land) as medium risk in the Lower Balonne.

The results of the water quality risk assessment for the Maranoa and Balonne River basin are displayed in Table 16.

Table 16: Key causes, or likely causes, of water quality degradation and the risk of each cause occurring in the Maranoa-Balonne River basin.

The causes of water quality degradation are reflective of the risk assessment results. A Risk Register Code is listed for all medium or higher risks and relates to the full water quality risk assessment, available online as supporting information to the HWMP for the Maranoa and Balonne River basin.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
Key causes, or likely causes, of water quality degradation identified from Schedule 10 of the Basin Plan					
	Elevated levels of salinity	The process of mobilisation of salt stores in the landscape and geological redisposition to salinity development, including by: (a) the following processes and activities relating to water flow or water management: (i) saline groundwater and surface water discharges into surface water systems	Maranoa	Low	The expert panel indicated that during high flows, natural salt spikes occur in the top end of the catchment. Mining and quarrying activities are present in Maranoa, specifically the Amby Creek area, however, impacts from these activities are regulated, managed and minimised through the Development Application and Environmental Authority approval process. The uncertainty of this risk is medium as the water quality technical panel indicated the risk was present, however this risk was not flagged during the water quality data analysis.
Surface water LM599			Upper Balonne Hotspot: Miles	Medium	The expert panel identified the potential for saline groundwater infiltrating surface water in the Fairy Meadow Road region near Miles of the Upper Balonne. The use of reverse osmosis water for irrigation has the potential to mobilise salts in the landscape. Further monitoring and modelling would assist in characterising the risk.
		(ii) increased deep drainage below irrigated agricultural land displacing saline groundwater to surface water systems	All surface and groundwater units	Low	The expert panel identified the potential for increased salinity due to recharge under irrigated land (deep drainage) in the St George Alluvium: Condamine-Balonne (Shallow) (GS61). However, this risk has not been identified as currently occurring, although rising groundwater trends indicate recharge is occurring. All other surface and groundwater units were a low risk.
		(iii) saline surface and shallow groundwater drainage from irrigated agricultural land into surface water systems	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
		(iv) irrigation at high salinity risk locations without adequate drainage management; Example: Locations where there is a high risk of recharge to groundwater resulting in saline discharges to surface waters	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur.
Groundwater WM11		(v) de-watering of saline groundwater which mobilises salt into surface water systems	St George Alluvium: Condamine-Balonne (Deep) (GS61)	Medium	The expert panel indicated that the St George Alluvium deep aquifer is comprised of low salinity groundwater. Due to aquifer connectivity, the expert panel identified that increased groundwater use from the St George Alluvium deep aquifer could result in elevated levels of salinity. This would result from infiltration of poorer quality saline waters from the surrounding St George Alluvium shallow aquifer and the Great Artesian Basin. This risk is managed through the water planning process by DNRME. The uncertainty for this risk is low as the high aquifer connectivity and presence of salinity issues is supported by the current literature.
		(vi) reduction in stream flows, limiting the dilution of salinity.	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur. DNRME have assessed the risk of reduced flow and have found the risk is low. It should be noted that reduced flows could result under a changing climate. DNRME have assessed the risk of climate change resulting in reduced flows and have found the risk is low. This is based on modelling wet/median/dry scenarios. It should also be noted that the modelling has a low level of precision (high uncertainty). The uncertainty is medium for this risk due to the uncertainty surrounding the flow conditions under climate change.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
		(b) land management practices involving the replacement of deep-rooted vegetation with shallow-rooted crops and pastures, resulting in increased rainfall recharge displacing saline groundwater to surface water systems	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur.
		(2) The use of groundwater for irrigation purposes at locations where highly saline upper aquifer water drains to the lower aquifer.	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur.
		(3) With respect to soil degradation, the use of water with a high ratio of sodium to calcium and magnesium for irrigation.	All surface and groundwater units	Low	Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur.
	Elevated levels of suspended matter	Sediments entering Basin water resources, which is contributed to by: (a) the following land management practices: (i) inappropriate frequency, timing and location of cultivation; Example: Cultivation taking place at times of the year when the risk of erosion is high (e.g. during the high rainfall season), excessive	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. Although the expert panel identified the presence of irrigated production adjacent streams as a contributor to transport of sediment to stream, based on the analysis of water quality data this cause does not present a medium or high risk. The uncertainty for this risk is low as the water quality data sample size was sufficient (Lower Balonne N=623, Upper Balonne N=917, Maranoa N=287).

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
LM38 LM55		frequency of cultivation, and cultivation of steep slopes	Lower Balonne Upper Balonne	Medium	The data analysis comparison to the ANZECC guidelines identified the potential for sediment to impact aquaculture operations on occasion. However, the consequence was rated as minor as aquaculture is not currently a prevalent industry in the assessment units.
		(ii) overgrazing of catchments and grazing of riverbanks and floodplains; Example: The riparian zone along watercourses kept in permanent vegetation can effectively mitigate the movement of sediment within farmlands and from farmlands	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. Riparian vegetation is scarce in the Upper Balonne and the expert panel identified that the lack of riparian vegetation combined with the dominant land use (grazing and mining activities) contributes to erosion and transport of sediment. Despite this, based on the analysis of water quality data these drivers do not present a medium or high risk. The uncertainty for this risk is low as the water quality data sample size was sufficient (Lower Balonne N=623, Upper Balonne N=917, Maranoa N=287).

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
		(iii) poor soil conservation practices; Example: Practices that fail to use management strategies that prevent soil erosion, acidification, salinisation or other chemical soil contamination, or fail to adopt proven soil conservation technologies such as the construction of contour banks	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. The expert panel identified erosion in the floodplain areas occurring due to unregulated levee banks. Despite this, based on the analysis of water quality data this driver does not present a medium or high risk. The uncertainty for this risk is low as the water quality data sample size was sufficient (Lower Balonne N=623, Upper Balonne N=917, Maranoa N=287).
		(iv) practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration.	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. However, it should be noted that the expert panel identified the lack of riparian fencing as a contributing factor to stream bank erosion and gully development. Further, QMDB Source Water Quality model (Davidson, 2018) shows that in the Balonne, 53% of sediment is contributed to stream from gully sources. The uncertainty for this risk is medium as the water quality data sample size was sufficient (Lower Balonne N=623, Upper Balonne N=917, Maranoa N=287), however expert opinion and QMDB Source Water Quality model suggest that practices causing gully erosion may be present.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
		(b) the following water management practices: (i) rapid drawdown of water within a surface water resource; Example: Rapid drawdown of water in a dam (ii) the volume or manner of release of water, resulting in back or bed erosion.	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. Across the assessment units for Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur. Although Beardmore Dam does release water periodically, impacts from this activity resulting in increased turbidity and/or suspended solids have not been identified. This risk could increase if the dam operation strategies to prevent this risk from occurring are altered. Water storages are managed through the water planning process.
		(c) wave wash (for example, that caused by speedboats).	All surface and groundwater units	Low	Across the assessment areas, the exceedance of the Basin Plan Target Application Zone (B1) and (A1) aquatic ecosystem guideline for suspended solids was either rare or unlikely. The expert panel did not identify this cause as a risk. The uncertainty for this risk is low as the water quality data sample size was sufficient (Lower Balonne N=623, Upper Balonne N=917, Maranoa N=287).

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
Surface water LM54 *Surface water* LM36 *Surface water* LM37	Elevated levels of nutrients	Nutrients entering Basin water resources through both point and diffuse sources. The key sources of nutrients are: (a) soil and organic matter (b) animal waste (c) fertilisers (d) sewage and industrial discharges (e) nutrients from water storages released as a result of storage management practices.	Upper Balonne Lower Balonne	Medium	The analysis of water quality data from the Lower Balonne region shows that the Basin Plan Target Application Zone (A1) aquatic ecosystem guideline for total nitrogen and total phosphorus is likely to be exceeded. The uncertainty for this risk is low as the water quality data sample size is sufficient (TN: N=274 & TP: N=426). In addition, the data analysis shows that the NHMRC Recreation guideline for total phosphorus is likely to be exceeded in both the Upper Balonne and the Lower Balonne. The QMDB Source Water Quality Model (DNRM 2017) shows cropping land use contributes 25% of TN and 30% of TP to the Balonne system. Grazing is the predominant land use in this system and irrigated and dryland cropping is concentrated in close proximity to waterways. Although beneficial use of treated effluent to land is a regulated activity under the Environmental Protection Regulation 2008, it should be noted that this activity is present in the region. The uncertainty for the exceedance of the recreation guideline is high, as the total phosphorus guideline value was used as the sole indicator.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
Surface water LM18 *Surface water* LM5	Elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds	The interaction of the following factors: (a) a water body with little or no flow (b) stratification in the water body (c) sunlight (d) the availability of phosphorus and nitrogen in the water (e) seeding from up-stream (although cyanobacteria blooms may occur without this factor).	Upper Balonne Lower Balonne	Medium	Drivers that contribute nutrients to the system were identified – particularly grazing and irrigated agriculture. The uncertainty was medium as the exceedance of the guideline was based on using chlorophyll-a as a surrogate for cyanobacteria (Microcystins). The Queensland Harmful Algal Bloom Response Plan identifies roles and responsibilities of government agencies in the event of a harmful algal bloom.
Surface water WM6 *Surface water* WM7	Water temperature outside natural ranges	(1) The key cause of water temperature of Basin water resources below natural ranges is the release of stored water from below the thermocline from large water storages in spring, summer and autumn.	Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir	High	Beardmore Dam has been identified as a high risk for thermal alteration due to stratification (Department of Natural Resources and Mines, 2017). A multi off-take is installed for water releases, however the low level off-take and undershot spillway gates may result in thermal alteration, as the temperature differential is not being reduced. The expert panel also identified Jack Taylor Weir as a potential risk for thermal stratification (adequate depth, single level off-take) (NRM, 2002). Water storages are managed through the water planning process. The uncertainty for Beardmore Dam is low due to available literature and expert knowledge. The uncertainty for Jack Taylor Weir is high as information is not as prevalent in comparison.
Surface water LM723		(2) The key causes of water temperature of Basin water resources above natural ranges are the following: (a) the release of stored water from large water storages in winter	Upper Balonne – Yuleba Creek	Medium	The potential discharge of higher temperature Great Artesian Basin water was identified by the expert panel for Yuleba Creek. However, the uncertainty is high for this risk as current data is low in sample size (N=36) and does not align with the information from the expert panel (50th percentile = 19.6°C which is ~2°C lower than other catchments in Maranoa Balonne).
		(b) the removal of shading riparian vegetation	All surface and groundwater units	Low	Although riparian vegetation has decreased across the assessment units, the impact on water temperatures

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
					was determined as either rare or unlikely to occur. This risk level can be maintained into the future by ensuring riparian vegetation cover is maintained or increased.
		(c) reduced flow.	All surface and groundwater units	Low	Across the assessment units for the Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur. DNRME have assessed the risk of reduced flow and have found the risk is low. It should be noted that reduced flows could result under a changing climate. DNRME have assessed the risk of climate change resulting in reduced flows and have found the risk is low. This is based on modelling wet/median/dry scenarios. It should also be noted that the modelling has a low level of precision (high uncertainty). The uncertainty is medium for this risk due to the uncertainty surrounding the flow conditions under climate change.
Surface water LM17	Dissolved oxygen outside natural ranges	(1) Micro-organisms consuming organic matter and depleting oxygen at a rate faster than it can be replenished. Example: This can arise when there is a discharge from sewage treatment plants or the flushing of natural organic material from the floodplain.	Upper Balonne – Yuleba Creek	High	The expert panel have identified naturally occurring black water events in the Upper Balonne, specifically Yuleba Creek. Grazing land use can contribute to this risk by destabilising sediments containing organic material. During rain events the organic material can be transported to stream. The risk was primarily informed by the expert panel as water quality data specifically for Yuleba Creek was low.
Surface water WM4		(2) Bottom release from, or overturn within, a stratified water storage.	Lower Balonne – Downstream of Beardmore Dam and Jack Taylor Weir	High	Beardmore Dam has been identified as a high risk for thermal alteration due to stratification (Department of Natural Resources and Mines, 2017). The expert panel also identified Jack Taylor Weir as a potential risk for thermal stratification (adequate depth, single level off-take) (NRM, 2002). Water storages are managed through the water planning process. The uncertainty for Beardmore Dam is low due to available literature and expert knowledge.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
					The uncertainty for Jack Taylor Weir is high as information is not as prevalent in comparison.
		(3) Eutrophication leading to excessive plant growth causing high diurnal variations in dissolved oxygen levels, both above and below natural ranges.	All surface and groundwater units	Low	Across the assessment units for the Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur. The Queensland Harmful Algal Bloom Response Plan identifies roles and responsibilities of government agencies in the event of a harmful algal bloom. In the event of a fish kill, the type of response implemented will be dependent on the likely cause for concern, e.g. low dissolved oxygen, disease, etc. The Queensland Government will coordinate involvement across agencies depending on the nature of the event.
Surface water LM19	Elevated levels of pesticides and other contaminants	Poor management practices including the following: (a) pesticide spray drift (b) allowing pesticides or other contaminants into surface water runoff (c) allowing pesticides or other contaminants to leach into groundwater (d) allowing erosion of contaminated soil (e) inappropriate disposal of pesticides (f) inappropriate disposal and management of industrial and other waste (including from mining and coal-seam gas extraction).	Upper Balonne – Hotspot between Dalby and Condamine	Medium	The expert panel identified potential drivers are present for elevated levels of pesticides in Central Condamine and South-Western Condamine, specifically between Dalby and Condamine. Grazing is the predominant land use in this system and irrigated and dryland cropping is concentrated in close proximity to waterways.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
Surface water LM39	pH outside natural ranges	(1) The exposure to the air of soils containing iron sulphide minerals. Note: When iron sulphide minerals are exposed to air natural oxidation processes can result in the release of acid, which can be flushed into Basin water resources. (2) Agricultural practices that lead to the acidification of soils.	Lower Balonne – Hotspot: Griman Creek Formation & excavated channels	Medium	The expert panel highlighted the acidic shallow groundwater along the margins of the Griman Creek Formation in the Lower Balonne. Further, the expert panel indicated that excavated channels are predisposed to acidic, saline groundwater and acid sulfate soils formation. For the remainder of the assessment area, despite acid sulphate soils not being detected, if potential acid sulphate soils are present, poor agricultural land use practices may convert potential acid sulphate soils to actual acid sulphate soils. The uncertainty for this risk is high as local data analysis for pH did not align with the expert panel assessment.
		(3) Eutrophication leading to excessive plant growth causing high diurnal variation in pH.	All surface and groundwater units		Although elevated nutrients have been identified in Upper Balonne and Lower Balonne, it is not considered likely that pH will be impacted.
	Elevated pathogen counts	Pathogens entering Basin water resources through both point and diffuse sources. The key sources of pathogens are: (a) human and animal waste (b) sewage discharges.	All surface and groundwater units	Low	Across the assessment units for the Maranoa and Balonne, this cause of water quality degradation was determined as either rare or unlikely to occur. The uncertainty is high due to a lack of available data.
Additional key causes, or likely causes, of water quality degradation identified through consultation					

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
	Degradation of aquatic habitat, riparian extent/connectivity, riparian condition	Removal of riparian vegetation. Overgrazing of catchments and grazing of riverbanks and floodplains. Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration. The implementation of poor management practices leading to elevated levels of pesticides and other contaminants. Unmanaged fire risk leading to wildfires, destruction of riparian vegetation.	Upper and Lower Balonne River	Medium	Balonne River has lost approximately 45% of pre-European riparian vegetation (Clark, Healy, & Tindall, 2015). The Balonne River catchment area has low riparian connectivity in comparison to other rivers in Queensland's Murray-Darling Basin. Further, the proportion of the catchment's riparian area that is endangered is approximately 1% and the proportion that is of concern is approximately 20%. The removal or fragmentation of riparian vegetation increases the risk of pollutant transport to stream, reduces bank stability and can increase the amount of direct sunlight the stream receives. To prevent this risk from increasing to high risk best management practices should be implemented and continued in the basin.
	Climate change	The appropriate actions are not taken to reduce Greenhouse Gas emissions, increase carbon capture and promote adaptation. Rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods. Changes to flood frequency and duration may impact vegetation, reducing river shading and the contribution of organic matter to stream. This will impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011), as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).	Condamine, Balonne and Maranoa River basin	High	The Q-catchments report for QMDB (Negus, et al., 2015) assessed the risk of climate change on aquatic ecosystems in the Condamine, Balonne and Maranoa River basin, as high. A changing climate is likely to impact the water resources and freshwater ecosystems of the QMDB (Negus, et al., 2015). Rainfall variability is likely to increase with current climate modelling predicting that rainfall during winter and spring will decrease and the frequency of intense downpours will increase (The State of Queensland, 2017). It is likely that this will be associated with changes to river flows and to the frequency and extremity of droughts and floods. Climate change is predicted to impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011). Changes to flood frequency and duration may impact vegetation (river red gums - *Eucalyptus camaldulensis* for example), reducing river shading and reducing the contribution of organic matter to stream. This will impact fish species as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster under current climate predictions due to increased evapotranspiration and changes to flood frequency and

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
					duration (Balcombe, et al., 2011).
			Lower Balonne River basin	Medium	The Q-catchments report for QMDB (Negus, et al., 2015) assessed the risk of climate change on aquatic ecosystems in the Lower Balonne River basin, as medium. Mean river inflows in the Lower Balonne are likely to be impacted less than those in the Condamine, Balonne and Maranoa River basin, thus the risk is lower for this catchment. However, the impacts of climate change on aquatic ecosystems as described above in the Condamine, Balonne and Maranoa River basin are predicted to be similar.
	Pest fauna—Aquatic	Predation of native species. Competition with native fish populations for food, habitat and spawning locations. Increase in suspended sediment and nutrients. (Negus et al., 2012a-d).	Condamine, Balonne and Maranoa River basin	High	Of the 12 species of instream pest fauna present in the Murray-Darling basin (Lintermans, 2007), five fish species and one amphibian are known to occur, or have a real potential to occur in the Condamine, Balonne and Maranoa basins. The presence of instream pest fauna generally results in a decline in the populations and communities of native flora and fauna (Negus, et al., 2015). This is due to the increased predation and competition with native species. Pest fish are introduced into the ecosystem in a number of ways including, dumping of unwanted fish to waterways, the use of pest fish as bait, and stocking of fish in dams and impoundments.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of risk	Justification
			Lower Balonne River basin	High	Of the 12 species of instream pest fauna present in the Murray-Darling basin (Lintermans, 2007), three fish species and one amphibian are known to occur, or have a real potential to occur in the Lower Balonne basin. The presence of instream pest fauna generally results in a decline in the populations and communities of native flora and fauna (Negus, et al., 2015). This is due to the increased predation and competition with native species. Pest fish are introduced into the ecosystem in a number of ways including, dumping of unwanted fish to waterways, the use of pest fish as bait, and stocking of fish in dams and impoundments.
	Pest flora — Aquatic	Competition with native plants and reduction in the quality of habitat for native animals.	Lower Balonne River basin	Medium	Although introduced riparian flora was not identified as a priority threat by the Q-catchments program in the Condamine, Maranoa and Balonne River basin, riparian weeds, including Weeds of National Significance (WONS), have been detected. Introduced riparian flora was identified as a priority threat in the Lower Balonne (Negus, et al., 2015).

SECTION 8: MANAGEMENT RESPONSES

8 Management responses

Section 10.33 of the Basin Plan that a WQM Plan must specify measures to be undertaken in, or in relation to, the surface water resources of the water resource plan area that contribute to the achievement of objectives. Similarly, Section 10.35C of the Basin Plan specifies that regard must be had to whether it is desirable for the WQM Plan to include rules or measures that support the maintenance of water quality within groundwater SDL resource units, based on consideration of a number of matters specified in the Basin Plan.

A measure is recommended for accreditation in a WQM Plan for Queensland Murray-Darling Basin catchments if the:

- **level of risk is medium, high or very high;**
- **relevant water quality and salinity target values are identified in the HWMP;**
- **measure is an action within the scope of the *Water Act 2007* and Queensland *Water Act 2000*;**
- **measures are fit-for-purpose and cost effective.**

As a result of these criteria, the land management measures listed in a HWMP are not flow-related accredited measures for the purposes of the Basin Plan. However, in order to encapsulate the overall framework for the management of water quality in the Queensland Murray-Darling Basin, the WQM Plan under the Basin Plan recognises that the land management measures, listed in Section 8, contribute to improving water quality in the Maranoa and Balonne River basin.

The measures presented in this section have been developed to address the risks identified in Section 7 of this report and contribute to the achievement of the objectives and outcomes for water resources specified in Section 3. Management responses listed in the tables below address risks to water quality in the Maranoa and Balonne River basin identified as being at a medium or higher level of risk. Risks identified as at a low level, and the accompanying management responses to maintain low risk scores, are also included in these tables.

Existing projects being conducted across Queensland Murray-Darling Basin may inform future management responses and updates to this document. The implementation of future projects will be dependent on the allocation of funding and resources for natural resource management actions.

The extent and cost of the management responses is guided by the level of risk assigned to the type of water quality degradation the management response seeks to address. Management responses should also be fit-for-purpose and collaborative to increase cost efficiency.

The overarching NRM program “Regional Coordination and Evaluation” is relevant to the management of all risks. This project supports essential functions that assist to effectively deliver NRM outcomes including: design and on-going improvement of monitoring, evaluation, reporting and improvement (MERI) processes; development of shared evaluation and monitoring frameworks; analysis and interpretation of critical resource condition and spatial data; improving knowledge management systems; upskilling staff; engaging key stakeholders & developing partnerships; and, developing key strategies to ensure efficiencies and continuous improvement of project delivery. The Southern Queensland NRM project is delivered under the Queensland Government Natural Resources Investment Program 2018-2022.

The success of the management responses provided in this section will be assessed against the water quality target values specified in Section 10 of this report, where funded monitoring programs are available. The management responses have been designed to maintain and/or improve water quality to achieve these water quality targets.

8.1 Management responses to address risks and contribute to the achievement of objectives

8.1.1 Risk factor: Elevated levels of salinity

Risk level	
Upper Balonne at Miles	Medium
St George Alluvium: Condamine-Balonne (Deep) (GS61)	Medium
All other surface waters and groundwaters	Low

Table 17: Management responses to address risks from elevated levels of salinity

Key causes, or likely causes, of water quality degradation to be addressed	Measures to address risks
Saline groundwater and surface water discharges into surface water systems. De-watering of saline groundwater which mobilises salt into surface water systems Land management practices involving the replacement of deep-rooted vegetation with shallow-rooted crops and pastures. The use of groundwater for irrigation purposes at locations where highly saline upper aquifer water drains to the lower aquifer.	**Basin Salinity Management 2030** The Queensland Government will implement Basin Salinity Management 2030, in accordance with Schedule B of Schedule 1 of the Commonwealth *Water Act 2007* (and as revised) – for the purposes of long-term salinity planning and management. **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. Where the proposed environmentally relevant activity involves salinity being generated, applicants are encouraged to develop a detailed management strategy. The strategy should demonstrate that the environmentally relevant activity will be managed to minimise the impacts on the environment. **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** The risk of salinity is reduced by maintaining ground cover in sodic soil areas and through native vegetation management, such as maintaining/improving deep rooted vegetation. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels.

Key causes, or likely causes, of water quality degradation to be addressed	Measures to address risks
	• Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for electrical conductivity have also been established for the various water types in the plan area, which complement the end-of-valley salinity targets under Schedule B of Schedule 1 of the Commonwealth *Water Act 2007* (and as revised). Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives.

Key causes, or likely causes, of water quality degradation to be addressed	Measures to address risks
	Grazing BMP Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.2 Risk factor: Elevated levels of suspended matter—including deposited sediment

Risk level	
Upper Balonne	Medium
Lower Balonne	Medium
All other surface waters	Low
Not applicable to groundwater.	

Table 18: Management responses to address risks from elevated levels of suspended matter—including deposited sediment

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Land Restoration Fund A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream.
Inappropriate frequency, timing and location of cultivation; Example: Cultivation taking place at times of the year when the risk of erosion is high (e.g. during the high rainfall season), excessive frequency of cultivation, and cultivation of steep slopes.	**Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project.
Overgrazing of catchments and grazing of riverbanks and floodplains; Example: The riparian zone along watercourses kept in permanent vegetation can effectively mitigate the movement of sediment within farmlands and from farmlands.	**Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change.
Poor soil conservation practices; Example: Practices that fail to use management strategies that prevent soil erosion, acidification, salinisation or other chemical soil contamination, or fail to adopt proven soil conservation technologies such as the construction of contour banks.	**Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes.
Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration.	**Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Cluster Fencing** A Southern Queensland NRM project delivered under the Queensland Government funded Queensland Feral Pest Initiative – Round 3. The project aims to support for the establishment of new cluster fencing to reduce the impacts of wild dogs and enable the return and/or increase of sheep production and productivity in traditional wool production areas of the Quilpie, Paroo and Balonne Shires. In selected areas, cluster fencing can provide the benefit of excluding cattle from waterway banks, thus reducing erosion and sediment runoff into the waters. The establishment of new clusters is expected to increase landholder's ability to produce livestock sustainably and implement best practice grazing practices. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** The risk of suspended matter is reduced through maintaining ground cover and vegetation in riparian zones and the wider landscape. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Water quality objectives for turbidity have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.3 Risk factor: Elevated levels of nutrients, including phosphorus and nitrogen

Risk level	
Upper Balonne	Medium
Lower Balonne	Medium
All other surface waters and groundwaters	Low

Table 19: Management responses to address risks from elevated levels of nutrients, including phosphorus and nitrogen

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Nutrients entering Basin water resources through both point and diffuse sources. The key sources of nutrients are:	**Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
(a) soil and organic matter (b) animal waste (c) fertilisers (d) sewage and industrial discharges (e) nutrients from water storages released as a result of storage management practices.	contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Store and release code of practice 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons.

8.1.4 Risk factor: Elevated cyanobacteria cell counts or biovolume, toxins and odour compounds

Risk level	
Upper Balonne	High
Lower Balonne	High
All other surface waters and groundwaters	Low

Table 20: Management responses to address risks from elevated cyanobacteria cell counts or biovolume, toxins and odour compounds

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The interaction of the following factors: (a) a water body with little or no flow (b) stratification in the water body (c) sunlight (d) the availability of phosphorus and nitrogen in the water (e) seeding from up-stream (although cyanobacteria blooms may occur without this factor).	**Queensland Harmful Algal Bloom Response Plan** Seasonal incidents of harmful algal blooms can occur throughout Queensland. This response plan, developed in 2014 (and updated), identifies the appropriate response agency to deal with a harmful algal bloom incident or enquiry. The response plan ensures a coordinated response to address the issue and minimise the risk of harmful algal blooms to humans, livestock and wildlife. The Queensland Harmful Algal Bloom Response Plan is supported by the Queensland Harmful Algal Bloom operational procedures. <u>To address phosphorus and nitrogen in the water, the following management responses apply:</u> **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Grazing BMP Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons.

8.1.5 Risk factor: Water temperature outside natural ranges

Risk level	
Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir	High
Upper Balonne at Yuleba Creek	Medium
All other surface and groundwaters	Low

Table 21: Management responses to address risks from water temperature outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The release of stored water from below the thermocline from large water storages in spring, summer and autumn. The release of stored water from large water storages in winter The removal of shading riparian vegetation Reduced flow.	**Water planning framework under the Water Act 2000** The Water Act 2000 enables provisions to be included on Resource Operation Licences regarding operating rules to minimise impacts to ecosystems. The Water Act 2000 also provides for outcomes, measures, objectives and indicators to be developed for the respective plan area under a Water Plan. The release of water from storages is managed by conditions on each Resource Operations Licence (ROL) under the Water Act 2000. These ROL conditions are implemented by the Resource Operations Licence Holder e.g. SunWater. To address the risk of water temperature outside natural ranges due to the removal of shading riparian vegetation, the following management responses apply: **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** ‘The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin’ was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Toolkit measures In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.6 Risk factor: Dissolved oxygen outside natural ranges

Risk level	
Upper Balonne for Yuleba Creek	High
Lower Balonne downstream of Beardmore Dam and Jack Taylor Weir	High
All other surface waters	Low
Not applicable to groundwater.	

Table 22: Management responses to address risks from water temperature outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Micro-organisms consuming organic matter and depleting oxygen at a rate faster than it can be replenished. Example: This can arise when there is a discharge from sewage treatment plants or the flushing of natural organic material from the floodplain. Bottom release from, or overturn within, a stratified water storage. Eutrophication leading to excessive plant growth causing high diurnal variations in dissolved oxygen levels, both above and below natural ranges.	**Water planning framework under the Water Act 2000** The Water Act 2000 enables provisions to be included on Resource Operation Licences regarding operating rules to minimise impacts to ecosystems. The Water Act 2000 also provides for outcomes, measures, objectives and indicators to be developed for the respective plan area under a Water Plan. The release of water from storages is managed by conditions on each Resource Operations Licence (ROL) under the Water Act 2000. These ROL conditions are implemented by the Resource Operations Licence Holder e.g. SunWater. <u>To address the risk of dissolved oxygen outside natural ranges due to eutrophication, the following management responses apply:</u> **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	centres greater than 25,000 persons. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.7 Risk factor: Elevated levels of pesticides, heavy metals and other toxic contaminants

Risk level	
Upper Balonne between Dalby and Condamine	High
All other surface waters and groundwaters	Low

Table 23: Management responses to address risks from elevated levels of pesticides, heavy metals and other toxic contaminants

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Poor management practices including the following: Pesticide spray drift Allowing pesticides or other contaminants into surface water runoff Allowing pesticides or other contaminants to leach into groundwater Allowing erosion of contaminated soil Inappropriate disposal of pesticides Inappropriate disposal and management of industrial and other waste (including from	**Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for toxicants, including pesticides and heavy metals, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
mining and coal-seam gas extraction).	as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.8 Risk factor: pH outside natural ranges

Risk level	
Lower Balonne	Medium
All other surface waters and groundwaters	Low

Table 24: Management responses to address risks from pH outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The exposure to the air of soils containing iron sulphide minerals. Note: When iron sulphide minerals are exposed to air natural oxidation processes can result in the release of acid, which can be flushed into Basin water resources. Agricultural practices that lead to the acidification of soils. Eutrophication leading to excessive plant growth causing high diurnal variation in pH.	**State Planning Policy – Emissions and Hazardous Activities State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Emissions and Hazardous Activities seeks to minimise the disturbance to acid sulfate soils to reduce risks posed to the natural and built environments from the release of acid and metal contaminants. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.9 Risk factor: Elevated pathogen counts

Risk level	
All surface waters and groundwaters	Low

Table 25: Management responses to address risks from elevated pathogen counts

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Pathogens entering water through both point and diffuse sources. The key sources of pathogens include animal and human waste and sewage discharges.	**Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including pathogens, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Grazing BMP** Promote uptake of the Grazing BMP program by graziers in the plan area. The voluntary and industry-led Grazing BMP program provides graziers across Queensland with the opportunity to improve productivity and reduce soil run-off to waterways through the identification of improved practices. The Grazing BMP program is available to graziers online via the following website: https://www.bmpgrazing.com.au. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives.

8.1.10 Risk factor: Degradation of aquatic habitat, riparian extent/connectivity, riparian condition

Risk level	
Upper Balonne	Medium
Lower Balonne	Medium
Maranoa River	Low
Not applicable to groundwater.	

Table 26: Management responses to address the degradation of aquatic habitat, riparian extent/connectivity, riparian condition

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Removal of riparian vegetation. Overgrazing of catchments and grazing of riverbanks and floodplains. Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration. The implementation of poor management practices leading to elevated levels of pesticides and other contaminants. Unmanaged fire risk leading to wildfires, destruction of riparian vegetation.	**Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. In addition, persistent waterholes have been identified and assigned high ecological value management intent due to their importance as refugial habitats in 'boom and bust' landscapes. Water quality objectives, and accompanying mapping displaying management intent, will be recommended for scheduling under the Environmental Protection (Water) Policy 2009 to

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	inform statutory and non-statutory planning and decision-making. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Grazing BMP Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Aerial Survey of wetlands and waterbirds in Queensland** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the 'Aerial Survey of wetlands and waterbirds in Queensland' from 2014-2017. This project surveys 2,697,000 km^2 of eastern Australia and can monitor changes in the distribution and abundance of 50 waterbird species, including threatened species, and the health of rivers and wetlands. The survey is a powerful tool to observe changes in Ramsar wetland condition as well as other global and international conservation agreements. The survey can also detect potential long term changes through implementation of the Basin Plan. The aerial surveys are conducted by the University of New South Wales. Refer to https://www.ecosystem.unsw.edu.au/content/rivers-and-wetlands/waterbirds/eastern-australian-waterbird-survey for more information.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Fire management Actively manage fire risk to mitigate risk of wildfires, which can lead to destruction of riparian vegetation, high levels of erosion, and declines in water quality. This could be delivered through NRM bodies, local governments, landholder education, and ranger programs. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.11 Risk factor: Climate change

Risk level	
Condamine, Balonne and Maranoa River basin[13]	High
Lower Balonne River basin	Medium

[13] This risk level was determined under the Queensland Government Q-catchments Program (Q-catchments Program) which assessed the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, the combined basin area is reflected for Risk factor: Climate Change.

Table 27: Management responses to address risks from climate change

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives [14]
The appropriate actions are not taken to reduce Greenhouse Gas emissions, increase carbon capture and promote adaptation. Rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods. Changes to flood frequency and duration may impact vegetation, reducing river shading and the contribution of organic matter to stream. This will impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011), as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).	The Queensland Government is working closely with business and industry, local councils and regional communities to understand the impacts of climate change, and to guide the state to adapt and transition under a changing climate. The following initiatives have been funded by Queensland Government and directly relate to water and land management: • **Land Restoration Fund**: A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. • **CarbonPlus fund**: An $8.4 million project that will support and expand the carbon farming industry. The project has two parts: (1) equip Queensland Indigenous communities to participate in the carbon market and ensure the cultural, social and environmental co-benefits of Aboriginal carbon farming projects are recognised and appropriately valued. The Aboriginal Carbon Fund was engaged to undertake this component of the project. (2) the purchase of carbon credits to offset the Queensland Government's vehicle emissions from 2017-18 to 2018-19, with credits from Indigenous carbon projects being prioritised. In addition to the above, the current initiatives employed by the Queensland Government to understand, adapt and transition under a changing climate are not limited to water and land management initiatives, but instead include projects that encourage a whole-of-sector response (Refer to https://www.qld.gov.au/environment/climate/response for more information). These include: • **Transition to a zero carbon economy**: A strategy to ensure Queensland is positioned to take advantage of the opportunities as the world economy transitions to reduce pollution and adopt low carbon alternatives. • **1 million solar rooftops**: Supporting the deployment of solar PV on the rooftops of businesses, community buildings and commercial or industrial sites including on public housing and schools under the Advancing Clean Energy Schools program: http://education.qld.gov.au/facilities/solar/energy.html. • **Solar150**: The initiative, in conjunction with the large-scale solar PV competitive funding round conducted by the Australian Renewable Energy Agency (ARENA), will help support the development of large-scale solar energy projects in Queensland. • **Green Bonds**: Proceeds from QTC Green Bonds are to be used to fund qualifying green projects and assets for the State of Queensland. The proceeds are allocated to specific projects that support Queensland's transition to a low-carbon and climate resilient economy. So far, the qualifying green projects include rail links, cycleways and solar farms. • **Queensland Climate Resilient Councils**: a five year program working with Queensland local governments to strengthen internal council decision-making processes to respond to climate change (http://qcrc.lgaq.asn.au/). • **Biofutures**: The Advance Queensland's Biofutures 10-Year Roadmap and Action Plan has a vision for a $1 billion sustainable (including low carbon) and export-oriented industrial biotechnology and bioproducts sector: https://advance.qld.gov.au/our-vision/roadmaps/biofutures.aspx. The majority of Queensland-based vegetation management projects under the Australian Government's Emissions Reduction Fund are located in the Murray-Darling Basin [http://www.cleanenergyregulator.gov.au/maps/Pages/erf-projects/index.html]. These projects are

[14] As the strategies to mitigate climate change are not restricted to a basin level, but require local, national and international initiatives, the measures presented here are not restricted to those within the Maranoa and Balonne River basin.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives [14]
	actively contributing to reducing greenhouse gas emission and improved land management outcomes consistent with Australia's international climate change targets. <u>Future activities:</u> • Transitioning to a low carbon energy sector: Working with industry and the community to transition to an efficient, affordable and fair clean energy system, including: setting a 50% Renewable Energy Target by 2030 to drive jobs, investment, and cut carbon pollution; unlocking North Queensland's renewable energy potential; and supporting an additional 400 megawatts of new large-scale renewable capacity. • Continue to work collaboratively with land holders to consider, mitigate and adapt to climate change **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of remnant brigalow in the Queensland Murray Darling** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, fire, weeds, pest animals, overgrazing and climate change on brigalow, which is an Endangered Threatened Ecological Community under the Environment Protection and Biodiversity Conservation Act 1999. The management actions will include re-establishing brigalow in cleared areas; protecting remnant brigalow from further loss; reinstating habitat integrity, complexity and connectivity; reducing fire hazards; controlling weeds and pigs; and adopting appropriate grazing regimes.

8.1.12 Risk factor: Pest fauna—Aquatic

Risk level	
Condamine, Balonne and Maranoa River basins[15]	High
Lower Balonne River basin	High
Not applicable to groundwater.	

Table 28: Management responses to address risks from aquatic pest fauna

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Predation of native species. Competition with native fish populations for food, habitat and spawning locations. Increase in suspended sediment and nutrients. (Negus et al., 2012a-d).	**National Carp Control Plan** A $15-million planning process, on behalf of the Australian Government, to lead a large program of research and consultation to identify a smart, safe, effective and integrated suite of measures to control carp impacts. Consultation has occurred with Queensland stakeholders including, Northern Basin Aboriginal Nations, fishing groups, NRM bodies and community members. Further information can be found at http://www.carp.gov.au/. **Carp busting events** Fishing competitions that target carp are held throughout the catchment. Although it is recognised that these events are unlikely to have a significant impact on carp population numbers (except in closed systems), the educational opportunity that these events provide to the wider community about the detrimental impacts of pest fish are valuable. **Pest management plans**[16] Goondiwindi Regional Council, Balonne Regional Council, Western Downs Regional Council, Toowoomba Regional Council, and Southern Downs Regional Council. Pest management plans recognise the need to control pest species in the catchment through partnership with all levels of government, natural resource management bodies and community. **Barriers to Fish Passage** Mitigate existing barriers to fish passage, where possible. Options for the installation of fishways include the relevant Natural Resource Management body for the region or through the toolkit measures to complement environmental water recovery in the Northern Murray-Darling Basin under the Basin Plan – in consultation with Traditional Owners.

[15] This risk level was determined under the Queensland Government Q-catchments Program (Q-catchments Program) which assessed the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, combined basin area is reflected for Risk factor: Pest fauna - Aquatic.

[16] Pest management plans include plans from adjacent Local Government areas as it is recognised that addressing pest species in the Border Rivers and Moonie is not limited to local government boundaries.

8.1.13 Risk factor: Pest flora—Land

Risk level	
Lower Balonne River basin	Medium
Not applicable to groundwater.	

Table 29: Management responses to address risks from pest flora

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Competition with native plants and reduction in the quality of habitat for native animals.	**Pest management plans**[17] Goondiwindi Regional Council, Balonne Regional Council, Western Downs Regional Council, Toowoomba Regional Council, and Southern Downs Regional Council. Pest management plans recognise the need to control pest species in the catchment through partnership with all levels of government, natural resource management bodies and community.

[17] Pest management plans include plans from adjacent Local Government areas as it is recognised that addressing pest species in the Border Rivers and Moonie is not limited to local government boundaries.

SECTION 9: ABORIGINAL PEOPLE'S VALUES AND USES OF WATER ADDRESSED UNDER A HEALTHY WATERS MANAGEMENT PLAN

9 Aboriginal people's values and uses of water addressed under a healthy waters management plan

Section 10.52 of the Basin Plan outlines the process to identify objectives and outcomes based on Indigenous values and uses.

Section 9.5 of the Healthy Waters Management Plan for the Maranoa and Balonne River Basin outlines opportunities to strengthen the protection of Aboriginal values and uses of water that are relevant to the content of a HWMP. The values and uses of water resources and the risks to these values and uses (Refer to Section and Section 9.4) were identified through a consultation process led by the Department of Natural Resources, Mines and Energy and DES, with Nations within the eastern catchments of QMDB and the Northern Basin Aboriginal Nations (NBAN) (Refer to section 4.5). This consultation process also identified the objectives and outcomes that Aboriginal people within the eastern catchments of QMDB want to achieve for the water resources of the plan area (See Section 9.3). The content below has been informed by the Water Connections Report (DNRME, 2019). The identification of objectives and outcomes for water resources enables the values and uses to be protected and enhanced by water resource planning, particularly those relating to water quality and land management, which can be addressed under the *Environmental Protection (Water) Policy 2009* through the Maranoa and Balonne River Basin HWMP.

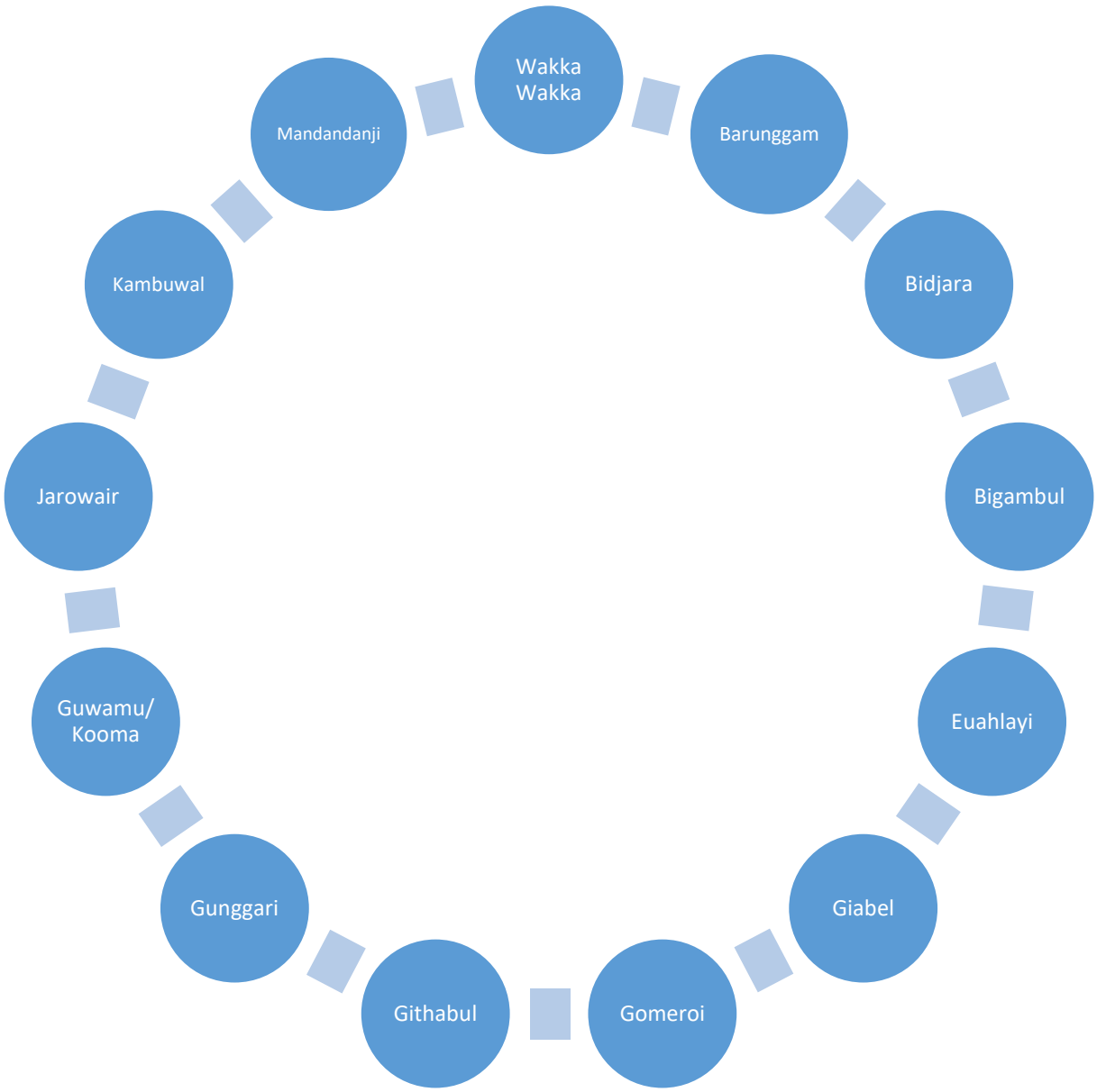

Figure 28 Aboriginal Nations consulted in the Border Rivers, Moonie, Condamine, and Maranoa-Balonne

9.1 Background

Aboriginal peoples[18] in Australia have frequently expressed the desire for better inclusion in the management of land and water resources. Aboriginal relationships with water are holistic, combining land, water, culture, society and economy. Water underpins social, spiritual and economic well-being, is inseparable from the land, and the relationship of Aboriginal peoples with waters, lands and their resources is crucial to cultural well-being and resilience (Human Rights Commission, 2008). It is worth emphasising the sense of responsibility that Aboriginal peoples feel for their land and water, to look after it as their ancestors have done for tens of thousands of years. This interest entails an inherent cultural responsibility to look after water, and presents an incredible source of knowledge and opportunity for involvement for water resource planning.

The Queensland Government is now working to improve Aboriginal involvement in water resource planning in the Queensland Murray-Darling Basin through the Basin Plan, which details the ways in which water planning authorities must consult with relevant Aboriginal organisations in relation to the requirements of section 10.52: Objectives and outcomes based on Indigenous values and uses. This work has been summarised in the Water Connections Report (DNRME, 2019).

The Aboriginal values and uses of water that can be protected and enhanced by a HWMP are those that are related to water quality. Good water quality supports all human uses and is fundamental to plants, animals and healthy aquatic ecosystems. Fishing, for example, relies on healthy ecosystems to support healthy fish in good numbers. For some Nations, specific species of fish, such as Yellowbelly (Golden perch), hold deep spiritual importance as a totem animal and is seen as a family member[19].

The HWMP can support cultural and spiritual values by protecting water quality through the water quality objectives (refer to section 10). The water quality objectives are designed to protect aquatic ecosystems of a certain condition (Highly Disturbed, Moderately Disturbed, Slightly Disturbed, and High Ecological Value). As other project outcomes come to light and are more clearly defined, for example the bioregional assessments (Constable & Love, 2015) and the Cultural Flows project (Section 9.4.1), it may be possible to develop water quality objectives that are specific to protecting cultural, spiritual and ceremonial values and uses.

Limitations

It is important to point out that while every effort has been made to speak to as many Traditional Owners as possible, the information obtained from the consultation process is not exhaustive, and there will be further values and uses and risks associated with these that have not been identified here. This provides a representation of the values and uses and associated risks identified by the Aboriginal Nations who engaged in the consultation process, consistent with those included in the Water Connections Report (DNRME, 2019). In addition, it is important to note the complexity of the holistic nature of Aboriginal perspectives of the landscape, for example, stories of Aboriginal people often focus on the creation of the whole landscape, not just individual rivers or elements of the landscape. Interconnected water sources are believed to have the same spiritual energy, forming part of the same ‘site’, in some cases in a similar way to groundwater connectivity, but also through waterways forming dreaming tracks and songlines (Australian Government, 2017). It is important to acknowledge that these values and uses remain the Intellectual Property of Traditional Owners, and this as well as the complexity of Aboriginal perspectives and culture is another reason it is imperative to involve Aboriginal people directly in water resource management, as they are the best people to speak for their land and water and it is their right.

9.2 Aboriginal people’s values and uses of water from consultation

As Aboriginal Nation boundaries are independent of water planning boundaries, the information contained in this section of the Maranoa and Balonne River Basins HWMP may have some overlap with information from Nations that are also represented in the Condamine River Basin HWMP, and/or the Queensland Border Rivers and Moonie River Basins HWMP.

The Traditional Owners of the Maranoa and Balonne basins described the way in which water is valued and used across the plan area, as described in Figure 29.

[18] In this chapter, the term *Indigenous* is used where quoting the Basin Plan and where used in other existing legislation or literature. *Aboriginal* or *Aboriginal peoples* will be used in this report in the context of Aboriginal people consulted with in the Murray-Darling basin, noting the great diversity of Aboriginal Nations and cultures.

[19] Not only because they are, but because knowing them and their distribution and behaviour in great detail give subtle information on changes in the landscape which can be very significant, even life-saving when living in the bush.

Figure 29 Aboriginal values and uses of water, and interrelated aspects of culture.

Water is a foundational element that runs through almost all aspects of Aboriginal culture, as described in the figure above. Clean water is essential for survival, ensures the survival of plants and animals needed for traditional diet and medicine. Scarred and carved trees that are large and old are likely to have very deep roots that tap into groundwater. Middens, for example those that are comprised of mollusc shells, often are situated near waterways due to the source of the materials, and are therefore susceptible to erosion from nearby creeks or rivers.

9.3 Aboriginal objectives and outcomes from consultation

The objectives and outcomes in this section were informed by the consultation process conducted by Queensland Government with the Traditional Owners of the Condamine, Maranoa, Balonne, Moonie and Border Rivers basins, as described in section 4.5. The objectives and outcomes aim to protect Aboriginal cultural, spiritual and ceremonial values and uses of water.

Table 30 Aboriginal objectives and outcomes from consultation

Objectives of water resource management as identified by Nations	Desired outcomes of water resource management as identified by Nations
Bigger populations and better health of animals and plants	A healthy system that supports populations of animals and plants
Better balance in how water is shared between users and environment	Clean, connected and flowing rivers, creeks, lakes, floodplains, wetlands and springs
Better sharing of water between users and Aboriginal peoples	Aboriginal peoples can use waterways for cultural, social, environmental, spiritual and economic purposes
More economic opportunities for the ownership, use and trade of water entitlements	Stronger connection to Country
More natural flows and connectivity down the system	Waterways are being accessed for swimming, fishing, storytelling, family gatherings, education
Improved water quality	A seat at the table for decisions on how water is managed and shared
Protected riparian zones, floodplains, waterways, springs, animals, plants, waterholes and cultural sites for future generations	Aboriginal peoples have the capacity and are fully informed about water planning
Improved access to waterways	Traditional ecological knowledge is used as part of water planning process
More involvement of Aboriginal peoples in decision making and management of waterways	
Improved and continuous consultation and participation in water planning process	
Improved capacity building and education of Aboriginal peoples and government	
Better integration of traditional knowledge and western science	

9.4 Risks to Aboriginal people's values and uses identified through consultation

Following the documentation of how Traditional Owners of the Maranoa and Balonne River Basins value and use water resources, the risks that threaten the continued availability of these values and uses were discussed. The risks raised at the workshops and during discussions were often relayed in the form of stories about impacts to important social, spiritual and cultural aspects of land and water. Participants also drew comparisons between the current state of the system and how they remembered using and valuing the system when they were children or from stories passed on from earlier generations. The common risks raised during the workshops were risks that are linked to insufficient water available for the environment, water being of a quality unsuitable for use, and the poor health of water-dependent ecosystems.

Many of the risks raised by Aboriginal peoples and Traditional Owners are related to the use and management of water resources, as well as from land use and other non-water related activities. Although some of the risks to values and uses identified by local Aboriginal peoples cannot be addressed specifically by the HWMP, they are included in this HWMP in order to understand the full range of issues affecting water related values and uses in the basin. The full list of risks and the factors contributing to the risks are displayed in Table 31.

Table 31 Risks and causes of risks to Aboriginal values and uses as identified during consultation with individual Aboriginal Nations

Risk to Aboriginal peoples values and uses	Factors contributing to risk
Risk to all Aboriginal peoples' values and uses (Climate change and associated extreme weather events)	Climate change: increasing rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods and associated water quality.
	Changes to flood frequency/duration may impact vegetation, reducing river shading and organic matter inputs. Increased temperatures and reduced food and habitat will impact native fish and other aquatic species.
	Drought refugia may dry out faster, impacting aquatic ecosystems and water availability.
Risk to continued availability of water resources for Aboriginal people (Reduced and altered flow from increases in take from watercourse and changing climate and rainfall patterns)	Flood and overland flow harvesting, dam operations, stock and domestic take, pumping from refugial waterholes, extraction of groundwater.
	Land clearing around the ranges that affects the rainfall on floodplains to the west and reducing inflows.
Risk to use of water resources for cultural, spiritual and ceremonial activities of Aboriginal peoples (Lack of access to waterways)	Lack of access to waterways
Risk to sense of obligation to care for Country (Lack of a role or responsibilities in managing and decision-making around water resources)	Lack of representation on committees, lack of recognition, lack of employment opportunities in government and other decision making bodies, lack of capacity, and lack of influence over decision making on land and water management.
Risk to water being of a quality unsuitable for use by Aboriginal people (Turbidity, nutrients and pesticides and other contaminants)	Erosion from stock, clearing of riparian vegetation, siltation behind infrastructure, land management activities, feral pigs, vehicle use, mining and motorboats causing wave wash.
	Erosion from stock, clearing of riparian vegetation, nutrient inputs promoting algal blooms, land management activities, mining, blueberry farms, sewage leaks
	Mining and farming activities and practices

Risk to Aboriginal peoples values and uses	Factors contributing to risk
Risk to health and wellbeing of Aboriginal people (Declining aquatic ecosystems)	Removal or decline of one animal or plant species affects the whole system and other species. Impact of weeds and pest species, such as carp and azolla. Algal blooms. Water pumps installed without screens.
Risk to degradation of important cultural sites (destruction and degradation of important cultural sites, such as burial grounds and scar trees)	Mismanagement of land and waterways, Council activities, farming and mining practices and motorboats.

9.5 Opportunities to strengthen the protection of Aboriginal values and uses of water under the HWMP

The opportunities to strengthen the protection of Aboriginal peoples' values and uses of water are linked to Basin Plan section 10.52(3). These opportunities are identified to be consistent with the objectives and outcomes (Section 9.4) identified during consultation with the Aboriginal Nations.

Aboriginal Waterways Assessments

Aboriginal Waterways Assessments (AWAs) are an in-field assessment of stream health from the perspective of Traditional Owners, and are a key initiative to increase the participation of Traditional Owners in natural resource and waterway management. They provide a tool for Aboriginal communities to consistently measure and prioritise river and wetland health so that they are better placed to negotiate for their Country's water needs.

AWAs were adapted from a Māori-originated water assessment tool by the Northern Basin Aboriginal Nations, Murray Lower Darling Rivers Indigenous Nations and the Murray-Darling Basin Authority Aboriginal Partnerships team.

The Queensland Government, with contribution from the MDBA, is funding six AWAs in the Condamine, Border Rivers, Moonie, Balonne and Warrego River basins. The AWAs are being conducted throughout 2018/19 and are being jointly delivered by the Northern Basin Aboriginal Nations and the former-NRM bodies, QMDC and Condamine Alliance (which are currently transitioning to Southern Queensland NRM). Additionally, DES, DNRME and MDBA are providing in-kind support to assist the Queensland AWA projects.

AWAs also align with the principles for engaging Indigenous peoples in water planning and management as stated in Section 1.3 of the *Module to the National Water Initiative (NWI) Policy Guidelines for Water Planning and Management: Engaging Indigenous Peoples in Water Planning and Management* (Australian Government, 2017):

"Investing in capacity building exercises for Indigenous peoples to develop their skills in water planning and management practices, and reciprocal knowledge transfer from Indigenous peoples to water planners." In addition the AWAs can facilitate intended active and informed participation of Indigenous people as stated in Section 10.53 (1) (e) of Basin Plan.

Under the HWMP, the Queensland Government will continue to seek to identify opportunities for further AWAs in the QMDB. With the approval of the Aboriginal Nation that conducted an AWA, the HWMPS can be amended to include main findings of the AWAs.

Queensland Indigenous Land and Sea Rangers

The Queensland Indigenous Land and Sea Ranger program currently provides funding for over 100 Indigenous land and sea rangers across Queensland, most of whom are Traditional Owners of the land on which they work. The Queensland Government, through the Department of Environment and Science, funds local Indigenous host organisations to employ the land and sea rangers. Traditional Owners and local communities have ownership of the work programs for their rangers, including fire and feral animal management, fencing of wetlands, land restoration, and conservation of rock art sites. Many of these practices assist in improving water quality, as well as preventing wildfires, reducing carbon emissions and improving biodiversity.

There are no Queensland Indigenous Land and Sea ranger positions in the Maranoa and Balonne River Basins of the Queensland Murray Darling basin. An expansion of the ranger program to the Maranoa and Balonne River Basins represents a significant opportunity to support current efforts to deal with pest management and a range of other risks to Aboriginal values and uses, while providing additional employment to Traditional Owners to support them looking after their Country, as discussed in Sections 9 and 9.4.

Rangers are critical to future land and water management throughout the Murray-Darling Basin. Identified Aboriginal ranger positions on Country, managed through native title bodies, Aboriginal corporations or through

NBAN, was a pressing need highlighted by many participants during the consultation with Aboriginal Nations. This consultation indicated that the rangers must be trained by Traditional Elders. Rangers could fulfil functions such as, but not limited to, the following:

- land and water care and management;
- pest management;
- fire management;
- locally appropriate revegetation;
- monitoring and reporting potential issues of non-compliance;
- monitoring of water quality and ecosystem health; and
- Cultural heritage protection.

Identified Aboriginal ranger positions could also take responsibility for identifying issues regarding cultural heritage and the care of managing and maintaining these locations.

Under the HWMP, the Queensland Government will continue to seek to identify opportunities to expand the Queensland Indigenous Land and Sea Ranger program in the Maranoa and Balonne River Basins.

Looking after Country Grant Program

The Looking after Country Grant program is a Queensland-based initiative that was formerly known as the Queensland Indigenous Land and Sea Grant Program. If successful following an application process, Aboriginal and Torres Strait Islander groups are provided with grants of up to $75,000 for projects on-Country, aimed at conserving environmental and cultural resources and values.

The program encourages collaborative projects that may address (but are not limited to) the following:

- cultural heritage site management
- protected species monitoring and conservation
- habitat restoration
- feral animal and weed management
- fire management
- erosion control
- the development and implementation of country management plans.

The application process for the Looking after Country Grant program is outlined on the following website: https://www.qld.gov.au/environment/plants-animals/conservation/community/land-sea-rangers/grants-program. The Looking after Country Grant program aligns with many of the responses received during the Aboriginal community consultation seeking opportunities for better involvement in natural resource management activities.

Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009

The Queensland Government schedules environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009 (EPP Water) to inform statutory and non-statutory planning and decision-making. This framework seeks to protect and maintain water quality within Queensland's waterways and groundwater aquifers. The environmental values and water quality objectives are informed by community consultation. Through the process of engaging with Aboriginal Nations, the following was determined and will be recommended for inclusion under Schedule 1 of the EPP Water:

- Cultural, spiritual and ceremonial environmental values apply to all surface water and groundwater in the Queensland Murray–Darling Basin, and this has been included on the relevant mapping.
- Default water quality objectives apply for the protection of the cultural, spiritual and ceremonial environmental values. In future, water quality objectives that are specific to cultural flows or developed by an Aboriginal nation may be available to update relevant documents accordingly.
- Persistent waterholes in the Queensland Murray–Darling Basin have been mapped and assigned the highest level of protection (high ecological value) under the Environmental Protection (Water) Policy 2009.
- Maintaining healthy riparian vegetation zones which reduce run-off and erosion was identified as important through consultation. Water quality objectives to protect environmental values in the plan area include targets for wetland extent, ground cover in grazing lands and riparian vegetation.

Environmental values support Aboriginal values and uses of water, and these values and uses of water will continue to be reflected in healthy waters management plans moving forward.

Queensland Carbon Plus Fund

In December 2016, the Queensland Government announced an $8.4 million project that will support and expand the carbon farming industry and create jobs for Traditional Owners. The project has two parts:

1. equip Queensland Aboriginal nations to participate in the carbon market and ensure the cultural, social and environmental co-benefits of Aboriginal carbon farming projects are recognised and appropriately valued. The Aboriginal Carbon Fund was engaged to undertake this component of the project
2. the purchase of carbon credits to offset the Queensland Government's fleet vehicle emissions from 2017–18 to 2018–19, with credits from Aboriginal carbon projects being prioritised.

Refer to this link for more information: https://www.qld.gov.au/environment/climate/climate-change/carbon-farming

Supporting Indigenous Participation

A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will support engagement and involvement of Aboriginal Australians in the planning and implementation natural resource management initiatives. Aboriginal Australians have been the custodians of Southern Queensland for at least 40,000 years and have looked after the natural assets and landscapes of the region successfully for thousands of generations. Southern Queensland NRM will engender a strong culture of learning, respect and inclusion of Traditional Owner groups. Involvement will be underpinned by a Reconciliation Action Plan and an Indigenous Participation Plan.

Healthy Waters Management Plan: Management Responses

Section 8 of the Healthy Waters Management Plans identifies management responses to address risks and contribute to the achievement of objectives. These actions will help to address water quality and aquatic ecosystem concerns captured in the consultation with Aboriginal nations, such as reducing sediment and nutrients entering water through streambank stabilisation and improving the health of riparian zones.

Great Artesian Basin – Environmental values and water quality objectives

Participants at the Aboriginal Nations' consultation identified that the Great Artesian Basin is of great cultural and spiritual significance to Aboriginal people, and is important for maintaining the health of aquatic ecosystems. There were concerns expressed over mining and coal seam gas operations in terms of the potential threat to the Great Artesian Basin, including over-extraction, pollution/contamination, and reduced aquifer recharge.

The environmental values and water quality objectives for groundwater established for the Queensland Murray–Darling Basin region include the Great Artesian Basin aquifers. The cultural, spiritual and ceremonial environmental value applies to all groundwater, based on the results of consultation with Aboriginal Nations. Environmental values and water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 and subsequently inform mining and coal seam gas development.

9.6 Recommendations broader than the HWMP

A range of comments and submissions received through consultation related to important issues that were broader than the HWMP. The Water Connections Report (DNRME, 2019) has summarised these issues and provides a response to each. The Queensland Government recognises the importance of following up these issues with the relevant agencies.

SECTION 10: WATER QUALITY TARGET VALUES

10 Water quality target values

Water quality target values[20] are quantitative measures of water quality indicators that protect a stated environmental value (Refer to section 5 of this report). The targets can be concentrations, loads or a biological measure, e.g. macroinvertebrate diversity. Where there are multiple water quality target values for a particular indicator to protect different environmental values at a location, the most stringent water quality target value applies.

Section 10.32 of the Basin Plan specifies that a WQM Plan is to identify surface water quality target values for fresh water-dependent ecosystems, irrigation water and water used for recreational purposes. Section 10.35B specifies that a WQM Plan must also identify the groundwater quality target values for the plan area for these purposes. Default water quality target values are provided in the Basin Plan (Chapter 9 and Schedule 11) for these matters. Subsections 10.32 (3) and (4) enables the WQM Plan to specify alternative surface water quality target values if they are developed in accordance with stated requirements. Similarly, subsection 10.35B (3) enables the WQM Plan to specify alternative groundwater quality target values if they are consistent with stated water quality objectives.

Where available, alternative local water quality targets to those specified in Chapter 9 and Schedule 11 of the Basin Plan have been included in Section 10 of the HWMP for the Maranoa and Balonne River basin for both surface water and groundwater. The application of the default Basin Plan water quality targets is considered inappropriate where local water quality target values have been developed. The default Basin Plan targets under Chapter 9 and Schedule 11 were developed for a broad spatial scale that does not reflect the variation in water types across the Maranoa and Balonne River basin (Refer to the waters types in Figure 30 and described in Appendix 2—Description of water types in the Maranoa and Balonne basins). Where local water quality data was available, local water quality target values were developed for surface water types, under high and base flow conditions, and for groundwater aquifer zones. Further information on the development of alternative water quality target values is provided in Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions.

Refer to the following sections of the Healthy Waters Management Plan for the water quality target values for accreditation under section 10.32 of the Basin Plan for surface water. Note: There are no Ramsar Wetlands currently identified in the plan area.

<u>Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)</u>

- **Section 10.2.1: Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems) Table 32 for the Maranoa and Balonne surface waters;**

<u>Irrigation water</u>

- **Irrigation infrastructure operators are defined under Section 7 (4) of the Water Act 2007. Based on this definition, there are two sites in the Maranoa and Balonne River Basin that qualify as an irrigation infrastructure operator for the purposes of Basin Plan Section 9.17, 10.32 (2)(b) and 10.34. These sites are shown in Figure 32. The water quality target values for accreditation under section 10.32 (2)(b) of the Basin Plan are Table 51 provision (1) and provision (2) – referring to Table 52 and Table 53.**

<u>Water used for recreation</u>

- **Section 10.3.5: Water quality targets for the protection of the Primary, Secondary and Visual Recreation Environmental Values Table 67, provision (1) for primary, secondary and visual recreation.**

Refer to the following sections of the Healthy Waters Management Plan for the water quality target values for accreditation under section 10.35B of the Basin Plan for groundwater:

<u>Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)</u>

- **Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Maranoa and Balonne River basin specified in Table 35, Table 36, Table 37 and Table 43;**

<u>Irrigation water</u>

- **As there are no groundwater irrigation infrastructure operators in the plan area (as defined under the Water Act 2007), irrigation water quality target values for accreditation do not apply. While not accredited under the Basin Plan, Section 10.3.1, Table 51 provision (3) for the Maranoa and Balonne River basin is recognised to provide targets for irrigation water in the plan area for the purposes of Queensland water quality planning and management.**

<u>Water used for recreation</u>

- **Section 10.3.5: Water quality targets for the protection of the Primary, Secondary and Visual Recreation Environmental Values Table 67, provision (1) for primary, secondary and visual recreation.**

[20] 'Water quality target values' under the Basin Plan are equivalent to 'Water Quality Objectives' under the EPP Water.

10.1 Targets for managing water flows

Water quality in relation to the management of water flows in the Maranoa and Balonne basin is addressed through the Department of Natural Resources, Mines and Energy water planning framework. Refer to the Department of Natural Resources, Mines and Energy —Water Management website for further information.

10.2 Water quality targets for the protection of the Aquatic Ecosystem Environmental Value

The water quality targets in this section apply where the Aquatic Ecosystem Environmental Value has been identified in the Maranoa and Balonne River basins (Refer to Section 5 of this report).

10.2.1 Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems)

Section 10.32 (2)(a) of the Basin Plan requires a WQM Plan to identify water quality targets for fresh water-dependent ecosystems other than declared Ramsar wetlands. Section 10.35B (2)(a) specifies that a WQM Plan must also identify the groundwater quality target values for the plan area for these purposes.

Under the Healthy Waters Management Plan, water quality targets for the protection of the Aquatic Ecosystem Environmental Value were developed for each water type[21] in the Maranoa and Balonne River basin, for low and high flow conditions, based on local data. A sub-set of these water quality targets are relevant to meeting the requirements of section 10.32 (2)(a) of the Basin Plan for fresh water-dependent ecosystems other than declared Ramsar wetlands. The water quality target values for accreditation under section 10.32 (2)(a) of the Basin Plan are the water quality target values in:

<u>Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)</u>

- **Section 10.2.1: Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems) in Table 32 for the Maranoa and Balonne surface waters.**

While not accredited under the Basin Plan, the water quality target values for additional indicators in Table 33 which were developed under the Queensland legislative water quality framework (see Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

Water quality targets were also developed for aquifers in the plan area based on local groundwater data. The water quality target values for accreditation under section 10.35B (2)(a) of the Basin Plan for groundwater are:

<u>Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)</u>

- **Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Maranoa and Balonne River basin specified in Table 35, Table 36, Table 37 and Table 43;**

While not accredited under the Basin Plan, the water quality target values in Table 38 to Table 42, which were developed under the Queensland legislative water quality framework (see Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

Note: The Maranoa and Balonne River basin does not currently contain declared Ramsar wetlands.

Local water quality targets for fresh water-dependent ecosystems were developed for each water type identified in Figure 30. A description of water types in the Maranoa and Balonne River basin is provided in Appendix 2—Description of water types in the Maranoa and Balonne basins. Where local data was unavailable, the target values for the target application zones listed in Schedule 11 of the Basin Plan apply. The relevant target application zones for the Maranoa-Balonne basins are B1 (Condamine, and Warrego valleys; Upland Zone) – Other water dependent ecosystems; and A1 (Condamine, Paroo and Warrego Valleys; Lowland Zone) – Other water dependent ecosystems[22] (also portrayed on Figure 30).

NOTE: The purpose of the targets provided in this section is to assist those involved in managing water resources to ensure that moderately disturbed aquatic ecosystems are adequately protected (Refer to Section 6: Levels of aquatic ecosystem protection). The local water quality targets presented below are applicable to low flow conditions and high flow conditions when sufficient data was available. Additional water quality monitoring and modelling is required to derive additional local water quality target values for other flow scenarios.

[21] Water types for the Maranoa and Balonne River basin are mapped in Figure 30 and are described in Appendix 2.

[22] Refer to the Murray-Darling Basin Authority website for spatial information on Water Quality Zones.

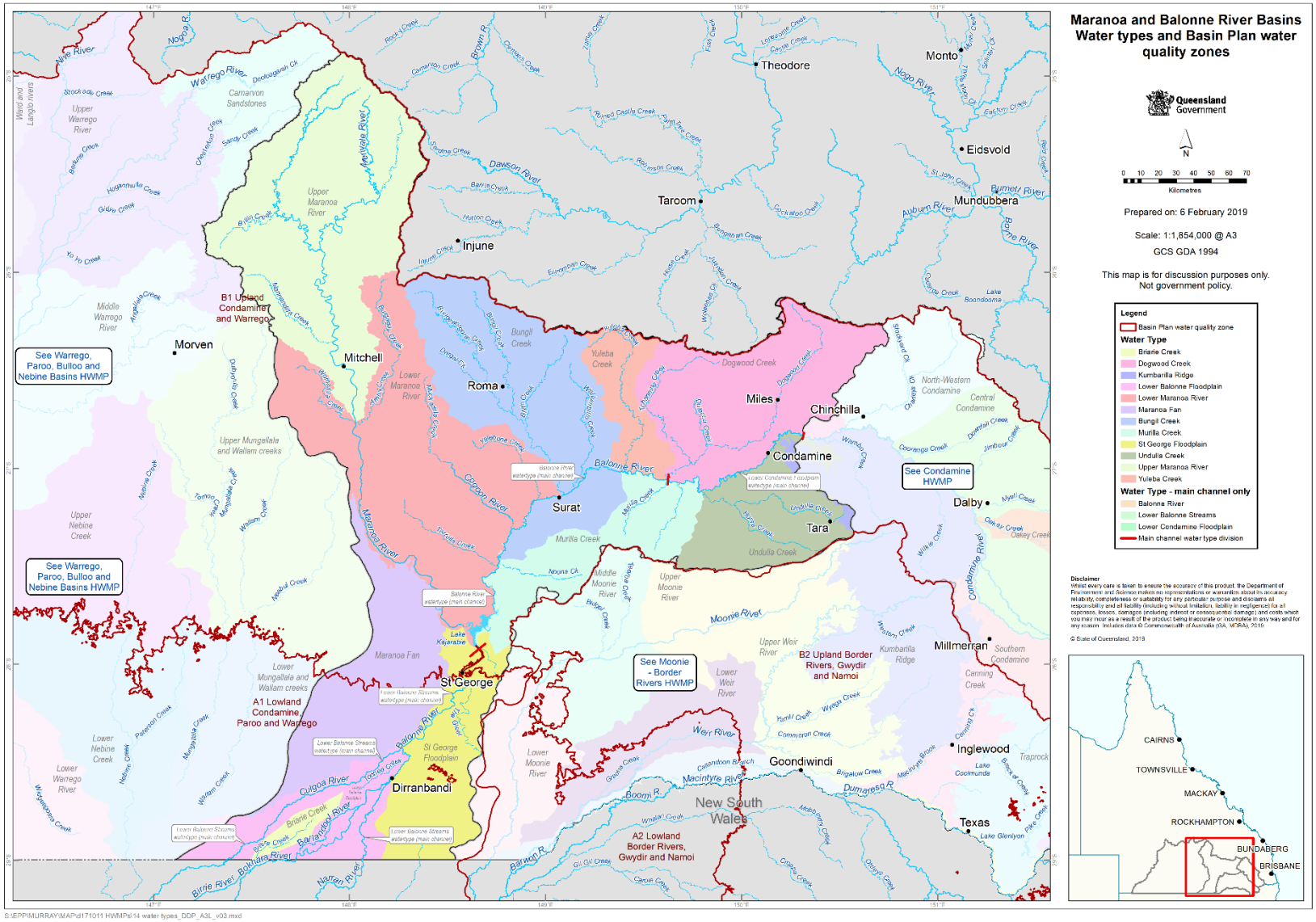

Figure 30: Water types for the Maranoa and Balonne basin. Local water quality target values for fresh water-dependent ecosystems apply to these water types (Refer to Table 32 and Table 33). See Appendix 2—Description of water types in the Maranoa and Balonne basins for a description of each water type.

Table 32: Water quality target values for Moderately Disturbed surface waters of the Maranoa and Balonne River basin under low and high flow conditions[23]. Refer to Figure 30 for the map of water types.

Water type	Management intent/ level of protection	Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.									
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**DO** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat				
BALONNE RIVER catchment waters	**Low Flow**									
	Moderately Disturbed	220 (s1)	270 (s1)	1100 (s1)	ID	60-110 (s2)	7.2-7.9 (s1)	Not applicable.	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	660 (s1)	530 (s1)	1700 (s1)	ID	60-110 (s2)	6.8-7.4 (s1)	Not applicable.	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
BEARDMORE DAM catchment	**No flow conditions separation applied**									

[23] Water quality target values in Table 32 are accreditable water quality target values for fresh water-dependent ecosystems (other than declared Ramsar wetlands) under section 10.32 of the Basin Plan

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
waters	Moderately Disturbed	450 (s1)	270 (s1)	1100 (s1)	ID	60-110 (s2)	7.3-7.8 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
BRIARIE CREEK catchment waters	**Low Flow**									
	Moderately Disturbed	265 (s1)	390 (s1)	1580 (s1)	>5.0 (s3)	60-110 (s3)	7.1-8.0 (s1)	150	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	180 (s1)	300 (s3)	1000 (s3)	>5.0 (s3)	60-110 (s3)	7.3-7.5 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
DOGWOOD CREEK catchment	**Low Flow**									

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
waters	Moderately Disturbed	110 (s1)	130 (s1)	1300 (s1)	ID	60-110 (s2)	6.5-7.5 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	190 (s1)	170 (s1)	1400 (s1)	ID	60-110 (s2)	6.2-7.2 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
LOWER BALONNE FLOODPLAIN catchment waters	**Low Flow**									
	Moderately Disturbed	290 (s1)	270 (s1)	980 (s1)	>5.0 (s3)	60-110 (s3)	7.3-8.0 (s1)	Ballandool River 170 Bohkara 170 Culgoa River 170 Narran River 160	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
	Moderately Disturbed	450 (s1)	330 (s1)	1330 (s1)	>5.0 (s3)	60-110 (s3)	7.0-7.6 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
LOWER BALONNE STREAMS catchment waters	**Low Flow**									
	Moderately Disturbed	290 (s1)	270 (s1)	980 (s1)	>5.0 (s3)	60-110 (s3)	7.3-8.0 (s1)	Ballandool River 170 Bohkara 170 Culgoa River 170 Narran River 160	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	450 (s1)	330 (s1)	1330 (s1)	>5.0 (s3)	60-110 (s3)	7.0-7.6 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
LOWER CONDAMINE FLOODPLAIN catchment waters	**Low Flow**									
	Moderately Disturbed	130 (s1)	270 (s1)	1100 (s1)	ID	60-110 (s2)	7.2-7.9 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	270 (s2)	450 (s2)	2000 (s2)	ID	60-110 (s2)	6.9-7.4 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
LOWER MARANOA catchment waters	**Low Flow**									
	Moderately Disturbed	60 (s1)	150 (s1)	970 (s1)	ID	60-110 (s2)	7.2-7.9 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
	Moderately Disturbed	380 (s1)	400 (s1)	1100 (s1)	ID	60-110 (s2)	6.9-7.8 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
MARANOA FAN catchment waters	**Low Flow**									
	Moderately Disturbed	60 (s1)	150 (s1)	970 (s1)	ID (s2) >5.0 (s3)	60-110 (s2, s3)	7.2-7.9 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	380 (s1)	400 (s1)	1100 (s1)	ID (s2) >5.0 (s3)	60-110 (s2, s3)	6.9-7.8 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
BUNGIL CREEK catchment waters	**Low Flow**									

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
	Moderately Disturbed	45 (s1)	200 (s1)	1090 (s1)	ID	60-110 (s2)	7.3-8.1 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	270 (s1)	330 (s1)	1410 (s1)	ID	60-110 (s2)	6.6-7.7 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
MURILLA CREEK catchment waters	**Low Flow**									
	Moderately Disturbed	45 (s1)	200 (s1)	1090 (s1)	ID	60-110 (s2)	7.3-8.1 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
	Moderately Disturbed	270 (s1)	330 (s1)	1410 (s1)	ID	60-110 (s2)	6.6-7.7 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
ST GEORGE FLOODPLAIN catchment waters	**Low Flow**									
	Moderately Disturbed	290 (s1)	270 (s1)	980 (s1)	ID (s2) >5.0 (s3)	60-110 (s2, s3)	7.3-8.0 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	450 (s1)	330 (s1)	1330 (s1)	ID (s2) >5.0 (s3)	60-110 (s2, s3)	7.0-7.6 (s1)		Between the 20th and 80th percentile of natural monthly water temperature. (s3)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
UNDULLA CREEK catchment waters	**Low Flow**									
	Moderately Disturbed	110 (s1)	130 (s1)	1300 (s1)	ID	60-110 (s2)	6.5-7.5 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature.	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.

Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.

Water type	Management intent/ level of protection	Turbidity (NTU) (Annual median)	Total Phosphorus (µg/L) (Annual median)	Total Nitrogen (µg/L) (Annual median)	DO (Annual median within the range)		pH (Annual median within the range)	Salinity (End-of-valley targets) (Median)	Temperature (Monthly median within the range)	Pesticides, heavy metals and other toxic contaminants
					mg/L	% sat				
									(s2)	
	High Flow									
	Moderately Disturbed	190 (s1)	170 (s1)	1400 (s1)	ID	60-110 (s2)	6.2-7.2 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
UPPER MARANOA catchment waters	**Low Flow**									
	Moderately Disturbed	20 (s1)	90 (s1)	660 (s1)	ID	60-110 (s2)	7.6-8.4 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	95 (s1)	310 (s1)	2000 (s2)	ID	60-110 (s2)	7.2-8.0 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
YULEBA CREEK catchment	**Low Flow**									

Water type	Management intent/ level of protection	**Table 32: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems; s3: Basin Plan Schedule 11 target value for A1 (Condamine, Paroo and Warrego valleys; Lowland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**DO** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat				
waters	Moderately Disturbed	105 (s1)	200 (s1)	1090 (s1)	ID	60-110 (s2)	7.1-8.0 (s1)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High Flow									
	Moderately Disturbed	270 (s2)	330 (s1)	1410 (s1)	ID	60-110 (s2)	7.0-8.5 (s2)	Not applicable	Between the 20th and 80th percentile of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.

Table 33: Additional water quality target values for Moderately Disturbed surface waters of the Maranoa and Balonne River basin under low and high flow conditions[24]. Refer to Figure 30 for the map of water types.

Water type	Management intent/ level of protection	Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids** (mg/L)	**Alkalinity** (mg/L as $CaCO_3$)	**Oxidised Nitrogen** (µg-N/L)	**Ammonium N** (µg-N/L)	**Filterable Reactive Phosphorus** (µg-P/L)	**Sulphate as SO_4** (mg/L)	**Chlorophyll-a** (µg/L)
BALONNE RIVER catchment waters	Moderately Disturbed	**Low Flow**							
		170 (s1)	100 (s1)	55 (s1)	130 (s1)	5 (s1)	35 (s1)	4 (s1)	6 (s1)
		High Flow							
		110 (s1)	695 (s1)	35 (s1)	160 (s1)	10 (s1)	70 (s1)	3 (s1)	3 (s1)
BEARDMORE DAM catchment waters	Moderately Disturbed	**No flow conditions separation applied**							
		150 (s1)	220 (s1)	50 (s1)	130 (s1)	5 (s1)	35 (s1)	5 (s1)	6 (s1)
BRIARIE CREEK catchment waters	Moderately Disturbed	**Low Flow**							

[24] While not accreditable under the Basin Plan, water quality target values in Table 33 are recognised to support the accreditable water quality target values in Table 32 to protect and restore fresh water-dependent ecosystems.

Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data.

Water type	Management intent/ level of protection	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Oxidised Nitrogen (µg-N/L)	Ammonium N (µg-N/L)	Filterable Reactive Phosphorus (µg-P/L)	Sulphate as SO_4 (mg/L)	Chlorophyll-a (µg/L)
		250 (s1)	165 (s1)	110 (s1)	5 (s1)	16 (s1)	50 (s1)	2 (s1)	ID
		High Flow							
		165 (s1)	130 (s1)	75 (s1)	ID	ID	ID	ID	ID
DOGWOOD CREEK catchment waters	Moderately Disturbed	**Low Flow**							
		110 (s1)	35 (s1)	21 (s1)	8 (s1)	30 (s1)	7 (s1)	2 (s1)	8 (s1)
		High Flow							
		80 (s1)	70 (s1)	14 (s1)	ID	ID	ID	3 (s1)	ID
LOWER BALONNE FLOODPLAIN catchment waters	Moderately Disturbed	**Low Flow**							
		180 (s1)	60 (s1)	55 (s1)	100 (s1)	9 (s1)	65 (s1)	5 (s1)	5 (s1)

Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data.

Water type	Management intent/ level of protection	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Oxidised Nitrogen (µg-N/L)	Ammonium N (µg-N/L)	Filterable Reactive Phosphorus (µg-P/L)	Sulphate as SO_4 (mg/L)	Chlorophyll-a (µg/L)
		High Flow							
		130 (s1)	220 (s1)	45 (s1)	230 (s1)	13 (s1)	65 (s1)	4 (s1)	4 (s1)
LOWER BALONNE STREAMS catchment waters	Moderately Disturbed	**Low Flow**							
		180 (s1)	60 (s1)	55 (s1)	100 (s1)	9 (s1)	65 (s1)	5 (s1)	5 (s1)
		High Flow							
		130 (s1)	220 (s1)	45 (s1)	230 (s1)	13 (s1)	65 (s1)	4 (s1)	4 (s1)
LOWER CONDAMINE FLOODPLAIN catchment waters	Moderately Disturbed	**Low Flow**							
		220 (s1)	40 (s1)	70 (s1)	20 (s1)	11 (s1)	55 (s1)	4 (s1)	6 (s1)
		High Flow							

Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data.

Water type	Management intent/ level of protection	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Oxidised Nitrogen (µg-N/L)	Ammonium N (µg-N/L)	Filterable Reactive Phosphorus (µg-P/L)	Sulphate as SO_4 (mg/L)	Chlorophyll-a (µg/L)
		160 (s1)	ID	ID	ID	ID	ID	ID	ID
LOWER MARANOA catchment waters	Moderately Disturbed	**Low Flow**							
		170 (s1)	70 (s1)	50 (s1)	ID	ID	14 (s1)	5 (s1)	8 (s1)
		High Flow							
		110 (s1)	600 (s1)	40 (s1)	ID	ID	ID	4 (s1)	ID
MARANOA FAN catchment waters	Moderately Disturbed	**Low Flow**							
		170 (s1)	70 (s1)	50 (s1)	ID	ID	14 (s1)	5 (s1)	8 (s1)
		High Flow							
		110 (s1)	600 (s1)	40 (s1)	ID	ID	ID	4 (s1)	ID

Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data.

Water type	Management intent/ level of protection	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Oxidised Nitrogen (µg-N/L)	Ammonium N (µg-N/L)	Filterable Reactive Phosphorus (µg-P/L)	Sulphate as SO_4 (mg/L)	Chlorophyll-a (µg/L)
BUNGIL CREEK catchment waters	Moderately Disturbed	**Low Flow**							
		250 (s1)	20 (s1)	140 (s1)	9 (s1)	5 (s1)	30 (s1)	14 (s1)	ID
		High Flow							
		120 (s1)	220 (s1)	50 (s1)	110 (s1)	12 (s1)	95 (s1)	2 (s1)	ID
MURILLA CREEK catchment waters	Moderately Disturbed	**Low Flow**							
		250 (s1)	20 (s1)	140 (s1)	9 (s1)	5 (s1)	30 (s1)	14 (s1)	ID
		High Flow							
		120 (s1)	220 (s1)	50 (s1)	110 (s1)	12 (s1)	95 (s1)	2 (s1)	ID
ST GEORGE FLOODPLAIN catchment waters	Moderately Disturbed	**Low Flow**							

Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values

Notes:

1. Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated.

2. ID: Insufficient data to develop a target value.

3. Sources: s1: Local Data.

Water type	Management intent/ level of protection	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Oxidised Nitrogen (µg-N/L)	Ammonium N (µg-N/L)	Filterable Reactive Phosphorus (µg-P/L)	Sulphate as SO_4 (mg/L)	Chlorophyll-a (µg/L)
		180 (s1)	60 (s1)	55 (s1)	100 (s1)	9 (s1)	65 (s1)	5 (s1)	5 (s1)
		High Flow							
		130 (s1)	220 (s1)	45 (s1)	230 (s1)	13 (s1)	65 (s1)	4 (s1)	4 (s1)
UNDULLA CREEK catchment waters	Moderately Disturbed	**Low Flow**							
		110 (s1)	35 (s1)	21 (s1)	8 (s1)	30 (s1)	7 (s1)	2 (s1)	8 (s1)
		High Flow							
		80 (s1)	70 (s1)	14 (s1)	ID	ID	ID	3 (s1)	ID
UPPER MARANOA catchment waters	Moderately Disturbed	**Low Flow**							
		300 (s1)	25 (s1)	95 (s1)	2 (s1)	4 (s1)	25 (s1)	6 (s1)	6 (s1)

Water type	Management intent/ level of protection	Table 33: MARANOA AND BALONNE RIVER BASIN SURFACE WATERS – additional water quality target values **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids** (mg/L)	**Alkalinity** (mg/L as $CaCO_3$)	**Oxidised Nitrogen** (µg-N/L)	**Ammonium N** (µg-N/L)	**Filterable Reactive Phosphorus** (µg-P/L)	**Sulphate as SO_4** (mg/L)	**Chlorophyll-a** (µg/L)
		High Flow							
		140 (s1)	120 (s1)	50 (s1)	ID	ID	ID	5 (s1)	ID
YULEBA CREEK catchment waters	Moderately Disturbed	**Low Flow**							
		200 (s1)	65 (s1)	45 (s1)	9 (s1)	5 (s1)	30 (s1)	7 (s1)	ID
		High Flow							
		110 (s1)	ID	ID	110 (s1)	12 (s1)	95 (s1)	ID	ID

10.2.2 Water quality targets for declared Ramsar wetlands

As a Ramsar Convention signatory, Australia is expected to describe and maintain the ecological character of each of its current 65 Ramsar sites. An ecological character description (ECD) is a rigorously prepared assessment of the ecosystem components, processes and benefits/services of a site. The trigger levels contained in the ECD provide the benchmark against which ecological changes at the site are assessed for significance.

Section 10.32 (2)(a) of the Basin Plan requires a WQM Plan to identify water quality targets for fresh water-dependent ecosystems that are declared Ramsar wetlands.

The Maranoa and Balonne River basin does not currently contain any declared Ramsar wetlands. If, following publication of this document, sites within the Maranoa and Balonne River basin are declared as Ramsar wetlands, locally relevant water quality target values for low and high flow conditions should be developed for these sites to ensure no deterioration of the water quality range occurs over time.

10.2.3 Water quality targets for lakes other than declared Ramsar wetlands

Lakes in dryland regions are diverse in their natural water conditions and biology. Local investigations of the natural range of water quality in all stages of inundation and drying are necessary to develop local water quality target values.

To protect the aquatic ecosystem values of lakes, they should be protected against threats of secondary salinity, sedimentation and disrupted hydrologic regime. Thus, there should be no change from historic hydrologic regime (i.e. no change in flow frequency, intensity required to inundate the lake), and loads of salt and sediments from upstream catchments should be managed in accordance with the management intent for the waters (Refer to section 6.4) and consistent with the Basin Salinity Management Strategy 2030.

As additional data becomes available, it is recommended that water quality targets are developed for lakes throughout the Maranoa and Balonne River basin.

10.2.4 Water quality targets for Slightly Disturbed waters

The water quality target values for pesticides, heavy metals and other toxic contaminants for Slightly Disturbed waters in the Maranoa and Balonne River basin are that the values in the ANZECC guidelines (as updated), for the protection of 99% of species must not be exceeded.

The water quality target values for Slightly Disturbed waters in the Maranoa and Balonne River basin for all other indicators are as follows:

1. if the measures for indicators achieve the water quality target values for High Ecological Value waters (section 10.2.5) in the Maranoa and Balonne River basin, maintain the water quality to this standard;
2. if the measures for indicators do not achieve the water quality target values for High Ecological Value waters (section 10.2.5) in the Maranoa and Balonne River basin, progressively improve the water quality at the site towards achieving the High Ecological Value water quality target values for each indicator.

Refer to section 6.4 for a description of the management intent under the EPP Water for Slightly Disturbed waters in the Maranoa and Balonne River basin.

The Slightly Disturbed waters are mapped at Figure 26.

10.2.5 Water quality targets for High Ecological Value waters

The water quality targets for pesticides, heavy metals and other toxic contaminants for High Ecological Value waters is that the values in ANZECC guidelines (as updated), for the protection of 99% of species must not be exceeded.

The water quality target for High Ecological Value waters in the Maranoa and Balonne basins for all other indicators is to maintain the existing water quality distribution (i.e. maintain the 20th, 50th and 80th percentile values for each indicator). Refer to the Queensland Water Quality Guidelines 2009 (section 4) for appropriate procedures to derive sub-regional water quality guidelines.

Refer to section 6.4 for a description of the management intent under the EPP Water for High Ecological Value waters in the Maranoa and Balonne drainage basins.

The High Ecological Value waters are mapped at Figure 26.

10.2.5.1 Persistent waterholes

Persistent waterholes, as mapped at Figure 26 and listed at Appendix 4— Persistent Waterholes in the Maranoa and Balonne, are important for their outstanding natural values in dryland river systems. In dryland regions, many rivers stop flowing for extended periods of time and become disconnected waterholes and wetlands. The waterholes are critical refugia for aquatic organisms, such as fish, turtles and invertebrates. Permanent waterholes also support birds, plants, other reptiles and amphibians.

Due to the variable nature of rainfall in the Queensland Murray-Darling Basin, the refugial waterholes along the river systems in the region represent the only permanent aquatic habitat during extended periods of low or no flow and are critical components of a functioning 'source and sink' system for aquatic organisms in semi-arid landscapes.

Waterholes experience variable patterns of connection and disconnection. This is a fundamental driver of ecological processes in dryland riverine environments, vital for dispersal and survival of diverse populations of biota. Waterholes require careful management, both individually and as an integrated system of waterholes along the length of rivers and channels.

Waterhole persistence is associated with active channel-forming processes (to provide deep waterhole habitat for biota) and bankfull discharge[25]. In-channel flows, or flow pulses, are important for connecting waterholes and improving water quality (Sheldon, 2010). As a result, the water quality of waterholes in the Queensland Murray-Darling Basin will be largely influenced by the strategies for water resource development implemented through water planning instruments. It is recommended water resource development maintains the hydrological variability of waterholes and prevents extreme levels of water abstraction (Sheldon, 2010).

As the permanent waterholes mapped in Figure 26 are classified as High Ecological Value waters, refer to section 10.2.5 for the water quality target values that apply. Additionally:

1. riparian vegetation surrounding identified waterholes should be maintained or, as necessary over time, restored
2. disturbance to beds and banks of waterholes should be minimised where possible to reduce sedimentation through offstream watering of stock.

[25] Bankfull discharge is the point at which water overflows onto a floodplain.

10.2.6 Water quality targets to protect groundwater aquatic ecosystem environmental values

Section 10.35B (2)(a) specifies that a WQM Plan must identify water quality target values for groundwater fresh-water dependent ecosystems in the plan area.

The water quality parameters shown in Schedule 11 of the Basin Plan are not applicable to groundwater as the majority of parameters listed are not appropriate in gauging groundwater quality. Further, the target application zones shown in Schedule 11 do not allow for the complexities of groundwater aquifer systems and accompanying water quality variability to be represented. Thus, alternative water quality target values for accreditation under section 10.35B (3) of the Basin Plan have been developed for groundwater in the Maranoa and Balonne River basin.

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

- **Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Maranoa and Balonne River basin specified in Table 35, Table 36, Table 37 and Table 43;**

The groundwater aquifer zones are displayed in Figure 17 to Figure 25.

While not accredited under the Basin Plan, the water quality target values in Table 38 to Table 42, which were developed under the Queensland legislative water quality framework (see Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

This section lists the water quality targets for various groundwater sub-aquifers to protect the aquatic ecosystem environmental values stated for the groundwaters of the Maranoa and Balonne River basins (Refer to Section 5).

Water quality targets for groundwaters of QMDB have been determined following the identification of aquifer types, which are based on the clustering of zones of similar water chemistry (McNeil, Raymond, Bennett, & McGregor, 2017). Sub-aquifer chemistry zones were further defined within each aquifer to allow development of water quality targets that are representative of local groundwater conditions. Following the derivation of sub-aquifer chemistry zones, the groundwater quality data was used to calculate a range of percentiles for several water quality parameters including, major ions, pH and electrical conductivity. The percentiles are used to form the water quality targets which are based on over 7700 sub-artesian and 4200 artesian water quality samples collected from 6600 bores within QMDB since the mid-1960s. For a full description of the methods used to develop the groundwater water quality targets for QMDB, refer to Regional groundwater chemistry zones: Queensland Murray-Darling Basin, 2017.

The water quality targets for the groundwaters of Maranoa and Balonne River basin are displayed in Table 35 to Table 43. It is important to note that the spatial extent of groundwater aquifer zones are not restricted to the spatial extent of surface water basins. Where groundwaters interact with surface waters, groundwater quality should not compromise identified environmental values and water quality targets for those waters. The ANZECC Guidelines (as updated) recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles). Moreover, ANZECC Guidelines (as updated) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded. The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

10.2.6.1 Groundwater aquifer zones in the Maranoa and Balonne River basins

The groundwater aquifer zones in the Maranoa and Balonne River basins are shown in Figure 17 to Figure 25. The table below shows the sub-aquifer groundwater chemistry zones arranged under nine aquifer types (McNeil, Raymond, Bennett, & McGregor, 2017):

Aquifer Zone	Sub-aquifer chemistry zone
s1. Alluvial zones	Lower Condamine Wallam Moonie Lower Balonne Lower Maranoa Upper Balonne Upper Maranoa
s2. Fractured rock	Eastern Basement With Basalt Remnants Main Range Volcanics
s3. Sediments above the GAB	Tertiary sediments Weathered alluvium
s4. Upper GAB	Central Upper Cretaceous aquitard Winton Mackunda Eastern
s5. Main GAB aquitard	Eastern Wallumbilla Outcrop Central Surat Mid Cretaceous Wallumbilla Doncaster Outcrop
s6. Mid GAB aquifers	Southeast Kumbarilla Eastern Cretaceous Outcrop North Wallumbilla Bungil and Mooga Northern Surat Thickest Bungil and Mooga Surat Thicker Mooga Saline Area Northern Central Outcrop Area Northern Maranoa Bungils Central Mooga and Orallo Outcrops Hooray Northern Outcrop Western Hooray Lower Balonne Gubberamunda
s7. Lower GAB	Hutton Western Eromanga Region Northern Hutton Outcrop Eastern Springbok Outcrop Northeastern Hutton Outcrop Northern Walloons North East Walloons Central Surat Springbok Area
s8. Basal GAB	Precipice Outcrop Eastern Central Area Western Evergreen Only Northeastern Evergreen Outcrop Northwestern Evergreen Outcrop

Aquifer Zone	Sub-aquifer chemistry zone
s9. Earlier Basins Partially Underlying the GAB	Bowen Basin Upper Bowen Basin

The Groundwater Chemistry Zones that intersect the Groundwater Sustainable Diversion Limit resource units identified under the Basin Plan are identified in Table 34.

Table 34: The groundwater aquifer zones in the Maranoa and Balonne River basin that intersect the Groundwater Sustainable Diversion Limit resource units under the Basin Plan (refer to Figure 9).

	Groundwater aquifer zones								
Groundwater SDL resource unit	**s1—Alluvial zones**	**s2—Fractured Rock zones**	**s3—Sediments Overlying the GAB zones**	**s4—Upper GAB zones**	**s5—Main GAB Aquitard zones**	**s6—Mid GAB Aquifer zones**	**s7—Lower GAB zones**	**s8—Basal GAB zones**	**s9— Earlier Basins Partially Underlying the GAB**
Queensland Murray-Darling Basin: deep (GS56)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sediments above the GAB: Condamine-Balonne (GS58)	✓		✓	✓	✓	✓	✓	✓	✓
St George Alluvium: Condamine-Balonne (deep) (GS61)	✓		✓	✓	✓	✓	✓	✓	✓
St George Alluvium: Condamine-Balonne (shallow) (GS61)	✓		✓	✓	✓	✓	✓	✓	✓
Upper Condamine Alluvium (Tributaries) (GS64b)	✓			✓	✓	✓	✓	✓	✓

Table 35: Water quality targets to protect the aquatic ecosystem environmental value for Alluvial groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 17).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
s1.Alluvial																												
8 - Lower Condamine	20th	110	65	9	3	10	8	152	7	96	45	9.9	2	0.10	0	625	65	7.3	133.0	13.0	0.15	0.005	0.000	ID	ID	4.70	0.028	ID
	50th	586	79	40	7	37	14	330	17	608	77	54.5	5	0.50	0	2700	256	7.8	276.0	33.0	0.30	0.100	0.040	ID	ID	18.10	0.109	ID
	80th	1889	87	130	14	164	21	616	44	2930	87	220.5	8	4.01	0	9910	997	8.2	511.5	57.3	0.80	0.630	0.295	ID	ID	28.70	0.274	ID
8 - Lower Condamine near stream	20th	74	61	10	4	10	8	136	5	77	45	13.7	3	0.11	0	563	77	7.2	116.0	13.0	0.10	0.019	0.000	ID	ID	4.00	0.020	ID
	50th	320	74	38	8	31	16	307	18	450	73	58.5	5	0.50	0	1950	230	7.8	256.5	30.0	0.30	0.100	0.053	ID	ID	13.25	0.087	ID
	80th	1926	86	128	16	185	22	464	47	3300	88	228.7	9	4.46	1	10440	1094	8.1	398.0	61.0	0.70	0.960	0.295	ID	ID	28.12	0.191	ID
10 - Upper Balonne	20th	611	66	71	9	45	9	169	2	942	68	78.8	3	0.00	0	3442	360	6.7	141.2	30.0	0.21	0.000	0.050	0.002	0.000	16.70	ID	ID
	50th	1530	78	172	11	124	15	392	5	2610	85	414.0	11	1.25	0	8380	943	7.4	323.0	51.5	0.24	0.025	0.277	0.061	0.017	22.00	ID	ID
	80th	3823	82	553	13	360	18	453	27	6876	86	1292.0	12	5.00	0	21150	2853	7.9	378.8	58.0	0.44	0.030	1.470	0.097	0.019	31.00	ID	ID
10 - Upper Balonne near stream	20th	505	65	46	7	20	6	154	1	510	59	24.8	2	0.00	0	2567	182	6.6	126.4	29.7	0.20	0.000	0.010	0.004	0.007	11.67	ID	ID
	50th	3490	74	525	12	336	18	392	5	6000	85	1050.0	7	1.25	0	19300	2690	7.4	323.0	40.5	0.32	0.025	1.250	0.088	0.017	29.00	ID	ID
	80th	3952	84	564	13	363	18	481	38	6945	91	1372.0	13	5.63	0	21590	2898	7.9	398.3	72.0	0.56	0.156	1.672	0.097	0.051	31.90	ID	ID
12 - Upper Maranoa	Insufficient data																											
15 - Lower Maranoa	20th	87	59	18	7	12	10	164	7	69	32	17.3	5	0.00	0	528	93	7.0	150.3	33.0	0.13	0.000	0.001	0.005	0.010	4.10	0.016	ID
	50th	349	76	32	12	27	13	205	31	416	67	83.8	10	0.50	0	1528	199	7.9	183.0	52.0	0.20	0.005	0.005	0.005	0.015	11.00	0.054	ID
	80th	777	83	95	16	70	22	256	60	1258	81	234.7	12	2.50	0	4403	521	8.3	216.9	69.3	0.31	0.005	0.118	0.010	0.015	15.00	0.543	ID
15 - Lower Maranoa near stream	20th	65	54	19	11	13	12	166	7	65	26	10.9	5	0.00	0	339	115	6.9	142.2	51.0	0.11	0.000	0.001	0.000	0.001	2.71	0.016	ID
	50th	255	74	45	12	41	14	206	40	231	47	51.0	10	0.25	0	1580	273	7.6	170.5	54.0	0.18	0.005	0.005	0.005	0.015	8.05	0.054	ID
	80th	932	76	130	20	81	26	311	69	1545	82	266.2	11	2.50	0	4740	659	8.2	260.2	74.4	0.22	0.005	0.188	0.010	0.015	15.55	0.543	ID
16 - Lower Balonne	20th	154	78	9	5	7	6	153	9	79	38	19.5	6	0.25	0	822	49	7.0	165.6	36.7	0.10	0.000	0.000	0.005	0.010	6.70	0.038	0.000
	50th	677	83	38	7	27	9	258	42	888	75	184.5	10	2.50	0	3460	203	7.9	230.0	50.5	0.23	0.005	0.005	0.010	0.015	20.00	0.652	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
s1.Alluvial																												
	80th	1287	89	109	10	78	12	519	53	1828	80	372.4	12	6.00	1	5705	606	8.3	458.7	65.0	0.39	0.020	0.050	0.010	0.015	25.52	2.717	0.000
16 - Lower Balonne near stream	20th	282	78	8	3	6	4	323	25	174	38	30.9	6	0.25	0	1105	45	7.7	291.4	52.3	0.29	0.000	0.000	0.003	0.005	11.31	0.054	ID
	50th	410	87	41	5	32	7	560	39	511	54	98.0	7	4.80	0	2140	231	8.2	482.0	65.0	0.38	0.005	0.005	0.010	0.013	18.15	1.043	ID
	80th	909	93	69	10	49	12	860	52	1040	63	161.4	9	13.85	1	4259	386	8.4	709.1	72.0	0.59	0.068	0.017	0.010	0.015	24.76	3.011	ID
17 - Moonie	20th	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	26460	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
	50th	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	46150	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
	80th	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	56280	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
18 - Wallam	20th	161	66	21	7	13	8	0	15	162	42	27.7	4	0.00	0	0	106	7.1	179.8	ID	0.18	ID	ID	ID	ID	6.04	ID	ID
	50th	281	77	38	10	27	13	264	41	236	52	65.4	9	0.00	0	1100	204	7.4	329.5	ID	0.30	ID	ID	ID	ID	11.35	ID	ID
	80th	1475	83	159	16	132	17	703	49	2140	71	367.0	12	1.35	0	6005	945	8.2	576.5	ID	0.60	ID	ID	ID	ID	21.53	ID	ID

Table 36: Water quality targets to protect the aquatic ecosystem environmental value for Fractured Rock groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 18).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S2. Fractured Rock																												
4 - Eastern Basement With Basalt Remnants (merged with Fitzroy River basin Zone 3)	20th	157	46	10	3	4	3	361	25	102	25	11.6	2	0.00	0	1033	49	8.0	308.1	18.0	0.10	0.000	0.000	0.010	0.010	3.68	0.000	0.005
	50th	225	68	32	7	52	21	519	50	275	44	30.0	4	0.30	0	1500	331	8.3	431.5	25.0	0.29	0.010	0.010	0.010	0.010	9.65	0.065	0.033
	80th	668	93	109	18	129	39	719	71	933	67	130.5	8	3.33	0	2922	750	8.5	596.3	55.7	0.41	0.138	0.070	0.027	ID	20.76	0.724	0.082
5 - Main Range Volcanics (continues as Fitzroy River basin Zone 5)	20th	72	30	15	6	13	12	302	48	35	12	4.0	1	0.40	0	688	104	7.5	247.5	25.0	0.12	0.000	0.000	0.005	0.001	1.69	0.087	0.000
	50th	122	46	38	15	44	33	460	72	80	23	12.0	3	2.55	0	1032	291	8.0	383.0	45.0	0.26	0.020	0.010	0.010	0.005	3.20	0.554	0.082
	80th	237	78	68	28	80	44	602	85	245	43	45.9	7	20.12	2	1866	489	8.3	500.0	61.0	0.49	0.050	0.020	0.040	0.015	9.04	4.374	0.082

Table 37: Water quality targets to protect the aquatic ecosystem environmental value for Sediments overlying the GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 19Figure 19).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. For all groundwater aquifers,**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
s3. Sediments overlying GAB																												
1 - Weathered Alluvium	20th	168	67	13	5	8	7	73	1	144	47	36.3	6	0.00	0	624	71	7.0	78.6	45.0	0.13	0.000	0.000	0.008	0.000	8.10	0.000	0.000
	50th	666	76	82	10	73	13	197	10	982	77	281.7	12	2.40	0	2690	569	7.6	199.7	57.0	0.40	0.000	0.010	0.050	0.015	19.45	0.011	0.000
	80th	4418	87	592	15	550	19	384	40	8590	86	1600.0	16	12.50	0	22710	3706	7.9	333.3	80.0	0.80	0.120	0.184	0.190	0.035	30.10	2.717	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. For all groundwater aquifers,**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
s3. Sediments overlying GAB																												
1 - Weathered Alluvium near stream	20th	104	63	7	4	4	2	156	5	75	33	15.1	5	0.00	0	525	27	7.2	134.6	18.3	0.15	0.000	0.000	0.017	0.000	4.65	0.130	ID
	50th	289	74	24	10	10	13	256	49	180	40	76.0	11	2.40	0	1269	102	7.7	210.0	70.0	0.30	0.000	0.010	0.040	0.015	11.50	1.930	ID
	80th	1368	92	170	22	149	20	388	58	2398	83	504.5	15	7.20	1	6400	1000	8.3	321.0	86.0	0.52	0.044	0.043	0.210	0.017	28.32	0.000	ID
3 - Tertiary Sediments	20th	395	81	3	1	0	0	0	4	195	34	0.0	0	ID	ID	0	9	ID	136.1	ID	ID	ID	ID	ID	ID	ID	ID	ID
	50th	432	97	15	2	4	2	212	26	520	74	1.8	0	ID	ID	1575	58	ID	207.5	ID	ID	ID	ID	ID	ID	ID	ID	ID
	80th	3058	99	50	8	6	11	682	63	4712	96	34.9	5	ID	ID	2180	203	ID	609.0	ID	ID	ID	ID	ID	ID	ID	ID	ID

Table 38: Water quality targets to protect the aquatic ecosystem environmental value for Upper GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 20).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S4. Upper GAB																												
3 - Winton Mackunda Eastern	20th	276	74	21	5	13	5	0	4	168	41	20.5	3	0.00	0	0	99	7.4	124.9	16.1	0.15	0.000	0.000	ID	ID	11.59	0.000	0.000
	50th	1025	83	59	8	40	10	240	15	1260	75	138.0	9	0.50	0	1976	291	7.9	282.5	38.0	0.30	0.000	0.000	ID	ID	22.45	0.109	0.000
	80th	1584	89	142	11	97	14	534	50	2483	86	410.5	12	7.21	0	7920	715	8.2	518.6	53.0	0.65	0.017	0.100	ID	ID	31.55	1.567	0.000
5 - Central Upper Cretaceous Aquitard	20th	240	80	8	2	2	1	120	10	172	49	16.0	2	ID	ID	546	27	7.8	153.5	ID	0.31	ID	ID	ID	ID	11.28	ID	ID
	50th	460	87	14	5	11	7	259	36	455	57	37.0	7	ID	ID	1520	70	8.0	310.0	ID	0.65	ID	ID	ID	ID	17.39	ID	ID
	80th	1026	97	44	7	53	13	585	48	1511	81	185.3	11	ID	ID	3745	331	8.3	516.9	ID	1.29	ID	ID	ID	ID	38.28	ID	ID

Table 39: Water quality targets to protect the aquatic ecosystem environmental value for Main GAB Aquitard groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 21).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S5. Main GAB aquitard																												
1 - Eastern Wallumbilla Outcrop	20th	440	73	3	1	1	0	53	2	158	23	0.0	0	0.00	0	877	9	7.1	144.9	13.0	0.19	0.000	0.000	0.006	0.000	26.72	0.000	ID
	50th	660	96	14	2	6	2	506	31	650	59	9.0	1	0.00	0	2399	53	8.1	567.0	17.0	0.98	0.020	0.040	0.020	0.015	41.59	0.000	ID
	80th	3365	99	493	12	344	15	859	75	6238	89	766.2	7	2.25	0	10000	2580	8.5	763.1	50.4	1.73	0.434	1.800	0.107	0.156	62.61	0.489	ID
2 - Wallumbilla Doncaster Outcrop	20th	157	42	10	5	1	2	0	3	197	42	40.7	4	0.00	0	0	34	7.4	106.0	12.0	0.10	0.000	0.000	ID	ID	4.88	0.000	ID
	50th	279	70	74	19	16	8	82	17	360	56	140.0	17	0.00	0	960	271	7.6	155.0	17.0	0.20	0.000	0.000	ID	ID	12.79	0.000	ID
	80th	781	93	318	30	173	22	245	31	1631	80	1003.7	34	2.02	0	2200	1471	8.2	230.6	26.0	0.50	0.020	0.365	ID	ID	22.76	0.439	ID
3 - Central Surat Mid Cretaceous	20th	454	66	29	6	14	6	90	1	351	47	44.2	5	0.00	0	3151	146	6.8	100.2	35.5	0.08	0.000	0.000	0.005	0.001	15.85	0.000	0.000
	50th	2010	76	256	10	169	13	253	4	3282	84	464.8	10	1.25	0	24000	1322	7.5	221.5	56.0	0.21	0.005	0.020	0.030	0.015	26.05	0.272	0.000

Table 40: Water quality targets to protect the aquatic ecosystem environmental value for Mid GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 22).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S6. Mid GAB Aquifers																												
1 - Northern Maranoa Bungils	20th	210	67	6	2	1	0	0	3	125	34	46.5	6	0.00	0	0	20	7.2	88.0	13.0	0.15	0.000	0.000	0.000	0.000	9.42	0.000	0.000
	50th	443	89	28	7	5	2	0	18	443	52	120.1	19	0.50	0	0	122	7.9	191.0	16.0	0.30	0.010	0.010	0.015	0.010	19.57	0.109	0.000
	80th	1153	97	205	21	58	12	277	49	1344	75	806.5	38	2.32	0	2050	790	8.4	301.8	20.0	0.80	0.100	0.030	0.050	0.020	32.23	0.504	0.023
2 - Central	20th	199	74	3	1	0	0	0	26	102	30	20.0	5	0.00	0	0	10	7.6	237.0	11.0	0.11	0.000	0.000	ID	ID	8.99	0.000	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S6. Mid GAB Aquifers																												
Mooga and Orallo Outcrops	50th	356	93	13	4	4	2	316	46	220	41	75.7	11	0.50	0	1065	55	8.2	334.0	15.5	0.30	0.020	0.010	ID	ID	22.41	0.109	0.016
	80th	588	99	51	14	21	11	454	64	660	55	228.0	19	2.00	0	2145	213	8.6	454.0	21.1	0.70	0.465	0.060	ID	ID	49.29	0.435	0.033
3 - Eastern Cretaceous Outcrop	20th	162	82	4	1	1	0	105	6	85	32	0.5	0	0.05	0	771	14	7.3	100.0	13.7	0.10	0.000	0.000	0.005	0.010	12.49	0.021	0.000
	50th	395	93	10	3	4	2	293	30	337	64	8.0	1	0.50	0	1650	47	8.0	263.0	17.0	0.39	0.070	0.010	0.010	0.015	28.30	0.109	0.000
	80th	1167	98	74	9	22	7	644	66	1780	89	95.1	6	1.89	0	3870	267	8.5	571.0	33.3	0.65	0.809	0.182	0.110	0.015	49.27	0.285	0.065
4 - Hooray Northern Outcrop	20th	76	48	19	17	6	9	0	15	74	34	29.4	9	0.00	0	0	84	7.3	88.0	21.1	0.10	0.000	0.009	ID	ID	2.85	0.000	ID
	50th	115	57	42	25	15	16	169	33	156	46	66.0	17	0.00	0	710	185	7.6	168.0	28.5	0.20	0.020	0.010	ID	ID	3.87	0.000	ID
	80th	263	68	135	34	42	21	251	48	334	56	359.2	32	0.50	0	1650	526	8.1	217.5	34.3	0.40	0.075	0.041	ID	ID	4.83	0.109	ID
5 - Lower Balonne Gubberamunda	20th	255	98	2	0	0	0	415	57	88	19	0.0	0	0.00	0	1063	5	8.0	351.8	21.0	0.44	0.000	0.000	0.000	0.014	35.76	0.000	0.000
	50th	341	99	2	1	0	0	561	71	130	28	5.0	1	0.25	0	1360	8	8.4	496.0	26.0	0.80	0.010	0.010	0.005	0.015	51.80	0.054	0.000
	80th	510	99	4	1	1	1	863	80	260	37	28.8	4	1.00	0	2016	15	8.6	761.1	29.0	1.50	0.213	0.010	0.010	0.020	72.97	0.217	0.000
6 - North Wallumbilla Bungil and Mooga (merged with Fitzroy River basin zone '3 Bungil and Mooga Outcrops')	20th	425	89	4	1	1	0	0	4	283	46	5.9	0	0.00	0	1983	17	7.4	143.0	13.0	0.20	0.000	0.000	ID	ID	28.95	0.000	0.000
	50th	770	96	19	2	5	1	200	14	921	76	115.2	8	0.50	0	3867	81	8.1	300.5	15.0	0.40	0.025	0.010	ID	ID	44.80	0.109	0.016
	80th	1796	99	110	7	40	5	462	50	2599	87	571.3	17	3.41	0	8893	395	8.6	506.6	16.0	0.67	0.575	0.040	ID	ID	63.32	0.741	0.163
8 - Northern Surat Thickest Bungil and Mooga	20th	355	98	1	0	0	0	520	56	120	17	0.0	0	0.00	0	1400	5	8.1	495.5	14.0	0.47	0.000	0.000	0.000	0.000	42.74	0.000	0.000
	50th	444	99	2	1	1	0	763	74	154	25	1.0	0	0.50	0	1720	11	8.4	680.0	17.0	1.25	0.050	0.005	0.005	0.015	65.35	0.109	0.000
	80th	521	99	4	1	1	1	989	82	252	42	24.3	3	0.50	0	2026	16	8.7	874.5	20.0	2.23	0.190	0.010	0.010	0.021	83.91	0.109	0.049
9 - Northern Central Outcrop Area	20th	45	48	11	7	1	1	0	13	46	27	16.6	7	0.00	0	0	39	7.2	67.8	14.0	0.10	0.000	0.001	ID	ID	2.27	0.000	ID
	50th	225	70	47	22	7	6	73	28	180	45	100.0	20	0.50	0	437	156	7.7	150.0	18.5	0.12	0.010	0.010	ID	ID	6.33	0.109	ID
	80th	470	91	81	31	18	19	295	59	511	59	238.5	32	1.13	0	1739	278	8.0	283.5	29.9	0.30	0.060	0.282	ID	ID	19.28	0.246	ID
11 – South-east	20th	315	98	2	0	0	0	459	60	72	13	0.0	0	0.00	0	1173	6	8.0	506.0	13.0	0.55	0.005	0.000	0.000	0.000	38.10	0.000	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S6. Mid GAB Aquifers																												
Kumbarilla	50th	417	99	3	1	1	0	720	80	120	19	2.0	0	0.50	0	1600	10	8.4	660.0	15.0	1.50	0.020	0.010	0.005	0.015	56.30	0.109	0.000
	80th	530	99	4	1	2	1	969	86	260	39	9.1	1	1.30	0	2050	19	8.6	864.6	19.0	3.20	0.130	0.010	0.017	0.015	71.65	0.283	0.033
13 - Surat Thicker Mooga Saline Area	20th	427	98	3	1	0	0	399	28	250	40	0.0	0	0.00	0	1872	9	8.2	333.5	16.0	1.00	0.004	0.000	ID	ID	51.50	0.000	ID
	50th	506	99	4	1	0	0	543	43	439	56	3.2	0	0.50	0	2308	11	8.4	491.5	18.0	1.80	0.020	0.010	ID	ID	62.58	0.109	ID
	80th	572	99	6	1	1	0	675	56	530	59	97.2	7	1.07	0	2565	19	8.6	578.1	21.0	2.08	0.251	0.023	ID	ID	71.23	0.233	ID
14 - Western Hooray	20th	171	96	2	1	0	0	313	65	55	16	0.0	0	0.00	0	710	7	8.0	273.7	20.0	0.49	0.000	0.000	0.000	0.000	23.25	0.000	0.000
	50th	223	98	3	2	0	0	430	75	74	24	1.0	0	0.00	0	917	10	8.3	372.0	23.0	0.60	0.010	0.010	0.005	0.010	29.59	0.000	0.000
	80th	291	99	5	2	1	1	555	83	135	33	8.1	2	1.10	0	1200	18	8.6	473.3	26.0	1.05	0.050	0.010	0.010	0.015	37.21	0.239	0.000

Table 41: Water quality targets to protect the aquatic ecosystem environmental value for Lower GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 23).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S7. Lower GAB																												
1 - Central Surat Springbok Area (continues as Fitzroy River basin Zone 1)	20th	235	96	2	1	0	0	346	48	80	19	0.5	0	0.00	0	1042	6	7.9	316.7	14.0	0.40	0.000	0.000	0.000	0.003	27.76	0.000	0.000
	50th	319	99	3	1	1	0	540	71	125	26	10.0	2	0.50	0	1300	12	8.3	472.5	18.0	0.70	0.010	0.005	0.005	0.015	45.00	0.109	0.000
	80th	546	99	10	2	4	2	749	79	407	50	33.6	5	1.20	0	2100	40	8.6	661.0	28.1	1.80	0.165	0.015	0.010	0.020	64.00	0.261	0.000
2 - Eastern Springbok Outcrop	20th	243	79	5	1	2	1	198	7	183	41	0.7	0	0.00	0	963	19	7.5	194.3	13.0	0.19	0.005	0.000	0.005	0.001	14.75	0.000	0.000
	50th	677	91	20	3	11	4	345	26	737	70	8.0	1	0.70	0	2925	96	8.0	308.5	18.0	0.30	0.050	0.010	0.010	0.015	28.97	0.152	0.000
	80th	1830	98	89	10	83	12	838	58	2970	90	47.6	3	2.50	0	9021	612	8.4	795.2	52.1	1.75	0.891	0.097	0.049	0.030	56.49	0.543	0.016
4 - North East Walloons	20th	339	61	12	2	6	2	249	7	334	48	4.0	0	0.00	0	1650	58	7.5	230.0	12.0	0.20	0.005	0.005	0.005	0.010	9.05	0.000	0.000
	50th	750	82	53	8	41	9	390	20	968	76	35.8	2	1.00	0	3500	308	8.0	344.5	15.0	0.40	0.020	0.020	0.020	0.015	17.69	0.217	0.000
	80th	1554	96	155	18	134	21	615	47	2931	91	134.0	6	5.00	0	9015	864	8.4	539.5	27.9	0.80	0.100	0.087	0.043	0.033	48.99	1.087	0.033
5 – North-eastern Hutton Outcrop (continues as Fitzroy River basin Zone 5)	20th	421	76	7	1	1	0	64	8	468	67	0.0	0	0.00	0	2000	26	7.5	149.5	11.7	0.10	0.000	0.000	0.004	0.000	11.61	0.000	0.000
	50th	674	93	24	3	8	2	243	16	923	80	19.0	1	0.50	0	3050	119	7.9	236.0	15.0	0.30	0.020	0.025	0.020	0.010	35.63	0.109	0.000
	80th	1250	98	81	8	75	13	522	27	1882	91	85.1	5	3.19	0	5670	532	8.4	482.0	41.2	0.66	0.120	0.110	0.135	0.015	53.71	0.693	0.016
6 - Northern Hutton Outcrop (merged with Fitzroy River basin Zone 9)	20th	39	38	20	20	5	3	0	37	40	20	9.3	3	0.00	0	437	91	7.0	134.2	12.0	0.05	0.000	0.000	0.003	0.000	1.63	0.000	ID
	50th	78	50	36	31	15	18	213	55	65	33	26.0	7	0.25	0	570	162	8.0	185.0	19.5	0.13	0.000	0.005	0.010	0.005	2.49	0.054	ID
	80th	135	69	63	35	27	29	264	71	194	56	64.1	13	0.70	0	934	259	8.3	218.0	36.4	0.30	0.020	0.040	0.025	0.015	7.28	0.152	ID
7 - Northern Walloons (continues as Fitzroy River basin Zone 4)	20th	239	91	3	1	1	0	162	8	175	42	0.0	0	0.00	0	1100	11	7.9	217.1	12.0	0.20	0.000	0.000	ID	ID	23.20	0.000	ID
	50th	510	97	9	2	3	1	323	29	580	69	6.0	0	0.60	0	2200	32	8.2	308.0	15.0	0.69	0.000	0.010	ID	ID	39.46	0.130	ID
	80th	1361	99	56	5	15	2	497	52	2003	91	42.0	4	3.10	0	5696	190	8.6	438.6	20.0	1.30	0.163	0.020	ID	ID	64.04	0.674	ID
12 - Hutton	20th	121	94	2	1	0	0	184	58	52	19	1.6	0	0.00	0	597	6	7.9	162.0	22.0	0.25	0.000	0.000	0.000	0.000	13.20	0.000	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S7. Lower GAB																												
Western Eromanga Region	50th	177	98	3	2	0	0	311	68	71	29	11.9	4	0.00	0	810	8	8.3	270.0	29.5	0.50	0.010	0.010	0.005	0.010	27.40	0.000	0.000
	80th	259	99	6	4	2	3	420	80	105	34	23.7	7	0.50	0	1392	22	8.6	384.0	38.0	1.40	0.050	0.015	0.020	0.015	36.50	0.109	0.000

Table 42: Water quality targets to protect the aquatic ecosystem environmental value for Basal GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 24).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S8. Basal GAB																												
1 - Precipice Outcrop (merged with Fitzroy River basin Zone 3)	20th	16	27	14	19	6	17	101	64	16	15	4.3	3	0.00	0	247	75	7.0	89.4	11.0	0.10	0.000	0.010	0.000	0.000	0.70	0.000	0.000
	50th	23	34	24	35	12	28	136	71	25	22	9.7	6	0.00	0	340	110	7.5	133.0	13.0	0.10	0.010	0.040	0.005	0.015	0.88	0.000	0.000
	80th	34	63	38	40	18	36	194	81	35	27	14.0	8	0.50	0	440	157	8.1	189.2	21.2	0.15	0.020	0.070	0.034	0.020	1.88	0.109	0.016
2 - Eastern Central Area (merged with Fitzroy River basin zone '5 Eastern Central Area')	20th	87	92	2	1	0	0	150	57	36	17	0.0	0	0.00	0	185	6	7.5	162.2	14.0	0.15	0.000	0.000	ID	ID	8.48	0.000	0.000
	50th	255	97	3	2	1	1	420	72	99	26	5.0	2	0.25	0	1040	11	8.2	347.0	19.0	0.53	0.008	0.010	ID	ID	27.56	0.054	0.000
	80th	342	99	8	5	5	4	674	82	165	37	29.6	5	1.00	0	1463	33	8.6	569.6	26.0	2.20	0.180	0.030	ID	ID	48.45	0.217	0.016
3 - Northeastern Evergreen Outcrop (merged with Fitzroy River	20th	175	77	6	1	1	1	126	8	130	28	0.5	0	0.00	0	1225	33	7.3	150.0	14.0	0.37	0.020	0.010	ID	ID	10.69	0.000	ID
	50th	629	91	17	4	7	2	377	34	542	66	8.4	1	0.80	0	2950	85	7.8	342.5	17.0	0.70	0.070	0.025	ID	ID	19.08	0.174	ID

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S8. Basal GAB																												
basin zone '2 South Eastern Evergreen Outcrop')	80th	1386	98	106	14	70	8	576	66	1499	89	28.0	3	3.00	0	5465	595	8.4	487.7	20.0	1.40	0.755	0.051	ID	ID	60.08	0.652	ID
5 - Northwestern Evergreen Outcrop	20th	16	31	7	23	6	26	20	27	22	28	6.9	5	0.00	0	149	43	6.3	38.0	11.0	0.09	0.000	0.020	ID	ID	0.85	0.000	ID
	50th	22	41	13	28	10	31	68	41	35	40	13.0	11	0.05	0	247	81	7.1	65.0	12.0	0.10	0.010	0.040	ID	ID	1.18	0.011	ID
	80th	53	48	64	41	22	34	177	57	146	54	50.0	22	0.50	0	889	228	7.9	148.7	13.0	0.27	0.038	0.090	ID	ID	1.63	0.109	ID
6 - Western Evergreen Only	20th	32	86	2	3	0	0	81	59	16	24	5.0	5	0.00	0	278	8	7.9	83.2	27.0	0.21	0.000	0.005	0.000	0.000	3.10	0.000	ID
	50th	104	91	7	7	1	1	177	63	53	29	18.7	8	0.00	0	520	22	8.2	158.0	28.0	0.30	0.030	0.040	0.005	0.010	9.60	0.000	ID
	80th	118	97	8	11	2	4	192	67	57	32	21.0	9	0.05	0	543	38	8.5	165.3	32.7	0.53	0.065	0.040	0.017	0.015	19.40	0.011	ID

Table 43: Water quality targets to protect the aquatic ecosystem environmental value for Earlier Basins Partially Underlying the GAB groundwater aquifer zones in the Maranoa and Balonne River basin (refer to Figure 25).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. For all groundwater aquifers,**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S9. Earlier Basins Partially Underlying the GAB																												
1 - Bowen Basin (merged with Fitzroy River basin zone '8 Lower Bowen')	20th	51	96	2	0	0	0	113	56	14	9	0.0	0	0.00	0	218	5	7.4	105.0	13.0	0.20	0.000	0.000	0.005	0.001	89.57	0.000	0.000
	50th	440	99	2	1	1	0	685	78	109	19	0.0	0	0.00	0	1700	7	8.3	611.0	17.0	1.65	0.040	0.005	0.005	0.001	50.82	0.000	0.000
	80th	853	99	5	3	1	1	1217	90	316	42	2.9	1	0.50	0	3001	19	8.6	1080.9	22.0	5.46	0.150	0.010	0.010	0.015	109.14	0.109	0.000
2 - - Upper	20th	51	96	2	0	0	0	113	56	14	9	0.0	0	0.00	0	218	5	7.4	105.0	13.0	0.20	0.000	0.000	0.005	0.001	89.57	0.000	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. For all groundwater aquifers,**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.**

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S9. Earlier Basins Partially Underlying the GAB																												
Bowen Basin (merged with Fitzroy River basin zone '8 Lower Bowen')	50th	440	99	2	1	1	0	685	78	109	19	0.0	0	0.00	0	1700	7	8.3	611.0	17.0	1.65	0.040	0.005	0.005	0.001	50.82	0.000	0.000
	80th	853	99	5	3	1	1	1217	90	316	42	2.9	1	0.50	0	3001	19	8.6	1080.9	22.0	5.46	0.150	0.010	0.010	0.015	109.14	0.109	0.000

Notes

1. Abbreviations: Na: Sodium, Ca: Calcium, Mg: Magnesium, HCO_3: Bicarbonate, Cl: Chloride, SO_4: Sulfate, NO_3: Nitrate, EC: Electrical conductivity, Hard: hardness, Alk: alkalinity, SiO_2: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, TN: total nitrogen, TP: total phosphorus, mg/L: milligrams per Litre, µS/cm: microsiemens/centimetre

2. Percentiles are provided in most cells where samples are available for a particular indicator. The Queensland Water Quality Guidelines (section 4) contains information on recommended minimum sample size when deriving percentiles for use in deriving water quality guidelines. For this table, where less than 8 samples were available, cell shows insufficient data ('id'); where 8–20 samples were available, 50_{th} percentile values are provided (in bold). Where greater than 20 samples were available, the full percentile ranges are provided. The intent is to maintain current water quality (20_{th}, 50_{th} and 80_{th} percentile ranges) where water quality is in natural condition. Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be established and reflected by adoption of an alternative (e.g. 40_{th} percentile) value.

3. Na, Ca and other ion % columns: The percentages of major cations (Na, Ca and Mg) were evaluated for each sample, as were the major anions (Cl, HCO3, SO4 and NO3). Then the ion % columns were compiled by calculating the percentiles of these percentages independently of each other. For instance, in Alluvium zone 15 - Lower Maranoa, the 50th percentile of Na is 74, while the 20th–80th percentile range is 54–76. This means that half of the samples contain at least 74% of dissolved Na, with the balance being made up of Ca and Mg in any proportions. Because of this, the sum of the 50th percentiles in Alluvium zone 15 - Lower Maranoa is near to 100%, with Ca contributing 12% and Mg contributing 14%. However, the 20th and 80th percentiles of each of the major cations are based on ranges of that cation, and add up to less or more than 100% respectively.

4. Low TP values (e.g. recordings of zero) may be due to concentrations below detection limits. Concentrations of TP are usually low in Queensland groundwaters, because most of the phosphorus binds to particles in the soil and unsaturated zone, restricting its movement to the aquifer (Holman et al. 2008).

5. Refer to accompanying figures (maps) for locations of chemistry zone. In some locations (mainly within the alluvial aquifer class) a chemistry zone is identified by entire zone and the 'near stream' (within 1.5km of stream channel) component of the zone, where near stream water quality characteristics may be different from overall zone. Percentiles are provided in each case. Overall zone includes near stream and other areas. Near stream zone is shown on large scale plans accompanying this report, available on the department's website.

10.2.7 Target for wetland extent

As identified in Section 2.2 of this report, the extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished.

Target 1: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels.

The indicators are:

- wetland area by system (2013): Whole of plan area
- wetland area by system (2013): Water resource plan basins

Refer to Table 6 and Table 7 of this report for a description of these indicators.

10.2.8 Riparian targets and catchment ground cover

The following recommendations are aimed at NRM bodies, with specific focus on aquatic ecosystem health.

10.2.8.1 Riparian health

Riparian zones are recognised as an important component of riverine ecosystems. Healthy riparian zones contain varying proportions of both forest and ground cover vegetation. This vegetation helps to stabilize banks and reduce erosion, provides a filtering mechanism for catchment run-off, provides habitat for various aquatic related species and provides shading, which reduces temperature extremes in waterbodies. Maintaining healthy riparian zones is therefore important to overall ecosystem health. Due to these factors, riparian targets have been included in the HWMP for the Maranoa and Balonne River basins.

Details of ground cover mapping in the Queensland Murray Darling Basin can be found in the Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchments for 2013 (Clark, Healy, & Tindall, 2015) and the Queensland Murray-Darling Basin Ground Cover 2015 reports (van den Berg, Trevithick, & Tindall, 2015). Mapping of riparian areas is done using satellite imagery with a pixel resolution of 30 m. For the purposes of these reports, the riparian area is defined as the area within 100 metres either side of a (mapped) stream or riverine wetland, and two forms of riparian area are considered—forested and non-forested. These are defined as follows:

Forested: Areas where tree crown cover is >~20%

Non-forested: Areas where tree crown cover is <~20%

In wetter coastal areas, riparian areas would naturally be 100% forested. However, in the drier western catchments considered in this document, extensive reaches of the riparian zones may be naturally non-forested.

See Riparian Vegetation Levels in the Queensland Murray-Darling Basin and Bulloo Catchment for 2013 (Clark, Healy, & Tindall, 2015) for further information.

Indicators for forested riparian areas

Indicator 1—Total forested riparian area: This is the total forested riparian area measured in each catchment in 2013. The target is that there should be no further net loss of the existing (2013) forested area.

Indicator 2—Normalised Patch Density (NPD): Establishes the number of riparian forest patches per kilometre of stream network and provides a measure of the linear connectivity of riparian forest along the stream network. This measure is normalised to account for the different proportion of each catchment's riparian area that is forested. A low NPD score is assigned to catchments with a highly connected riparian forest. Conversely, a high NPD score indicates there is lower connectivity between riparian forest patches in a catchment. The target is to have no increase from existing (2013) NPD scores.

Indicator 3—Patch Size and Connectivity Index (PSCI): The PSCI analyses the size of riparian forest patches and the distance between them. As vegetation extent is increased, the PSCI value will also increase. This indicates that riparian forest patches have become larger and more connected at the landscape scale. Alternatively, as patches either become smaller or the distance between them increases, the PSCI value will decrease. This indicates a loss of connectivity at the landscape scale. A value of 100 indicates fully connected riparian forests while a value of 0 indicates no connectivity. The target is to have no decline in existing (2013) PSCI scores.

Indicators for non-forested riparian areas

In the non-forested areas, satellite imagery is able to assess the density of ground cover vegetation (grasses, small shrubs, general plant litter). The standardised method is to assess three categories of ground cover density:

- >70% ground cover
- 30 to 70% ground cover
- <30% ground cover

Non-forested riparian areas are classified in good condition if ground cover is >70%.

Indicator 4—Riparian area with ground cover >70%: This is the total non-forested riparian area with >70% cover as measured in each catchment in 2013. The objective is that there should be no further net loss of the existing area with >70% cover. It is recognised that riparian ground cover varies significantly with rainfall and so the objective will need to be assessed over a range of seasons.

Riparian targets

Due to the natural occurrence of non-forested riparian areas in these catchments, and also the variation in proportions of natural forested/non-forested riparian areas between catchments, the targets are tailored to each catchment. The overall aim is to maintain existing riparian quality as measured by the indicators described above.

Riparian targets, and corresponding indicators, are specified in Table 44 to Table 46.

Table 44: Total forested riparian area target and supporting indicator

Target 1: No reduction in forested riparian areas from 2013 baseline levels.	
	Indicator 1—Total forested riparian area (ha) in 2013.
Maranoa	153,825
Balonne	173,329

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

Table 45: Riparian connectivity target and supporting indicators

Target 2: No reduction in riparian forest connectivity from 2013 baseline levels.		
	Indicator 2—No increase in the Normalised Patch Density (NPD) value for each major catchment.	Indicator 3—No reduction in the Patch Size and Connectivity Index (PSCI) value for each major catchment.
Maranoa	12.3	57.2
Balonne	31.6	58.8

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

Table 46: Riparian ground cover target and supporting indicator

Target 3: In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water.	
	Indicator 4—No reduction from 2013 baseline levels in the area of non-forested riparian ground cover that has more than 70% coverage (ha) in each major catchment.
Maranoa	34,628
Balonne	78,635

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

10.2.8.2 Ground cover in grazing lands

The Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) established a baseline for ground cover in grazing lands by calculating a 28-year long-term mean and seasonal changes in ground cover during 2015. The study was limited to reporting areas, defined by a grazing land-use with foliage projection cover of less than 60% (which is the method limit for 'fractional ground cover'). Within the reporting area for each of the 11 defined catchments, the mean (average) level of ground cover in each season was calculated for 2015, and compared to the corresponding 28-year mean. The report also calculated the area with less than 70% ground cover, as independent studies have indicated that a ground cover level of at least 70% is required to minimise erosion by water (van den Berg, Trevithick, & Tindall, 2015).

Ground cover is defined as the vegetation (living and dead), biological crusts and stone that are in contact with the soil surface. Ground cover levels are the result of complex interactions between landscape function (soil type, topography and vegetation dynamics), climate and land management. Some areas maintain naturally higher levels of ground cover due to factors such as high soil fertility and consistently high annual rainfall. The impacts of grazing land management practices on ground cover levels in these areas may be minimal due to the resilience of the land to respond to pressures. In areas where rainfall is less reliable and soils are less fertile, ground cover levels can vary greatly and the influence of grazing land management practices on ground cover levels and the species composition of the ground cover can be more pronounced.

Target 1: Maintain 90% of catchment with a ground cover level of >70% in the late dry season.

It is important to note that the influences of rainfall and grazing pressure can be particularly evident in Queensland Murray-Darling Basin (QMDB) catchments where a strong east to west rainfall gradient exists, the impacts of drought can be prolonged and rainfall can be highly variable in space and time. Some parts of the QMDB (e.g. Paroo and Bulloo catchments) also have soils of lower fertility and low mean annual rainfall. Ground levels in these areas are naturally lower than eastern QMDB catchments and will therefore rarely attain levels of 90% of the catchment with ground cover above 70 percent.

The Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) set the ground cover results in the context of climatic conditions. Rainfall was below average in 2015 for all catchments within the QMDB, with large parts of western Queensland drought declared during mid-late 2013 and 2014. Generally drier conditions across the QMDB area led to reductions in ground cover levels. The effects of high rainfall in 2010 and 2011 were observed for all catchments, with significant increases in ground cover levels and subsequent reduction in the area with ground cover below 70 percent.

Table 47 and Table 48 characterise the level of ground cover in the grazing lands of each drainage basin in 2015. The values in each table can be used as a baseline to track increases or decreases in groundcover through time, while working towards the target of 90% of the catchment area with greater than 70% ground cover in the late dry season. Maintaining and/or improving ground cover levels in grazing lands from 2015, with consideration to soil type, topography, vegetation dynamics, climate and land management, would have multiple benefits to the Maranoa and Balonne River basins. Ground cover is a key component of many soil processes including infiltration, runoff and surface erosion. It is particularly important to try to maintain ground cover during dry periods or periods of unreliable rainfall to minimise loss of water, soil, and nutrients when rainfall eventually occurs. This will also maximise the pasture response to rainfall. Implementation of appropriate and sustainable land management practices, particularly careful management of grazing pressure, can help to maintain or improve ground cover and improve the stability and resilience of the grazing system

See Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) for further information.

Maranoa

Mean rainfall for 2015 in the Maranoa catchment was 425 millimetres, 146 mm below the long term mean of 571 mm. The preceding year was also below the mean with 543 mm.

In 2015, the proportion of grazing lands with greater than 70 per cent ground cover was highest during autumn, at 93 per cent. The Maranoa catchment had high mean ground cover across all seasons for 2015, but was noticeably lower during spring compared to the other seasons. The highest mean cover was in autumn at 84 per cent, and the lowest in spring, at 70 per cent. The 2015 results were similar to the 28-year mean ground cover, with the largest difference for spring (6 per cent). Despite the generally high levels of cover, the Maranoa did not quite meet the ground cover target.

Table 47: A summary of ground cover in the Maranoa River basin per season.

	Area of reporting region with greater than 70% ground cover averaged over previous 28 years (%)	Area of reporting region with greater than 70% ground cover in 2015 (%)	28-year mean ground cover (%)	2015 mean ground cover (%)
Summer	80	84	79	80
Autumn	91	93	84	84
Winter	91	92	83	81
Spring	76	57	76	70

Note: This assessment is based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Queensland Murray-Darling Basin Ground Cover Report—2015 (Van den berg et al., 2015)

Balonne

Mean rainfall for 2015 in the Balonne catchment was 377 millimetres, 146 mm below the long term mean of 523 mm. The preceding year was also below the mean with 426 mm.

Mean ground cover for 2015 in the Balonne catchment was at its highest in autumn and winter (76 per cent), resulting in a high proportion of the catchment (73 and 78 per cent respectively) above 70 per cent cover. While the 2015 results were similar to the 28-year mean ground cover, they were a little lower across all seasons, particularly for spring. The low mean ground cover across seasons resulted in the catchment failing to meet the target by a considerable degree.

Table 48: A summary of ground cover in the Balonne River basin per season.

	Area of reporting region with greater than 70% ground cover averaged over previous 28 years (%)	Area of reporting region with greater than 70% ground cover in 2015 (%)	28-year mean ground cover (%)	2015 mean ground cover (%)
Summer	64	61	73	71
Autumn	77	73	79	76
Winter	82	78	80	76
Spring	61	44	72	66

Note: This assessment is based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Queensland Murray-Darling Basin Ground Cover Report—2015 (Van den berg et al., 2015)

10.2.9 Targets for freshwater macroinvertebrates

Freshwater macroinvertebrates are organisms without a backbone that are able to be seen with the naked eye and are found in freshwater environments (Negus, Steward, & Blessing, 2013). Freshwater macroinvertebrates are diverse, common and widespread throughout many aquatic ecosystems and are easily sampled. Different taxa groups react differentially to varied stressors in the environment. These varied responses allow for a range of indices, such as salinity index, to be calculated from each sample of macroinvertebrates collected. These indices can then provide an integrated measure of stream condition.

Negus et al. (2013) recommends that targeted macroinvertebrate sampling is conducted for the Maranoa and Balonne River basin to allow the development of locally relevant macroinvertebrate guidelines. It is recommended that sampling occur in waters of High Ecological Value (HEV) as well as Slightly Disturbed (SD) to Moderately Disturbed (MD) waters to allow development of targets for the different levels of protection under EPP Water.

10.2.10 Targets for freshwater fish

Fish are an important component of the fauna of Australian river systems and can be used as indicators of ecosystem health (Kennard, Harch, Arthington, Mackay, & Pusey, 2001). For example, fish have been used as an indicator of ecosystem health in the Murray-Darling Basin (Hutchinson, 2014) and (MDBC, 2008) and also in south east Queensland (EHMP, 2006). Ecosystem health is indicated by developing fish metrics, which are a tool to score the composition of fish communities in a given system. Once developed, scores may be compared against an expected or average condition derived from existing data sets or expert opinion.

Hutchinson (2014) used fish data from various surveys conducted in the Condamine-Balonne system between 1995 and 2014 to determine fish species occurrence frequencies (proportion of capture from multiple surveys, across multiple sites), the mean native species richness and the mean non-native species richness of the system. This information can be used to provide a baseline against which to compare the catch rates of individual species over a series of sites, or over a period of time, to determine if catch rates are near to what is expected or above or below what might be expected.

Due to the size of the Condamine-Balonne system in the study, the catchment area was divided into sections. These sections are (Refer to Figure 31Figure 31):

A. from the headwaters (near Killarney), including adjoining tributaries, to the Murray Bridge.
B. from Murray Bridge to the north and south Condamine River anabranch bifurcation (near Cecil Plains).
C. from the anabranch bifurcation (near Cecil Plains) to immediately downstream of Dogwood Creek,
D. from immediately downstream of Dogwood Creek to the NSW boarder, including distributaries and adjoining tributaries (including the Maranoa River).

Table 49 and Table 50 display the targets for freshwater fish the relevant catchment sections based on the occurrence frequency of native and non-native species, mean native species richness and the mean non-native species richness.

For the purposes of the Maranoa and Balonne River basin HWMP, only findings from catchment sections C and D above are displayed in Table 49 and Table 50.

Hutchinson (2014) recommends a survey method for the Condamine-Balonne system which includes a site size between 300m and 2km in length, noting that when surveying in dry years a site may consist of several sections of pools with dry areas in between; a fish sampling method involving electrofishing, combined with fine meshed fyke nets, as this is most likely to detect the largest range of species with the least impact on the sampled fish; fish captured in standard electrofishing and fyke shots should have a sub-sample of up to 20 fish from each species measured per shot. Survey methods used to develop fish metrics can be found in full in the report ‘Fish assemblages as indicators of ecosystem health in the Condamine-Balonne River system’ (Hutchinson, 2014).

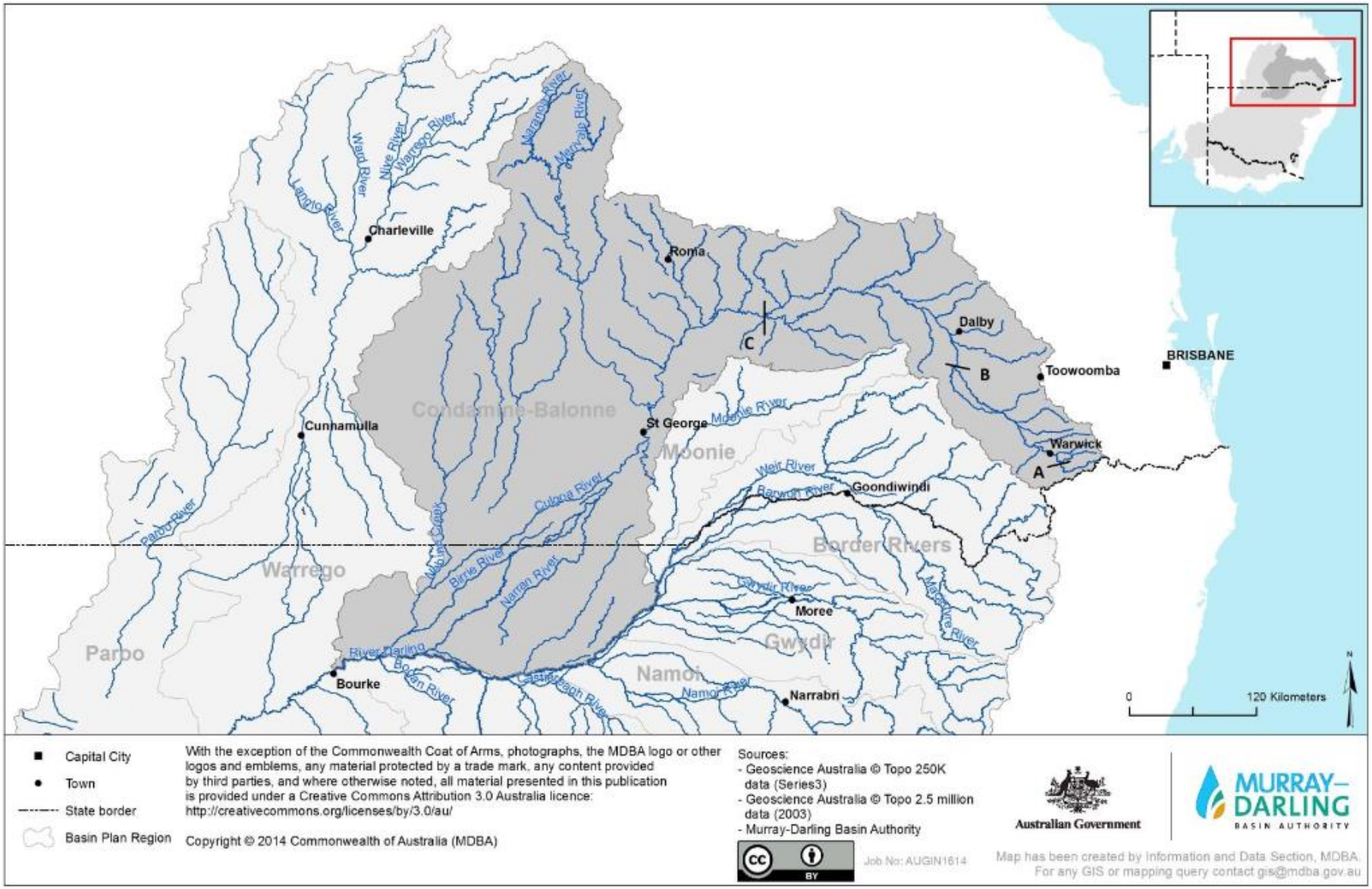

Figure 31: The area surveyed and the different catchment sections for the Condamine-Balonne fish assemblages survey (Hutchinson, 2014).

Table 49: Derived frequency of native and non-native species fish capture and mean native and mean non-native species richness in section C of the Condamine-Balonne system (Hutchinson, 2014).

Target 1: **Maintain or improve occurrence frequency**			
Species	**Derived frequency of occurrence**		
	Main river	**Tributary**	**Lagoon**
Golden perch (*Macquaria ambigua*)	0.91	0.60	0.54
Murray cod (*Maccullochella peelii*)	0.29*	0.27*	0.08*
Silver perch (*Bidyanus bidyanus*)	0.03*	0.03*	0
Spangled perch (*Leiopotherapon unicolor*)	0.82	0.85	0.92
Bony bream (*Nematalosa erebi*)	1.00	0.78	0.92
Freshwater catfish (*Tandanus tandanus*)	0.15*	0.40	0.23*
Hyrtl's tandan (*Neosilurus hyrtlii*)	0.28*	0.53	0.38
Rendahl's tandan (*Porochilus rendahli*)	0	0.05*	0.15*
Carp gudgeon spp. (*Hypseleotris* spp.)	1.00	0.95	0.92
Dwarf flathead gudgeon (*Philypnodon macrostomus*)	0.58	0	0.08*
Purple spotted gudgeon (*Mogurnda adspersa*)	0	0.03*	0
Unspecked hardyhead (*Craterocephalus stercusmuscarum fulvus*)	0.15*	0.55	0.23*
Murray-Darling rainbowfish (*Melanotaenia fluviatilis*)	0.56	0.82	0.15*
Australian smelt (*Retropinna semoni*)	0.74	0.60	0.23*
Olive perchlet (*Ambassis agassizii*)	0.26*	0.52	0.46
Mean native species richness	**6.65**	**6.78**	**5.31**
Target 2: Maintain or decrease occurrence frequency			
Carp (*Cyprinus carpio*)	0.65	0.70	0.53
Goldfish (*Carassius auratus*)	0.68	0.75	0.84
Mosquitofish (*Gambusia holbrooki*)	0.94	0.93	0.77
Mean non-native species richness	**2.26**	**2.38**	**1.90**

Notes:

* Indicates a rare species for that part of the catchment.

Table 50: Derived frequency of native and non-native species fish capture and mean native and mean non-native species richness in section D of the Condamine-Balonne system (Hutchinson, 2014).

Target 1: **Maintain or improve occurrence frequency**			
Species	**Derived frequency of occurrence**		
	Main river	**Tributary**	**Lagoon**
Golden perch (*Macquaria ambigua*)	0.83	0.64	0.92
Murray cod (*Maccullochella peelii*)	0.12*	0	0
Silver perch (*Bidyanus bidyanus*)	0.17*	0	0
Spangled perch (*Leiopotherapon unicolor*)	0.67	0.91	0.85
Bony Bream (*Nematalosa erebi*)	1.00	0.73	1.00
Freshwater catfish (*Tandanus tandanus*)	0.02*	0.27*	0.15*
Hyrtl's tandan (*Neosilurus hyrtlii*)	0.29*	0.14*	0.29*
Rendahl's tandan (*Porochilus rendahli*)	0.01*	0	0.09*
Carp gudgeon spp. (*Hypseleotris* spp.)	0.33	0.82	0.77
Purple spotted gudgeon (*Mogurnda adspersa*)	0.01*	0	0
Murray-Darling rainbowfish (*Melanotaenia fluviatilis*)	0.50	0.54	0.62
Australian smelt (*Retropinna semoni*)	0.45	0.36	0.31
Olive perchlet (*Ambassis agassizii*)	0.17*	0.14*	0.08*
Mean native species richness	**5.00**	**4.27**	**4.54**
Target 2: Maintain or decrease occurrence frequency			
Carp (*Cyprinus carpio*)	0.67	0.82	0.81
Goldfish (*Carassius auratus*)	0.67	0.45	0.54
Mosquitofish (*Gambusia holbrooki*)	0.50	0.45	0.57
Mean non-native species richness	**2.21**	**1.73**	**2.00**

Notes:

* Indicates a rare species for that part of the catchment.

10.3 Water quality targets for the protection of human use environmental values

These water quality targets apply where the following human use environmental values have been identified in the Maranoa and Balonne River basin (Refer to Section 5 of this report). Where more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the adoption of the most stringent water quality target for each water quality indicator will then protect all identified EVs. The water quality targets in this section are, unless otherwise specified, based on national water quality guidelines, including ANZECC Guidelines (as updated), the National Health and Medical Research Council Guidelines for managing risks in recreational water, the Food Standards Australia New Zealand, and the Australian Drinking Water Guidelines (NHMRC, 2011, as amended). Where national guidelines are the source for the stated water quality targets, it is recommended that users refer directly to the sources to obtain comprehensive listings of all indicators and up-to-date information.

10.3.1 Water quality targets for the protection of primary industry environmental values

Section 10.32 (2)(b) of the Basin Plan requires a WQM Plan to identify water quality targets for irrigation water. The target values for irrigation water are set out in Section 9.17 of the Basin Plan. Section 10.34 of the Basin Plan requires a WQM Plan to identify the locations of targets for irrigation water. As per Section 9.17 of the Basin Plan, the target values apply at sites in the Murray-Darling Basin where water is extracted by an irrigation infrastructure operator for the purpose of irrigation. Section 10.35 (2)(b) also requires irrigation water quality target values to be specified for groundwater.

Irrigation infrastructure operators are defined under Section 7 (4) of the Water Act 2007. Based on this definition, there are two sites in the Maranoa and Balonne River Basin that qualify as an irrigation infrastructure operator for the purposes of Basin Plan Section 9.17, 10.32 (2)(b) and 10.34.

The water quality target values for accreditation under section 10.32 (2)(b) of the Basin Plan are:

- **Table 51 provision (1) and provision (2) – referring to Table 52 and Table 53.**

For the purposes of Section 10.34 of the Basin Plan, the locations within the plan area where the targets for irrigation water specified in Table 51 provision (1) and provision (2) apply are displayed in Figure 32.

While not accredited under the Basin Plan, Table 51, provision (3) for the Maranoa and Balonne River basin is recognised to provide targets for irrigation water in the plan area for the purposes of Queensland water quality planning and management.

There are no groundwater irrigation infrastructure operators in the plan area for the purposes of specifying irrigation water quality target values under 10.35 (2)(b).

Table 51: Suitability of water supply for irrigation: Water quality targets

WATER QUALITY TARGET VALUES FOR IRRIGATION		
Environmental value	Water type/area	Water quality targets to protect environmental value
Suitability for irrigation	All surface waters and groundwaters	**For the Maranoa and Balonne River basin**: 1. Basin Plan target values for salinity are provided in Table 52. 2. Basin Plan target values for sodium adsorption ratio are provided in Table 53. 3. ANZECC (2000) targets for pathogens and metals are provided in Table 54 and Table 55. For all other indicators, such as major ions and herbicides refer to the ANZECC Guidelines (2000, and updates).

Table 52: Suitability of water supply for irrigation: Water quality target value for salinity in the Northern Basin[1]

Basin Region	Target value (EV) µS/cm
Northern Basin (Barwon River and Darling River and their tributaries)	957

1. **Source:** Murray-Darling Basin Plan 9.17.

Table 53: Suitability of water supply for irrigation: Water quality target value for sodium adsorption value

Target value for sodium adsorption ratio
The value which, if exceeded, would cause soil degradation[1] when that water is applied to land.

1. Soil degradation is defined as reduced permeability and soil structure breakdown caused by the level of sodium in the irrigation water, assessed using the sodium adsorption ratio.

Table 54: Suitability of water supply for irrigation: Water quality targets for thermotolerant (faecal) coliforms in irrigation waters used for food and non-food crops[1]

Intended use	Median values of thermotolerant coliforms (colony forming units–cfu) [2]
Raw human food crops in direct contact with irrigation water (e.g. via sprays, irrigation of salad vegetables)	<10 cfu/100mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu/100mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100mL
Pasture and fodder (for grazing animals except pigs and dairy animals, i.e. cattle, sheep and goats)	<1000 cfu/100mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100mL

Notes:

1. Adapted from ARMCANZ, ANZECC and NHMRC (1999).

2. Refer to ANZECC (2000), Volume 1, Section 4.2.3.3 for advice on testing protocols.

Source: ANZECC (2000), Volume 1, Section 4.2.3.3 and Table 4.2.2.

Table 55: Suitability of water supply for irrigation: Water quality targets for heavy metals and metalloids in agricultural irrigation water[1]—long-term trigger value (LTV), short-term trigger value (STV) and soil cumulative contamination loading limit (CCL)

Element	Soil cumulative contaminant loading limit (CCL) [2] (kg/ha)	Long-term trigger value (LTV) in irrigation water (up to 100 years) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 years) (mg/L)
Aluminium	ND[2]	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to ANZECC (2000), Vol 3, Table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 for citrus crops)	2.5 (0.075 for citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Notes:

1. Concentrations in irrigation water should be less than the trigger values. Trigger values should only be used in conjunction with information on each individual element and the potential for off-site transport of contaminants (refer ANZECC (2000), Volume 3, Section 9.2.5).

2. ND = Not determined; insufficient background data to calculate CCL.

Source: ANZECC (2000), Volume 1, Section 4.2.6 and Table 4.2.10.

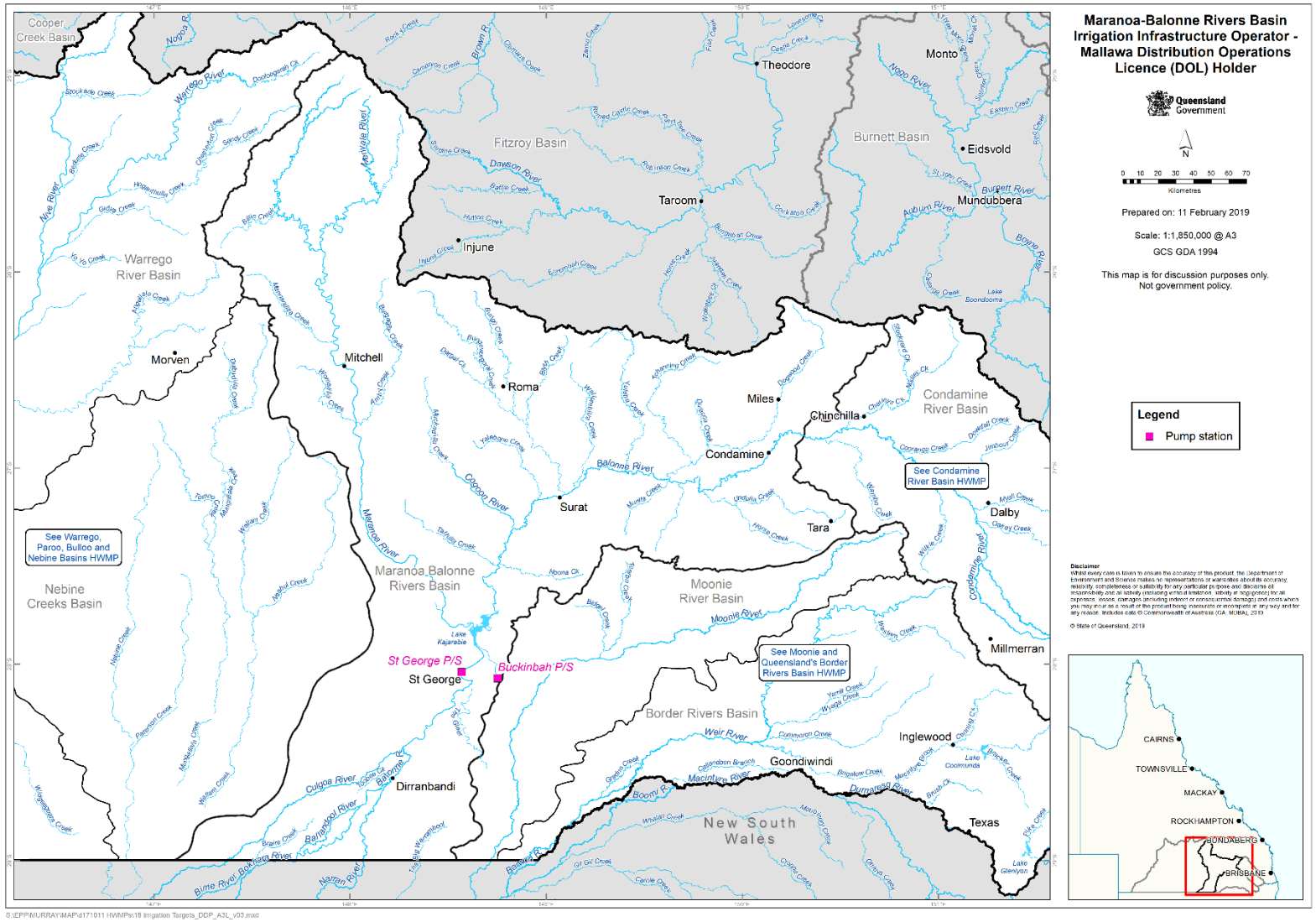

Figure 32: Locations within the Maranoa and Balonne River basin where Basin Plan targets for irrigation water apply, where water is extracted by an irrigation infrastructure operator.

Table 56: Suitability of water supply for stock watering: Water quality targets

WATER QUALITY TARGET VALUES FOR STOCK WATERING		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Suitability for stock watering	All surface waters and groundwaters	Water quality targets as per ANZECC (2000, and updates), including median faecal coliforms <100 organisms per 100 mL. Water quality targets for total dissolved solids and metals are provided in Table 57 and Table 58, based on ANZECC (2000). For other water quality targets, such as cyanobacteria and pathogens, see ANZECC (2000, and updates).

Table 57: Suitability of water supply for stock watering: Water quality targets for tolerances of livestock to total dissolved solids (salinity) in drinking water[1]

Livestock	Total dissolved solids (TDS) (mg/L)		
	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production.	Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually.
Beef cattle	0–4000	4000–5000	5000–10 000
Dairy cattle	0–2500	2500–4000	4000–7000
Sheep	0–5000	5000–10 000	10 000–13 000[2]
Horses	0–4000	4000–6000	6000–7000
Pigs	0–4000	4000–6000	6000–8000
Poultry	0–2000	2000–3000	3000–4000

Notes:

1. From ANZECC (1992), adapted to incorporate more recent information.

2. Sheep on lush green feed may tolerate up to 13 000 mg/L TDS without loss of condition or production.

Source: ANZECC (2000), Volume 1, Section 4.3.3.5 and Table 4.3.1.

Table 58: Suitability of water supply for stock watering: Water quality targets (low risk trigger values) for heavy metals and metalloids in livestock drinking water

Metal or metalloid	Trigger value (low risk)[1,2] (mg/L)
Aluminium	5
Arsenic	0.5 (up to 5[3])
Beryllium	ND
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	0.4 (sheep), 1 (cattle), 5 (pigs), 5 (poultry)
Fluoride	2
Iron	Not sufficiently toxic
Lead	0.1
Manganese	Not sufficiently toxic
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Vanadium	ND
Zinc	20

Notes:

1. Higher concentrations may be tolerated in some situations (further details provided in ANZECC (2000), Volume 3, Section 9.3.5).

2. ND = not determined, insufficient background data to calculate.

3. May be tolerated if not provided as a food additive and natural levels in the diet are low.

Source: ANZECC (2000), Volume 1, Section 4.3.4 and Table 4.3.2.

Table 59: Suitability of water supply for farm supply/use: Water quality targets

WATER QUALITY TARGET VALUES FOR FARM SUPPLY/USE		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Suitability for farm supply/use	All surface waters and groundwaters	Targets as per: • ANZECC guidelines (2000, and updates).

Table 60: Protection of the human consumer: Water quality targets

WATER QUALITY TARGET VALUES FOR HUMAN CONSUMER		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Protection of the human consumer	All surface waters and groundwaters	Targets as per: • ANZECC guidelines (2000, and updates) • Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.

Table 61: Suitability of water supply for aquaculture: Water quality targets

WATER QUALITY TARGET VALUES FOR AQUACULTURE		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Suitability for aquaculture	All surface waters and groundwaters	Targets as per: • Table 62 of this report • ANZECC guidelines (2000, and updates) • Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.

Table 62: Water quality targets for aquaculture (optimal growth of particular species in freshwater)

WATER QUALITY TARGET VALUES FOR AQUACULTURE						
Water parameter	**Barramundi**	**Eel**	**Silver perch**	**Jade perch**	**Sleepy cod**	**Redclaw**
Dissolved oxygen	4–9mg/L	>3mg/L	>4mg/L	>3mg/L	>4.0mg/L	>4.0mg/L
Temperature ˚C	26–32	23–28	23–28	23–28	22–31	23–31
pH	7.5–8.5	7.0–8.5	6.5–9	6.5–9	7.0–8.5	7.0–8.5
Ammonia (TAN, Total ammonia-nitrogen)		<1.0mg/L			<1.0mg/L	<1.0mg/L
Ammonia (NH_3, un-ionised form)*pH dependent	<0.46mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L
Nitrate (NO_3)			<100mg/L			
Nitrite (NO_2)	<1.5mg/L	<1.0mg/L	<0.1mg/L		<1.0mg/L	<1.0mg/L
Salinity (extended periods)	0–35ppt		<5ppt	<5ppt		<4ppt
Salinity bath	0–35ppt		5–10ppt for 1 hour		max. 20ppt for 1 hour	
Hardness ($CaCO_3$)			>50 mg/L	>50 mg/L	>40mg/L	>40mg/L
Alkalinity	>20mg/L		100–400 ppm	100–400 ppm	>40mg/L	>40mg/L
Chlorine	<0.04mg/L				<0.04mg/L	
Hydrogen sulphide	0–0.3mg/L				0–0.3mg/L	
Iron	<0.1mg/L		<0.5mg/L	<0.5mg/L	<0.1mg/L	<0.1mg/L
Spawning temperature °C	Marine		23–28	23–28	>24 for more than 3 days	

Source: Department of Primary Industries and Fisheries: Water Quality in Aquaculture—DPI Notes April 2004.

10.3.2 Water quality targets for the protection of the drinking water environmental value

These water quality targets apply where the drinking water environmental value has been identified in the Maranoa and Balonne River basin (Refer to Section 5 of this report).

Table 63: Suitability of drinking water supply: Water quality targets

WATER QUALITY TARGET VALUES FOR DRINKING WATER		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Suitability for drinking water supply	All surface waters and groundwaters	Targets as per: • Table 64- Water quality targets for drinking water supply. • The Australian Drinking Water Guidelines (2011, as amended) provides a framework for the quality of raw water for treatment for human consumption. For water quality after treatment or at point of use refer to legislation and guidelines, including: • Australian Drinking Water Guidelines (2011, as amended) • *Public Health Act 2005* and Regulation • *Water Fluoridation Act 2008* and Regulation • *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water management plan under the Act.

Table 64: Suitability of raw drinking water supply: Water quality targets for drinking water supply in the vicinity of off-takes, including groundwater, before treatment

This table outlines the water quality targets for water **before treatment**, unless otherwise stated (e.g. Australian Drinking Water Guidelines (NHMRC, 2011, as amended). For water quality after treatment or at the point of use, refer to relevant legislation and guidelines, including *Public Health Act 2005* and Regulation, *Water Supply (Safety and Reliability) Act 2008* and Regulation, including any approved drinking water management plan under the Act, *Water Fluoridation Act 2008* and Regulation, and the Australian Drinking Water Guidelines (NHMRC, 2011, as amended).

Indicator	Water quality target
Giardia	0 cysts (Queensland Water Supply Regulator) If *Giardia* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (NHMRC, 2011, as amended).
Cryptosporidium	0 cysts (Queensland Water Supply Regulator) If *Cryptosporidium* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (NHMRC, 2011, as amended).
E. coli	<100 cfu/100mL Treatment plants with effective barriers and disinfection are designed to address faecal contamination. *E. coli* or thermotolerant coliforms should not be present in any 100 mL sample of (treated) drinking water (NHMRC, 2011, as amended).
Blue-green algae (cyanobacteria)	<2000 cells/mL
Algal toxin	ADWG (NHMRC, 2011, as amended) health guideline: <1.3 µg/L Microcystin
pH	6.5-8.0
Sulphate	ADWG (NHMRC, 2011, as amended) health guideline: <500 mg/L
Dissolved oxygen	60-110 % saturation
Pesticides	Raw supplies: With good land and water quality management practices, pesticides should not be detected in source waters used for drinking water supplies (NHMRC 2011, Section 6.3.2, and Pesticide factsheets). Refer to the ADWG (2011, as amended) for specific human health related guideline values. Treated drinking water: Advanced treatment processes can aid in removal of pesticides from water supplies. Refer to the ADWG (NHMRC, 2011, as amended) for specific human health related guideline values.
Other indicators (including physico-chemical indicators)	Refer to ADWG (NHMRC, 2011, as amended).

10.3.3 Water quality targets for the protection of the cultural, spiritual and ceremonial environmental value

These water quality targets apply where the cultural, spiritual and ceremonial environmental value has been identified in the Maranoa and Balonne River basin (Refer to Section 5 of this report).

Table 65: Protection of cultural, spiritual and ceremonial values: Water quality targets

WATER QUALITY TARGET VALUES FOR CULTURAL, SPIRITUAL AND CEREMONIAL VALUES		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Protection of cultural, spiritual and ceremonial values	All surface waters and groundwaters	Protect or restore cultural, spiritual and ceremonial values consistent with approved policies and plans. Aboriginal Waterways Assessments may provide information to support the cultural, spiritual and ceremonial value.

10.3.4 Water quality targets for the protection of the industry environmental value

These water quality targets apply where the industry environmental value has been identified in the Maranoa and Balonne River basin (Refer to Section 5 of this report).

Table 66: Suitability for industrial use: Water quality targets

WATER QUALITY TARGET VALUES FOR INDUSTRY		
Environmental Value	Water type/area	Water quality targets to protect environmental value
Suitability for industrial use	All surface waters and groundwaters	Water quality requirements for industry vary within and between industries. The ANZECC guidelines (2000) do not provide targets to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This environmental value is usually protected by other values, such as the aquatic ecosystem environmental value.

10.3.5 Water quality targets for the protection of the primary, secondary and visual recreation environmental values

The following water quality targets apply where the following recreational environmental values have been identified in the Maranoa and Balonne River basin (Refer to Section 5 of this report).

Section 10.32 (2)(c) of the Basin Plan requires a WQM Plan to identify water quality targets for recreational purposes for surface waters and 10.35B (2)(c) for groundwaters.

The Healthy Waters Management Plan fulfils this requirement by specifying that the water quality targets for water used for recreational purposes includes the values for cyanobacteria cell counts or biovolume as set out in Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

The water quality target values for accreditation under section 10.32 (2)(c) and 10.35B (2)(c) of the Basin Plan are the water quality target values in Table 67, provision (1) for primary, secondary and visual recreation. The accredited water quality target values apply in the Maranoa and Balonne River basin.

While not accredited under the Basin Plan, Table 67, provision (2) for primary, secondary and visual recreation is recognised to support the accredited water quality target values for recreational purposes.

Table 67: Suitability for primary, secondary and visual recreation: Water quality targets

WATER QUALITY TARGET VALUES FOR RECREATION		
Environmental Value	**Water type/area**	**Water quality targets to protect Environmental Value**
Suitability for primary contact recreation 	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • recreational water bodies should not contain: ○ Level 1[1]: ≥ 10 µg/L total microcystins; or ≥ 50 000 cells/mL toxic *Microcystis aeruginosa*; or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or ○ Level 2[1]: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present; or ○ cyanobacterial scums consistently present. Further details are contained in (NHMRC, 2008) and Table 68. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • water free of physical (floating and submerged) hazards[26] • temperature range: 16–34°C • pH range: 6.5–8.5 • DO: >80% • faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin. Two principal components are required for assessing faecal contamination: ○ assessment of evidence for the likely influence of faecal material ○ counts of suitable faecal indicator bacteria (usually enterococci) These two components are combined to produce an overall microbial classification of the recreational water body. • avoiding exposure to freshwater free-living microorganisms (e.g. the protozoan *Naegleria fowleri* in warm fresh waters) • waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.

[26] Where permanent hazards exist appropriate warning signs should be clearly displayed.

WATER QUALITY TARGET VALUES FOR RECREATION		
Environmental Value	**Water type/area**	**Water quality targets to protect Environmental Value**
Suitability for secondary contact recreation	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Refer to the cyanobacteria and algae targets for primary recreation, NHMRC (2008) and Table 68 for further detail. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).
Suitability for visual recreation	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Refer to the cyanobacteria and algae targets for primary recreation, NHMRC (2008) and Table 68 for further detail. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.

Notes:

1. Level 1 recognises the probability of adverse health effects from ingestion of known toxins, in this case based on the toxicity of microcystins. Level 2 covers circumstances in which there are very high cell densities of cyanobacterial material, irrespective of the presence of toxicity or known toxins. Increased cyanobacterial densities increase the likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms (NHMRC, 2008; 8).

Table 68: Recreational waters: Alert levels and corresponding actions for management of cyanobacteria

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters. Monitoring/action requirements relative to cyanobacteria 'alert' levels are summarised below, and are explained more fully in the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Further details on the process to determine suitability of waters for recreation, relative to historical cyanobacterial levels and susceptibility to cyanobacterial contamination, are contained in Section 6 of the NHMRC guidelines (2008).

Green level surveillance mode[1]	Amber level alert mode[1]	Red level action mode[1]
Fresh waters		
≥ 500 to <5000 cells/mL *M. aeruginosa* or biovolume equivalent of >0.04 to <0.4 mm^3/L for the combined total of all cyanobacteria.	≥ 5000 to <50 000 cells/mL *M. aeruginosa* or biovolume equivalent of ≥0.4 to <4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume[2]. or[3] ≥0.4 to <10 mm^3/L for the combined total of all cyanobacteria where known toxin producers are not present.	Level 1 guideline[4]: ≥ 10 µg/L total microcystins. or ≥ 50 000 cells/mL toxic *M. aeruginosa* or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume. or[3] Level 2 guideline[4]: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present. or cyanobacterial scums are consistently present[5].

Notes:

1. Recommended actions at different alert levels are outlined below (based on NHMRC, 2008, Table 6.6—Fresh waters).
   a. **Green:** Regular monitoring. Weekly sampling and cell counts at representative locations in the water body where known toxigenic species are present (i.e. *Microcystis aeruginosa*, *Anabaena circinalis*, *Cylindrospermopsis raciborskii*, *Aphanizomenon ovalisporum*, *Nodularia spumigena*); or fortnightly for other types including regular visual inspection of water surface for scums.
   b. **Amber:** Notify agencies as appropriate. Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species (above) are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. Monitor weekly or fortnightly where other types are dominant. Make regular visual inspections of water surface for scums. Decide on requirement for toxicity assessment or toxin monitoring.
   c. **Red:** Continue monitoring as for (amber) alert mode. Immediately notify health authorities for advice on health risk. ('In action mode the local authority and health authorities warn the public of the existence of potential health risks; for example, through the media and the erection of signs by the local authority.' NHMRC, 2008; 114). Make toxicity assessment or toxin measurement of water if this has not already been done. Health authorities warn of risk to public health (i.e. the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).
2. The definition of 'dominant' is where the known toxin producer comprises 75% or more of the total biovolume of cyanobacteria in a representative sample.
3. This applies where high cell densities or scums of 'non-toxic' cyanobacteria are present i.e. where the cyanobacterial population has been tested and shown not to contain known toxins (microcystin, nodularian, cylindrospermopsin or saxitoxins).
4. Health risks and levels: Level 1 is developed to protect against short-term health effects of exposure to cyanobacterial toxins ingested during recreational activity, whereas the Level 2 applies to the circumstance where there is a probability of increased likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms, from exposure to very high cell densities of cyanobacterial material irrespective of the presence of toxicity or known toxins (NHMRC, 2008; 114).
5. This refers to the situation where scums occur at the recreation site each day when conditions are calm, particularly in the morning. Note that it is not likely that scums are always present and visible when there is a high population as the cells may mix down with wind and turbulence and then reform later when conditions become stable.

Source: Summarised from NHMRC (2008) Guideline for Managing Risks in Recreational Water (Tables 6.2 and 6.6).

10.4 Salinity targets for the purposes of long-term salinity planning and management

Table 69: Queensland Basin Salinity Management Strategy End-of-Valley Salinity Targets

WATER QUALITY TARGET VALUES FOR LONG-TERM SALINITY PLANNING AND MANAGEMENT									
Valley	Baseline as at 1 Jan 2000			End-of-Valley targets (as absolute value)			Valley reporting site	AWRC Site Number	Map EoV Site ID
	Salinity (EC µS/cm)		Salt Load (t/yr)	Salinity (EC µS/cm)		Salt Load (t/yr)			
	Median (50%ile)	Peak (80%ile)	Mean	Median (50%ile)	Peak (80%ile)	Mean			
Queensland									
Condamine-Balonne	170	210	4,200	170	210	4,200	Ballandool R @ Hebel-Bollon Rd	422207A	83
	170	210	5,000	170	210	5,000	Bokhara R @ Hebel	422209A	82
	150	280	6,500	150	280	6,500	Briarie Ck @ Wollerbilla-Hebel Rd	422211A	84
	170	210	29,000	170	210	29,000	Culgoa R @ Brenda[1]	422015[1]	85
	160	210	10,000	160	210	10,000	Narran R @ New Angledool[1]	422030[1]	81

Notes:

1. These sites are operated by NSW on behalf of Queensland.

Source: Appendix 1 of Schedule B to the Murray-Darling Basin Agreement (Schedule 1 of the Water Act 2007). Version 15 June 2010, and as amended.

SECTION 11: MONITORING, DATA MANAGEMENT, EVALUATION AND REPORTING

11 Monitoring, data management, reporting and governance

11.1 Monitoring

Monitoring should be designed in accordance with the EPP Monitoring and Sampling Manual 2018. The principles in section 13.04 of the Basin Plan (listed in the table below) should also be implemented when conducting monitoring and evaluation in the plan area. These principles apply to all Queensland Murray-Darling Basins, including the Bulloo drainage basin. This ensures consistency in monitoring practices across the Queensland portion of the Murray-Darling Basin, as well as across the Murray-Darling Basin.

The Queensland Government will continue to monitor water quality through both the Surface Water Ambient Network and Groundwater Ambient Network. End-of-Valley monitoring is also conducted as part of Queensland's responsibilities under Basin Salinity Management 2030, with data derived from gauging station sites in both Queensland and New South Wales. Continuous and field-based water quality monitoring to support the calibration of the QMDB water quality model has also been conducted in the QMDB, supported by the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement. Local short-term water quality monitoring programs are also conducted in the QMDB where funded opportunities arise. These are often implemented by natural resource management groups, community groups or other local stakeholders.

Some activities in Queensland have approval under the *Environmental Protection Act 1994* to release water to the environment. These point sources releases are monitored by the approval holder for various water quality parameters and release volumes. The approval holders can also undertake monitoring of the surrounding environment.

It is an aim of the healthy waters management plan over the life of the plan to identify opportunities for a Report Card for the QMDB region, similar to South East Queensland and the Great Barrier Reef.

Table 70: Principles to be applied in monitoring and evaluating the effectiveness of the Basin Plan (section 13.04 Basin Plan)

Principle	Description
Principles 1-2	Not applicable to the Queensland Government or other state agencies.
Principle 3	Commonwealth agencies and Basin States should report against matters in a manner which reflects the degree to which they are responsible for those matters.
Principle 4	Monitoring and evaluation should be undertaken within the conceptual framework of program logic. Note: Program logic is a mechanism that helps to determine when and what to evaluate so that resources can be used effectively and efficiently: see the Australian Government's NRM MERI Framework.
Principle 5	Monitoring and evaluation findings, including in respect of progress towards meeting targets and trends in the condition and availability of the Basin water resources, should enable decision-makers to use adaptive management.
Principle	Description
Principle 6	Monitoring and evaluation should harness the monitoring capabilities of existing Basin State and Commonwealth programs (including jointly funded programs), provided that the programs are consistent with the principles in this Part, with a view to aligning and improving these programs over time. Note: For example, water information provided by Basin States to the Bureau of Meteorology under Part 7 of the *Water Act 2007* may be used, where possible, for monitoring and evaluation to avoid duplication in the sourcing of that information.
Principle 7	The best available knowledge (including scientific, local and cultural knowledge), evidence and analysis should be used where practicable to ensure credibility, transparency and usefulness of monitoring and evaluation findings.
Principle 8	Basin States and the Commonwealth should collaborate on the technical and operational elements of monitoring and evaluation in order to build engagement and ownership.

Principle	Description
Principle 9	A risk-based approach should be used for investment in monitoring and evaluation.
Principle 10	Monitoring and reporting should be timely, efficient, cost-effective and consistent, and should supply the information needed for evaluation.
Principle 11	To the extent possible, there should be open access to information collected or used in, or generated by, monitoring and evaluation.

11.2 Data management and reporting

Data management and reporting should be consistent with the following:

1. Data should be stored with sufficient identifiers and metadata associated with the data to ensure its integrity.
2. A common, secure and accessible platform for archiving (storing and retrieval) and displaying water quality information is required.
3. Reporting should be specifically linked to management responses and outcomes.
4. Integration of reporting and linking to related reports should be considered, where possible.
5. Reporting should address progress against actions, performance indicators and timelines. Reporting should also address the outcomes of any review processes undertaken and any updates or improvements made to the plan.
6. Reporting should be web based, where possible.
7. Decision support models should be utilised, if available, to assist with evaluating progress and possible management intervention scenarios.

11.3 Governance

A collaborative partnership between the Queensland Government and the relevant NRM group for the Queensland Murray-Darling Basin region is the recommended approach for the delivery of the Condamine River Basin HWMP. Resources and implementation of the various management responses to address risks and contribute to the achievement of objectives for water resources will involve Commonwealth and State governments, key stakeholders including industry, commerce, landholders, science providers, environment groups and Traditional Owner groups and the broader community.

SECTION 12: DICTIONARY

12 Dictionary

ADWG means the Australian Drinking Water Guidelines (2011 and as updated), prepared by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC).

ANZECC means the Australian and New Zealand Environment and Conservation Council.

ANZECC Guidelines mean the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (recently updated to become ANZG, 2018), prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Aquatic ecosystems (defined in the AWQG) comprise the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime in which they interact. It is predominantly the physical components (e.g. light, temperature, mixing, flow and habitat) and chemical components (e.g. organic and inorganic carbon, oxygen, nutrients) of an ecosystem that determine what lives and breeds in it, and therefore the structure of the food web. Biological interactions (e.g. grazing and predation) can also play a part in structuring many aquatic ecosystems.

ARMCANZ means the Agriculture and Resource Management Council of Australia and New Zealand.

AWQG means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000), prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Basin Plan means the *Basin Plan 2012*, prepared under the Commonwealth *Water Act 2007*.

Ecological health (defined in the AWQG) means the 'health' or 'condition' of an ecosystem. It is the ability of an ecosystem to support and maintain key ecological processes and organisms so that their species compositions, diversity and functional organisations are as comparable as possible to those occurring in natural habitats within a region (also termed ecological integrity).

Environmental values (EVs) for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and waterways that are safe for community use. Particular waters may have different EVs. EVs for a specified region are listed in schedule 1 of the EPP Water.

EPP Water is the Environmental Protection (Water) Policy 2009.

Level of protection for a water (aquatic ecosystem EV) means the level of aquatic ecosystem condition specified in Table 14 of this document that the corresponding WQOs for that water are intended to achieve (refer to management intent definition below for further information).

Management intent (aquatic ecosystem EV) is defined in s. 14 of the EPP (Water). It is the management intent for the waters that the decision to release waste water or contaminant to the waters must ensure the following:

- for high ecological value (HEV) waters—the measures for the indicators are maintained
- for slightly disturbed (SD) waters—the measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives for high ecological value water
- for moderately disturbed (MD) waters:
    - if the measures for indicators of the EVs achieve the water quality objectives for the water— the measures for the indicators are maintained at levels that achieve the water quality objectives for the water, or
    - if the measures for indicators of the EVs do not achieve the water quality objectives for the water— the measures for indicators of the EVs are improved to achieve the water quality objectives for the water
- for highly disturbed (HD) waters—the measures for the indicators of all environmental values are progressively improved to achieve the water quality objectives for the water.

QWQG means the Queensland Water Quality Guidelines.

Queensland waters (as defined in *Acts Interpretation Act 1954*): means all waters that are a) within the limits of the state; or b) coastal waters of the state.

Toxicant (defined in the AWQG) means a chemical capable of producing an adverse response (effect) in a biological system at concentrations that might be encountered in the environment, seriously injuring structure

or function or producing death. Examples include pesticides, heavy metals and biotoxins.

Water quality guidelines (defined in the EPP (Water)) are numerical concentration levels or statements for indicators that protect a stated environmental value. Under the EVs setting process contained in the EPP (Water), water quality guidelines are used as an input to the development of WQOs.

Water quality indicator (for an EV) means a property that is able to be measured or decided in a quantitative way. Examples of water quality indicators include physical indicators (e.g. temperature), chemical indicators (e.g. nitrogen, phosphorus, metals), and biological indicators (e.g. macroinvertebrates, seagrass, fish).

Water quality objectives (WQOs) are long-term goals for water quality management. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. Water quality objectives are not individual point source emission objectives, but the receiving water quality objectives. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural and economic). Examples of WQOs include:

- total phosphorus concentration less than 20 micrograms per litre (µg/L)
- chlorophyll a concentration less than 1 µg/L
- dissolved oxygen between 95% and 105% saturation
- family richness of macroinvertebrates greater than 12 families
- exotic individuals of fish less than five per cent.

Water type means groupings of waters with similar characteristics. Water types can include fresh waters (lowland, upland, lakes/reservoirs), wetlands and groundwaters.

SECTION 13: REFERENCED SOURCES

13 Referenced sources

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SECTION 14: APPENDICES

14 Appendices

Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions

The need to refine water quality targets to reflect local conditions

Under s9.16 and Schedule 11 of the Basin Plan, the water quality target values for fresh water-dependent ecosystems are inappropriate and the target application zones are not relevant to developing local measures that address the causes of water quality degradation. The target application zones are not relevant at a spatial scale that recognises the different Queensland Murray-Darling Basin water types, mapped at sub-catchment level (Refer to Figure 30).

The adoption of the same water quality target values for key indicators across approximately 60% of the Queensland Murray-Darling Basin in Schedule 11 of the Basin Plan is inappropriate for the respective water resource plan areas. Most of the water quality target values in Schedule 11 are less stringent than local water quality target values and for key water–dependent ecosystem indicators, such as suspended solids, the water quality target values are unrealistically low. Further, the majority of the water quality indicators and subsequent target values in Schedule 11 are not applicable to groundwater. Consequently, the Schedule 11 water quality target values are neither environmentally nor economically appropriate. The default application of water quality target values would be inconsistent with s5.02 (1) (d) of the Basin Plan—by failing to optimise social, economic or environmental outcomes in the national (or local community or state) interest.

Under the water quality framework of the ANZECC guidelines and the EPP Water, local water quality targets hold higher precedence over regional, state or national targets. Local water quality targets for fresh water-dependent ecosystems are critical for appropriate economic and environmental management, as the direct application of default regional, state or national water quality targets often do not reflect local water types or water quality characteristics. This results in water quality targets, particularly for physico-chemical indicators, that potentially offer insufficient protection for the local aquatic ecosystem or impose excessive constraints on stakeholders to manage water quality to an inappropriate standard for the local area.

The ANZECC guidelines emphasise the need to tailor water quality targets to local conditions:

“It is not possible to develop a universal set of specific guidelines that apply equally to the very wide range of ecosystem types or production systems, in varying degrees of health, in Australia and New Zealand. Environmental factors can reduce or increase the effects of physical and chemical parameters at a site and these factors can vary considerably across the two countries. A framework is provided that allows the user to move beyond single-number, necessarily conservative values, to guidelines that can be refined according to local environmental conditions — that is, to developing site-specific guidelines. This is a key message of the Water Quality Guidelines….”

“This can produce values more appropriate to a particular water resource. Although tailoring guidelines to local conditions requires more work in some cases, it results in much more realistic management goals. It therefore has the potential to reduce costs for industry.” (ANZECC, 2000; Introduction to the guidelines, 8 - 9)

The ANZECC guidelines refer to four large regions of Australia (Figure A), and derive ‘default’ water quality guidelines for water types in each region. The split between the ‘Tropical’ region and the southern regions is the Tropic of Capricorn.

The QMDB drainage basins (416-Border Rivers, 417-Moonie, 422 Balonne-Condamine, 423-Warrego and 424-Paroo) and the Bulloo (011) fall within the ANZECC ‘South-east Australia’ region, which includes waters in New South Wales, Victoria and Tasmania.

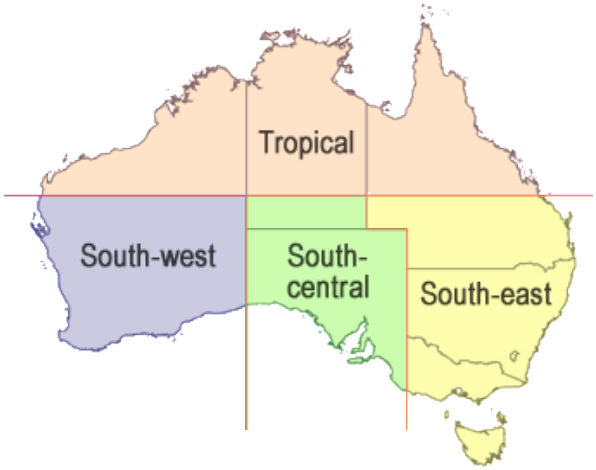

Figure A: ANZECC water type regions

The ANZECC guidelines state:

"The default trigger values in the present guidelines were derived from ecosystem data for unmodified or slightly-modified ecosystems supplied by state agencies. However, the choice of these reference systems was not based on any objective biological criteria. This lack of specificity may have resulted in inclusion of reference systems of varying quality, and further emphasises that the default trigger values should only be used until site- or ecosystem-specific values can be generated."

The water quality targets for fresh-water dependent ecosystems stated in Schedule 11 of the Basin Plan can be considered as 'default' regional trigger values, in the absence of local water quality targets. Refining the regional water quality targets for fresh-water dependent ecosystems stated in Schedule 11 of the Basin Plan based on local water quality data provides the best opportunity to achieve objectives and outcomes for water quality in the QMDB. Thus, where the water quality targets for fresh water-dependent ecosystems differ from those specified in the Basin Plan, they will be as effective in achieving consistency with the objectives described in the table below.

Procedure

Local water quality targets for fresh water-dependent ecosystems (surface water) were derived based on the procedure outlined for 'Physical and chemical stressors' in section 3.3 of the ANZECC guidelines. The purpose of establishing local water quality targets from this section of the ANZECC guidelines is to ensure that the slightly to moderately disturbed ecosystems of QMDB are adequately protected (Refer to Section 1).

The procedure for determining groundwater quality target values is described briefly in sub-section 10.2.6 of this report, and in full in Regional groundwater chemistry zones: Queensland Murray-Darling Basin (McNeil, Raymond, Bennett, & McGregor, 2017).

Data sources

Best available data was sourced from a variety of databases for the development of water quality target values, as described below.

Surface water

Section 3.3 of the ANZECC Guidelines describes the sources of information for use when deriving water quality targets for physical and chemical stressors:

1. biological and ecological effects data
2. reference system data
3. predictive modelling
4. professional judgement.

The following local data and information sources were used to refine the water quality targets for fresh water-dependent ecosystems stated in Schedule 11 of the Basin Plan:

- Department of Natural Resources and Mines water quality and quantity monitoring data (Surface Water and Project Science database)
- Surat and Galilee Basin Baseline Monitoring—December 2012-June 2013
- Sustainable Rivers Audit monitoring data from the Murray-Darling Basin Authority
- Condamine Catchment Management Association
- Condamine Balonne Monitoring and Information
- Queensland Murray-Darling Committee data
- Smart Rivers data
- New South Wales Office of Water data
- Published journal articles and data.

The refined water quality targets were prepared in conjunction with professional advice from the Water Quality Technical Panel. Data from approximately 850 water quality sampling occasions, conducted in the plan area between 1952 and 2017, was used in the analysis.

In the absence of local data for indicators, the regional targets specified in Schedule 11 of the Basin Plan apply.

Table 71 displays the metadata summary for surface water quality targets for all water types of the Maranoa and Balonne River basin.

Groundwater

Data was sourced from the Groundwater Database managed by the Queensland Department of Natural Resources and Mines. In the Queensland Murray-Darling Basin, there are more than 7,700 sub-artesian and 4,200 artesian water quality samples, supplemented by over 2,500 groundwater level measurements from around 6600 bores, mostly since the mid-1960s.

Site selection

Refer to Figure 33 for the surface water sites with available data that was analysed to derive alternative water quality targets for fresh water-dependent ecosystems in the Maranoa and Balonne River basin.

Refer to Figure 34 for the groundwater bores with available chemistry data that was analysed to develop groundwater quality targets for the Maranoa and Balonne River basin.

Data quality

Nutrient samples taken before 1995 were excluded from analyses due to inconsistencies with current sampling and laboratory procedures. Extreme or questionable data was inspected in finer detail, e.g. comparing the sampling dates with meteorological data, comparison with other variables, potential typographical errors, data reported in different units. Obvious errors were excluded, unless the data could be rationalized (e.g. EC recorded in mS/cm instead of µS/cm).

Consultation

Draft water quality target values were developed in consultation with the local government, natural resource management groups, industry groups, the Northern Basin Aboriginal Nations, the New South Wales Government and the community, based on participation at meetings held between March 2017 and January 2018.

Further information

For further information, refer to the Department of Environment and Science website: https://environment.des.qld.gov.au/water/policy/.

Table 71: Metadata summary for surface water quality targets in the Maranoa and Balonne River basin.

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
1. Upper Maranoa River catchment waters	**Low flow** <1.2 cumecs at gauge 422401D – Maranoa River at Mitchell	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	18 sample sites, 113 sample dates, N= 8-177 depending on parameter	1963-2016
	High flow >1.2 cumecs at gauge 422401D – Maranoa River at Mitchell	Total P Turbidity Suspended solids pH Conductivity Sulfate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	9 samples sites, 37 sample dates, N= 9-41 depending on parameter	1971-2015
2. Lower Maranoa catchment waters	**Low flow** <2.2 cumecs at gauge 422404A – Cashmere	Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	33 sample sites, 166 sample dates, N= 8-183 depending on parameter	1969-2016
	High flow >2.2 cumecs at gauge 422404A – Cashmere	Total N Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	8 sample sites, 35 sample dates, N= 8-39 depending on parameter	1971-2016
3. Bungil Creek catchment waters	**Low flow** <0.1 cumecs at gauge 422210A - Tabers	Ammonium N Oxidised N Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	17 sample sites, 132 sample dates, N= 10-162 depending on parameter	1972-2016

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
	High flow >0.1 cumecs at gauge 422210A - Tabers	Ammonium N Oxidised N Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	6 sample sites, 71 sample dates, N= 7-72 depending on parameter	1976-2017
4. Murilla Creek catchment waters	**Low Flow**	Insufficient data – Bungil Creek values applied.			
	High Flow				
5. Dogwood Creek catchment waters	**Low flow** <1.1 cumecs at gauge 422202B - Gilweir	Ammonium N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	22 samples sites, 142 sample dates, N= 14-131 depending on parameter	1964-2017
	High flow >1.1 cumecs at gauge 422202B - Gilweir	Total N Total P Turbidity Suspended Solids pH Conductivity Sulfate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee	4 sample sites, 28 sample dates, N= 13-29 depending on parameter	1971-2015
6. Yuleba Creek catchment waters	**Low flow** <0.4 cumecs at gauge 422219A - Forestry	Turbidity Suspended Solids pH Conductivity Sulfate Alkalinity	Surface Water database, Queensland Murray-Darling Committee	4 sample sites, 46 sample dates, N= 41-44 depending on parameter	1973-2016
	High flow >0.4 cumecs at gauge 422219A - Forestry	Conductivity	Surface Water database, Queensland Murray-Darling Committee	3 sample sites, 10 sample dates, N= 8	1976-2012
7. Kumbarilla Ridge catchment waters	**Low flow** <12.8 cumecs at gauge 422336A - Brigalow	Refer to Kumbarilla Ridge catchment waters – under Condamine Basin.			

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
	High flow >12.8 cumecs at gauge 422336A - Brigalow				
8. Lower Condamine Floodplain catchment waters	**Low flow** <21.8 cumecs at gauge 422325A - Cotswold	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Everyone's Environment Grants (EEG), Continuous water quality monitoring to validate and calibrate the Source Catchment model and refine local baseline water quality targets (DEHP5)	4 sample sites, 139 sample dates, N= 10-132 depending on parameter	1971-2017
	High flow >21.8 cumecs at gauge 422325A - Cotswold	pH Conductivity	Surface Water database, Queensland Murray-Darling Committee, DEHP5	3 sample sites, 12 sample dates, N= 8	1974-2017
9. Undulla Creek catchment waters	**Low flow** <21.8 cumecs at gauge 422325A - Cotswold	Total P Chlorophyll-a Turbidity pH Conductivity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Condamine Balonne Monitoring and Information	4 sample sites, 81 sample dates, N= 27-70 depending on parameter	1984-2015
	High flow >21.8 cumecs at gauge 422325A - Cotswold	Insufficient data – values from Dogwood Creek applied.			

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
10. Balonne River catchment waters	**Low flow** <30.0 cumecs at gauge 422220A - Surat	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Condamine Balonne Monitoring & Information	12 sample sites, 297 sample dates, N= 30-308 depending on parameter	1955-2016
	High flow >30.0 cumecs at gauge 422220A - Surat	Ammonium N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, EEG	7 sample sites, 70 sample dates, N= 8-71 depending on parameter	1965-2014
11. Beardmore Dam waters	**No flow condition separation applied**	Insufficient data – Balonne River 'low flow' values applied.			
12. Maranoa Fan catchment waters	**Low flow** <2.2 cumecs at gauge 422404A - Cashmere	Insufficient data – Lower Maranoa values applied.			
	High flow >2.2 cumecs at gauge 422404A - Cashmere				
13. St George Floodplain catchment waters	**Low flow** <48.4 cumecs at gauge 422201E – St George	Insufficient Data – Lower Balonne Streams values applied.			
	High flow >48.4 cumecs at gauge 422201E – St George				

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
14. Lower Balonne Streams catchment waters	**Low flow** <48.4 cumecs at gauge 422201E – St George	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Condamine Balonne Monitoring & Information, Smartrivers, DEHP5	48 sample sites, 656 sample dates N= 142-1157 depending on parameter	1965-2017
	High flow >48.4 cumecs at gauge 422201E – St George	Ammonium N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Condamine Balonne Monitoring and Information, Department of Science Information Technology and Innovation, EEG, DEHP5, NSW Government	25 sample sites, 133 sample dates N= 29-190 depending on parameter	1965-2017
15. Lower Balonne Floodplain catchment waters	**Low flow** <7.8 cumecs at gauge 422206A - Dirranbandi-Hebel Road	Insufficient data – Lower Balonne Streams values applied.			
	High flow >7.8 cumecs at gauge 422206A - Dirranbandi-Hebel Road				
16. Briarie Creek catchment waters	**Low flow** <0.1 cumecs at gauge 422211A - Woolerbilla-Hebel Road	Ammonia N Oxidised N Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulfate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray-Darling Committee, Department of Science Information Technology and Innovation	3 sample sites, 22 sample dates N= 10-19 depending on parameter	1981-2016

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
MARANOA-BALONNE					
	High flow >0.1 cumecs at gauge 422211A - Woolerbilla-Hebel Road	Turbidity Suspended Solids pH Conductivity Alkalinity	Surface Water database	1 sample site, 15 sample dates, N= 8-14 depending on parameter	1974-2012

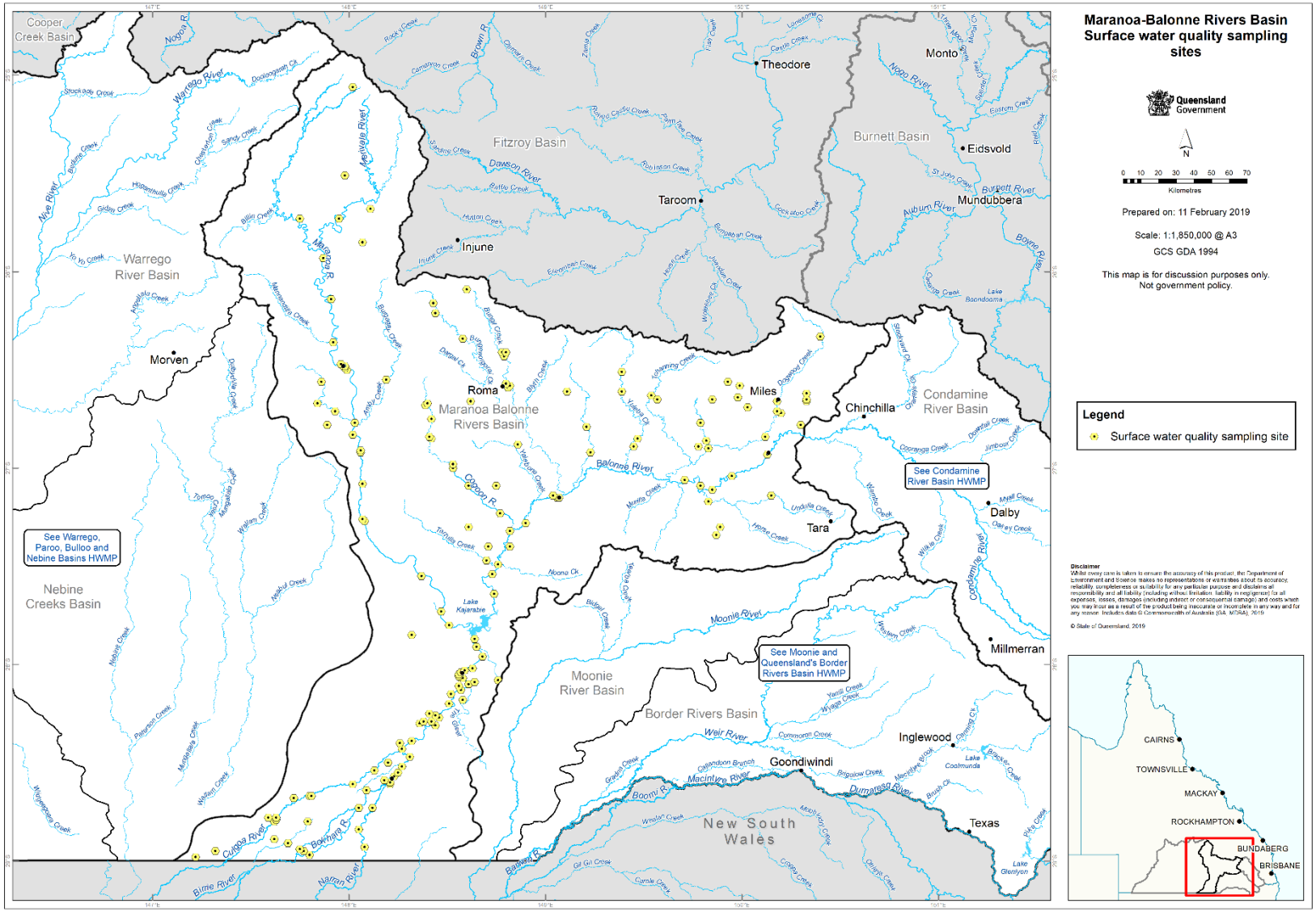

Figure 33: Surface water sample sites in the Maranoa and Balonne River basins.

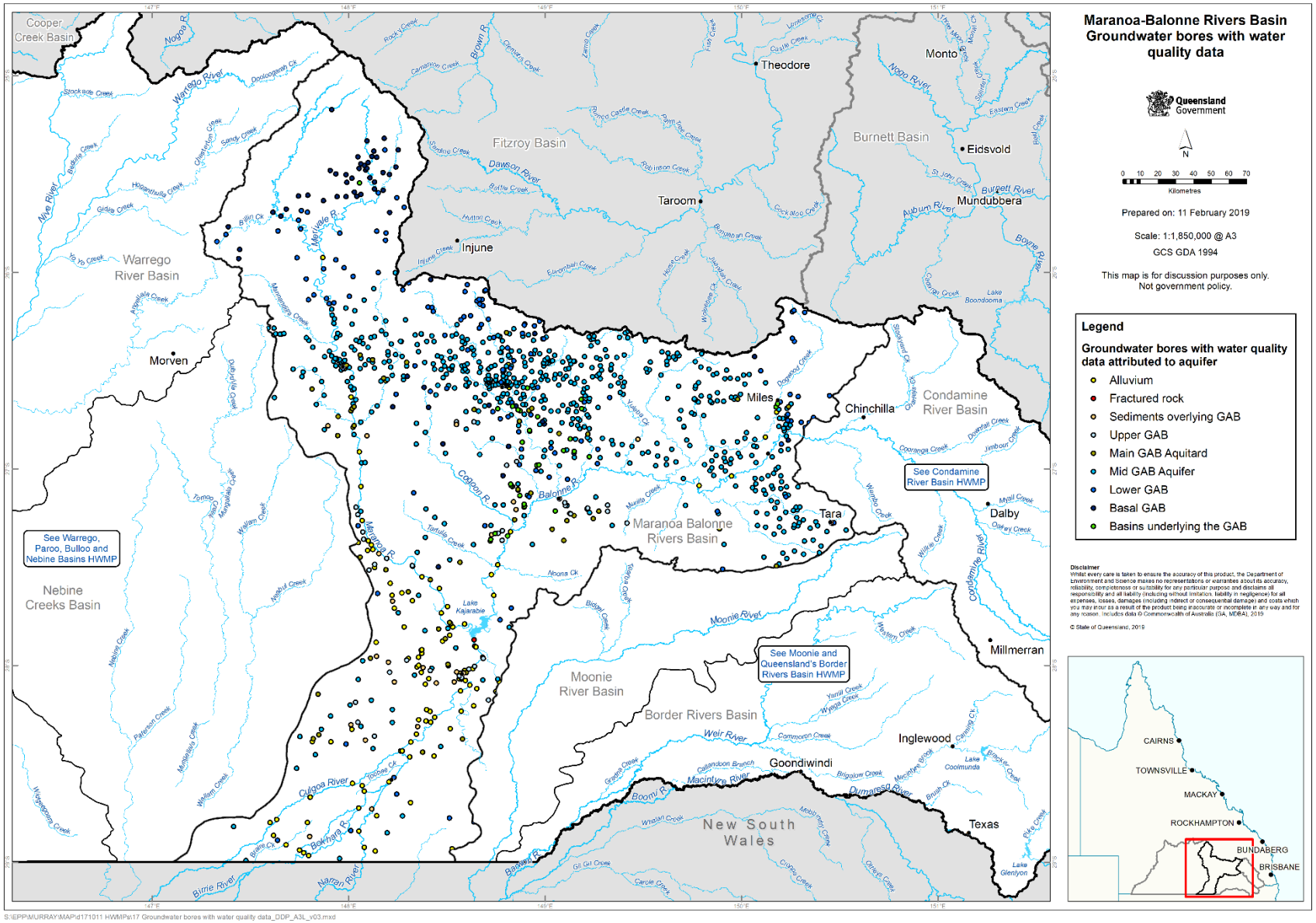

Figure 34: Groundwater bores with available chemistry data in the Maranoa and Balonne River basins.

Appendix 2—Description of water types in the Maranoa and Balonne basins

The Queensland Water Quality Guidelines 2009 states that the aim of defining water types is to create groupings within which water quality (or biological condition) is sufficiently consistent that a single guideline value can be applied to all waters within each group or water type. Water types are developed through expert opinion of soil type, geology, topography and rainfall. The water types were considered to best represent ecologically relevant spatial areas for key water quality parameters.

The common soil types in the eastern basins of QMDB are as follows (Queensland Government, 2016):

1. Dermosol: Red, brown, yellow, grey or black soils which have loam to clay textures. The potential for erosion is dependent upon the level of slope and ground cover.
2. Vertosol: Brown, grey or black soils which crack open when dry. This soil type has very high fertility and a large water-holding capacity, although is prone to sheet erosion if ground cover is not maintained. Vertosols are common throughout the Maranoa and Balonne.
3. Kandosol: Red, yellow and grey soils which have low fertility and poor water-holding capacity. This soil type produces significant runoff under low vegetation cover and is highly erodible. Red Kandosols are dominant the headwaters of the Maranoa and are associated with extensive areas of hard (stony) and soft (sandy/loamy) Mulga lands.
4. Kurosol: Texture-contrast soils which are strongly acidic and prone to erosion if vegetation is removed.
5. Tenosols and Rudosols: Poorly developed, shallow, stony soils which generally have low fertility and low water-holding capacity (highly erodible). These soils are common in the headwaters of the Maranoa.
6. Sodosol: Texture-contrast soils which are low in nutrients and very vulnerable to erosion (gully and tunnel) and dryland salinity when vegetation is removed.

The water types for the Maranoa and Balonne River basin are displayed in Figure 30.

The following descriptions of water types in the Maranoa and Balonne River basin were informed by expert opinion from the Water Quality Technical Panel.

Water type	Landscape description
MARANOA-BALONNE	
Upper Maranoa River catchment waters	The chemical signature of the Upper Maranoa River waters differed to the Lower Maranoa / Cogoon River catchment waters. The Carnarvon Sandstones land area in the headwaters of the Maranoa River were found to be consistent in chemical signature.
Lower Maranoa / Cogoon River catchment waters	The waters of the Lower Maranoa River and the Cogoon River have similar chemical signatures due to the similar land use, climate and geology. The boundary of this water type follows ACA Riverine Subsections.
Bungil Creek catchment waters	The boundary of this water type follows ACA Riverine Subsections. Tributary systems have differing water chemistry to that of trunk streams. Bungil Creek includes the southern creek systems south of the Balonne River because the geology and land systems were considered to be similar.
Dogwood Creek catchment waters	Dogwood creek extends over the Maranoa-Balonne basin and follows the Queensland Government sub-catchment boundary layer.
Yuleba Creek catchment waters	Tributary systems have differing water chemistry to that of trunk streams.
Kumbarilla Ridge catchment waters	The boundaries of this water type are defined by the extent of the sandstone ridge. The differing geology and slope of this land area to adjacent land areas results in a different chemical signature of these waters.
Lower Condamine Floodplain catchment waters	Trunk streams have differing water chemistry to that of tributaries and floodplains.

Water type	Landscape description
MARANOA-BALONNE	
Undulla Creek catchment waters	Tributary systems have differing water chemistry to that of trunk streams.
Balonne River catchment waters	Trunk streams have differing water chemistry to that of tributaries and floodplains.
Maranoa Fan catchment waters	The boundaries of these catchment waters were defined by the CSIRO land survey for Lands of the Balonne-Maranoa, 2012.
St George Floodplain catchment waters	Floodplain waters off-stream of the Lower Balonne River have different water chemistry to the main river. The boundary of this water type follows ACA Riverine Subsections.
Lower Balonne Streams catchment waters	Trunk streams have differing water chemistry to that of tributaries and floodplains. The water type boundary is below Beardmore Dam as releases of water from the dam will alter the chemistry of the Lower Balonne Streams.
Lower Balonne Floodplain catchment waters	Floodplain waters off-stream of the Lower Balonne River have different water chemistry to the main river.
Briarie Creek catchment waters	Water chemistry, specifically concentrations of carbonate, bicarbonate and calcium were higher than the adjacent Lower Balonne Floodplain and Lower Balonne Streams catchment waters. This is reflective of different sources of water and different local soil characteristics (Webb, P. 2012, *Development of Draft Water Quality Guidelines for the Lower Condamine and Upper Balonne region,* QMDC).

Appendix 3— Condamine-Balonne, Moonie and Queensland Border Rivers Water Quality Risk Assessment Methodology

Aim

This document aims to ensure that the risk assessment undertaken for the Healthy Waters Management Plans (HWMPs) for the Queensland Murray-Darling Basin Water Resource Plan (WRP) areas meets the requirements of the Murray-Darling Basin Plan (Basin Plan). The HWMPs intend to fulfil the requirement for a Water Quality Management Plan (WQM Plan) under section 10.29 of the Basin Plan.

This document outlines the methodology to identify, evaluate and treat water quality risks to the current and future condition, and continued availability of the water resources of Queensland Murray-Darling Basin WRP areas.

Background

Water quality for Queensland waters is managed under the *Environmental Protection Act 1994* and the Environmental Protection (Water) Policy 2009 (EPP Water). This legislation provides the framework for establishing environmental values (EVs), water quality objectives (WQOs) and HWMPs for Queensland waters.

Environmental values reflect the ways in which water is valued and used within a catchment and are displayed in Figure 1. The Department of Environment and Science (DES) undertakes a process to identify local environmental values for key regions in Queensland through community and stakeholder consultation. Once the refined set of environmental values has been identified for a region, they are recommended for scheduling under the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) (subordinate legislation under the *Environmental Protection Act 1994*) to inform statutory and non-statutory planning and decision-making. This is a key management action for maintaining and improving water quality for Queensland catchments.

The process to identify local environmental values for scheduling under the EPP Water has been undertaken across the Queensland Murray-Darling Basin (QMDB) WRP areas. It was conducted by DES, in consultation with the three former-Natural Resource Management groups of the region – Condamine Alliance, Queensland Murray-Darling Committee and South West NRM Ltd – which have now combined to become Southern Queensland NRM. Section 6 of the EPP Water states that in the absence of environmental values included in Schedule 1 of the EPP Water, the full list of environmental values applies to a region. The full set of environmental values was considered for the water quality risk assessment. This means that the impact of water quality degradation on aquatic ecosystems, irrigation, stock watering, recreation and other key values were included in the assessment.

Following the identification of EVs, local WQOs for receiving waters are developed for each catchment area, under base and high flow conditions where possible. WQOs set a numerical value for key water quality indicators, setting the benchmark that is required to achieve the protection of the EVs over time. These WQOs are also scheduled under the EPP Water alongside EVs to inform planning and decision-making. Local WQOs have been developed by DES for QMDB WRP areas, in consultation with Department of Natural Resources, Mines and Energy (DNRME) and key stakeholders.

Under section 10.29 of the Basin Plan, a water resource plan is to include a Water Quality Management Plan. The Queensland Government established that the HWMPs developed under the EPP Water will be aligned with the requirements for a Water Quality Management Plan under the Basin Plan.

Aquatic ecosystem
- The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways, waterholes and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, yellowbelly, cod and yabbies) and their habitat, food and drinking water.

Irrigation
- Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.

Farm water supply/use
- Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.

Stock watering
- Suitability of water supply for production of healthy livestock.

Aquaculture
- Health of aquaculture species and humans consuming aquatic foods (such as fish and prawns) from commercial ventures.

Human consumers of aquatic foods
- Health of humans consuming aquatic foods, such as fish and prawns, from natural waterways.

Primary recreation
- Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, diving and water-skiing.

Secondary recreation
- Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing.

Visual recreation
- Amenity of waterways for recreation which does not involve contact with water. For example, walking and picnicking adjacent to a waterway.

Drinking water supply
- Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection.

Industrial use
- Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.

Cultural, spiritual and ceremonial values
- Cultural, spiritual and ceremonial values of water means its aesthetic, historical, scientific, social or other significance, to the past, present or future generations.

Figure 1: Environmental values under the Environmental Protection (Water) Policy 2009

Chapter 10, Part 9 of the Basin Plan describes the approaches to addressing risks to water resources to be included in a water resource plan. In accordance with section 10.41(7) of the Basin Plan, the water resource plan must describe the data and methods used to identify and assess risks.

The focus of the risk assessment methodology detailed in this section is on risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable for use (water quality risk assessment).

Approach

The water quality risk assessment was conducted in line with the approach used by the Department of Natural Resources, Mines and Energy (DNRME) to conduct the risk assessment for water use. This approach is consistent with the AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines. It is also consistent with the National Water Initiative Policy Guidelines for Water Planning and Management—Risk Assessment Module developed by the Department of Sustainability, Environment, Water, Population and Communities. The risk management process follows 6 steps in a cycle, as detailed below and summarised in **Figure 2**.

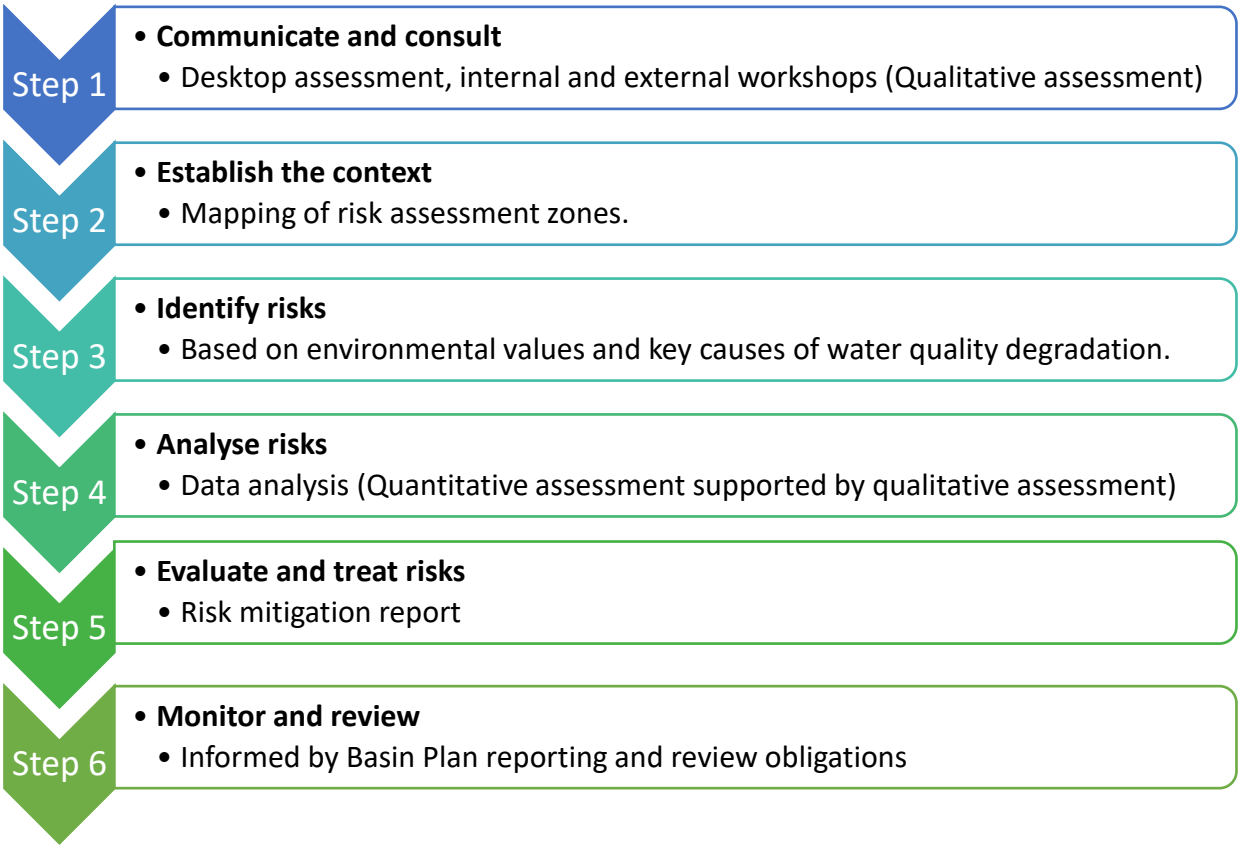

Figure 2: Summary of the approach used for the water quality risk assessment

Step 1: Communicate and consult

The following process was designed to ensure appropriate communication and consultation with internal and external stakeholders—

- preliminary desktop assessment of known risks and preparation of the risk assessment template.
- conduct an internal workshop to further identify and analyse risks featuring a panel of experts from across Queensland Government departments, with knowledge of the local area.
- present outcomes of the risk assessment process to external stakeholders with the Department of Natural Resources and Mines and the Department of Science, Information Technology and Innovation at a range of workshops across Queensland Murray-Darling Basin catchments.
- continue to obtain external feedback on the risk assessment through the development of the HWMP.

Step 2: Establish the context

For each Queensland Murray-Darling Basin WRP area, the assessment of surface water quality risks was based on groupings of several water type zones. These zones are displayed in **Figure 3.** This grouping allowed for a more manageable scale of assessment at the risk workshops. The Queensland Water Quality Guidelines 2009 states that the aim of defining water types is to create groupings within which water quality (or biological condition) is sufficiently consistent that a single guideline value can be applied to all waters within each water type. Water types are developed through expert opinion of soil type, geology, topography and rainfall, in addition to water quality data. The assessment of groundwater quality risks was based on the Groundwater and Deep Groundwater SDL resource units published by the Murray-Darling Basin Authority.

Step 3: Identify risks

This step describes risks in terms of what can happen and the impact that can result. Risks were identified based on the 10-year life span of a water resource plan, as defined by the *Water Act 2000* and the Basin Plan.

The water quality risk assessment focussed on risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable for use. For the purpose of the water quality risk assessment, ‘use’ was taken to mean all the Environmental Values applicable in the plan area (Figure 1). Environmental values define the uses of water for a region by aquatic ecosystems and for human uses (e.g. drinking water, irrigation, aquaculture, recreation). Thus, the risk assessment assesses the risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable to protect the environmental values in the plan area.

Under section 10.41(2) of the Basin Plan, the risks are to include (where applicable) risks arising from elevated levels of salinity or other types of water quality degradation. The identification of risk factors was informed by the key causes of water quality degradation in Schedule 10 of the Basin Plan. These were included in the water quality risk assessment template.

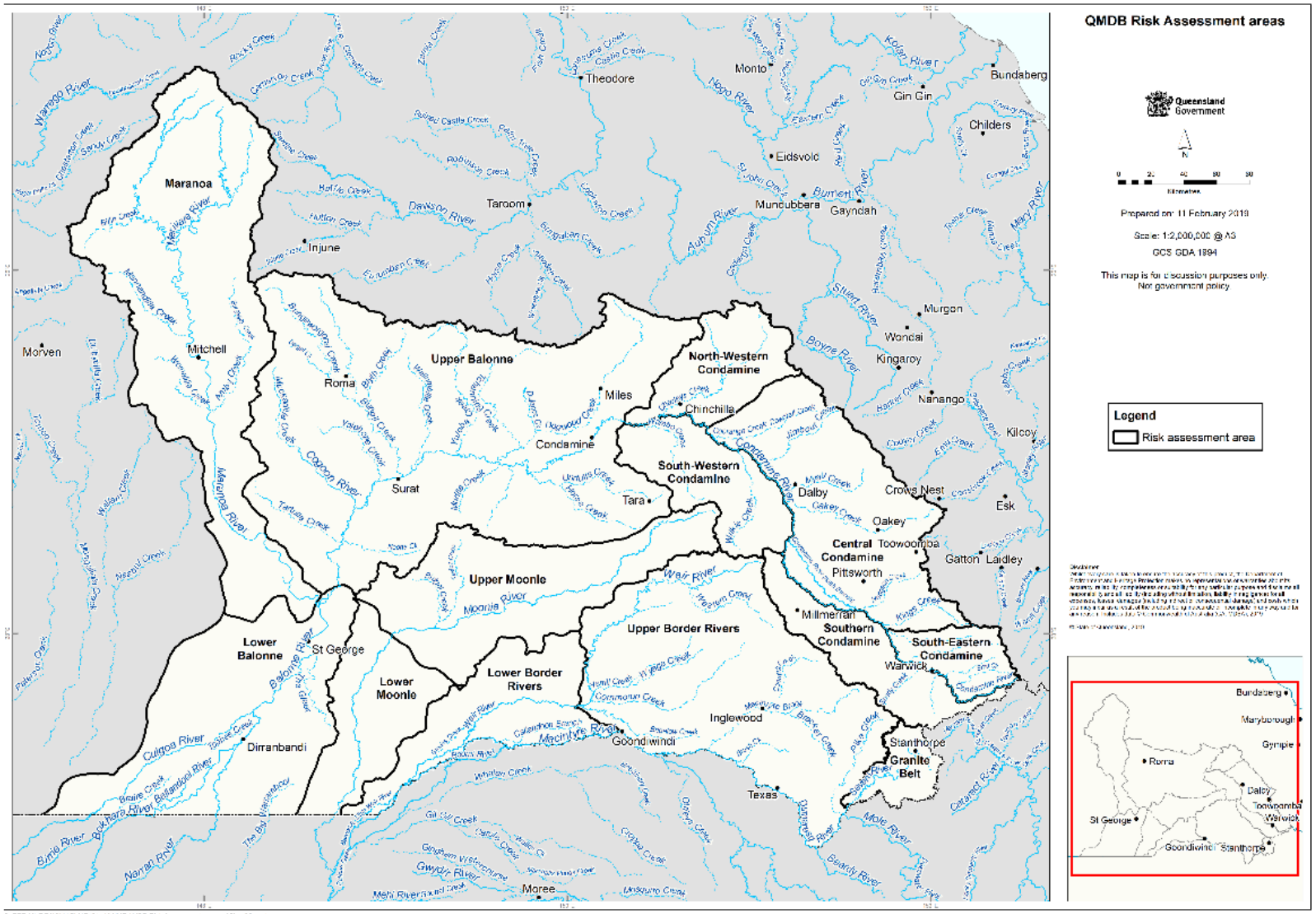

Figure 3: Surface water risk assessment units for the assessment of water quality in QMDB.

Step 4: Analyse risks

Each risk must be must be rated in terms of consequences and likelihood to establish the risk level (AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines). The Basin Plan does not specify detailed requirements for the risk assessment, such as a preferred risk analysis matrix. However, section 10.41(6) states that the level of risk, must be defined using the following categories—

- low
- medium
- high
- if it is considered appropriate, any additional category.

Section 10.42 of the Basin Plan specifies that a water resource plan must describe each risk identified as having a medium or higher risk and the factors that contribute to the risk.

Section 4.04 of the Basin Plan states that the Authority may publish guidelines setting out specific actions that may be taken in relation to the implementation of the strategies listed in subsection 4.03(3) to deal with the risks identified in section 4.02. These guidelines may include a specific risk assessment tool such as a risk analysis matrix; however, no such guidelines are currently available from the Murray-Darling Basin Authority. In the absence of specified guidelines, the existing risk analysis tools implemented by Queensland Government departments for water and aquatic ecosystems were utilised. This ensures consistency between the risk assessment approaches undertaken by DNRME and DES for the purpose of the Basin Plan accreditation package.

Defining consequence

Each consequence was categorised into ecological, economic and social/cultural impacts. Environmental values were grouped under each of these headings, as shown below:

Ecological:	Aquatic ecosystems
Economic:	Irrigation, stock watering, aquaculture, farm use/supply, industry, human consumption and drinking water
Social/cultural:	Cultural and spiritual values, primary recreation, secondary recreation and visual amenity.

Note 1: For a risk to be assigned a given consequence it should reflect the situations described for each of the respective categories. However, where more than one impact category is relevant, the category with the highest consequences was selected in order to determine a single consequence level for the particular risk.

Note 2: Cultural and spiritual values, of water, means its aesthetic, historical, scientific, social or other significance, to the present, past or future generations in the general community. Cultural, spiritual and ceremonial values and uses for people from the Aboriginal Nations of the QMDB are being determined through specific workshops. These workshops will also identify risks to cultural, spiritual and ceremonial values and uses raised by participants of each Nation. This information will be summarised through a separate report.

Refer to **Table 1** for a description of each consequence and its associated impacts.

TABLE 1: **DEFINING CONSEQUENCES**

Consequence	Environmental impacts	Economic impacts	Social/cultural impacts	Score
Insignificant	Impact on aquatic environmental values is negligible/undetectable	Minimal or no financial losses.	Minimal or no impact on cultural and spiritual values, recreational values and amenity.	1
Minor	Minimal detectable impact on environmental value, minor reduction in population size and community structure, change in food resource availability, recovery likely within a short time frame,	Financial loss requiring some reprioritisation and/or restructuring of business.	Minor impact on cultural and spiritual values, recreational values and amenity.	2
Moderate	Obvious and significant impacts on environmental value, change in community structure (loss of sensitive species), moderate habitat disturbance and loss, recovery possible within years.	Significant individual financial loss with minimal community level impact.	Moderate impact on cultural and spiritual values or a vital community resource, recreational values and amenity.	3
Major	Significant spatial and temporal impact on environmental values , changes to long-term recruitment processes possibly leading to local extinction of one or more populations, loss of sensitive species, major changes in food resources and food webs, major habitat loss.	Major financial loss with severe individual and some community level impact.	Major disturbances to significant cultural and spiritual values, recreational values and amenity. Access to resource denied, or vital community resource unavailable, in the medium to long-term.	4
Catastrophic	Extreme and widespread impacts – loss of species, dramatic changes to communities and ecosystem functions, replaced with generalists, exotic biota, and extensive loss of habitat.	Disastrous long-term financial loss with severe individual and community level impact.	Major disturbances to significant cultural and spiritual values, recreational values and amenity. The site or vital community resource permanently affected.	5

Defining likelihood

The likelihood (chance of something happening) table is consistent with risk assessments conducted by both DNRME and DES. **Table 2** identifies the likelihood categories and their definitions.

The risks to water quality were identified by statistical analysis of water quality data for waters of the Condamine-Balonne, Moonie and Queensland Border Rivers. The statistical analysis assessed the likelihood of water in a defined area exceeding the water quality guideline for that use of water. For example, the likelihood that waters in the Upper Balonne exceed the salinity water quality guideline value for aquaculture was determined to inform the likelihood score. This process was conducted for each Environmental Value in each risk assessment spatial unit. Where relevant, EVs of similar type were combined, allowing the assessment of risks to water quality for each environmental value to be streamlined. The EVs that were combined are:

- Recreation:
  - Primary recreation
  - Secondary recreation
  - Visual recreation
- Consumption of aquatic food:
  - Aquaculture
  - Human consumers of aquatic foods
- Agriculture:
  - Irrigation
  - Stock watering
  - Farm water supply

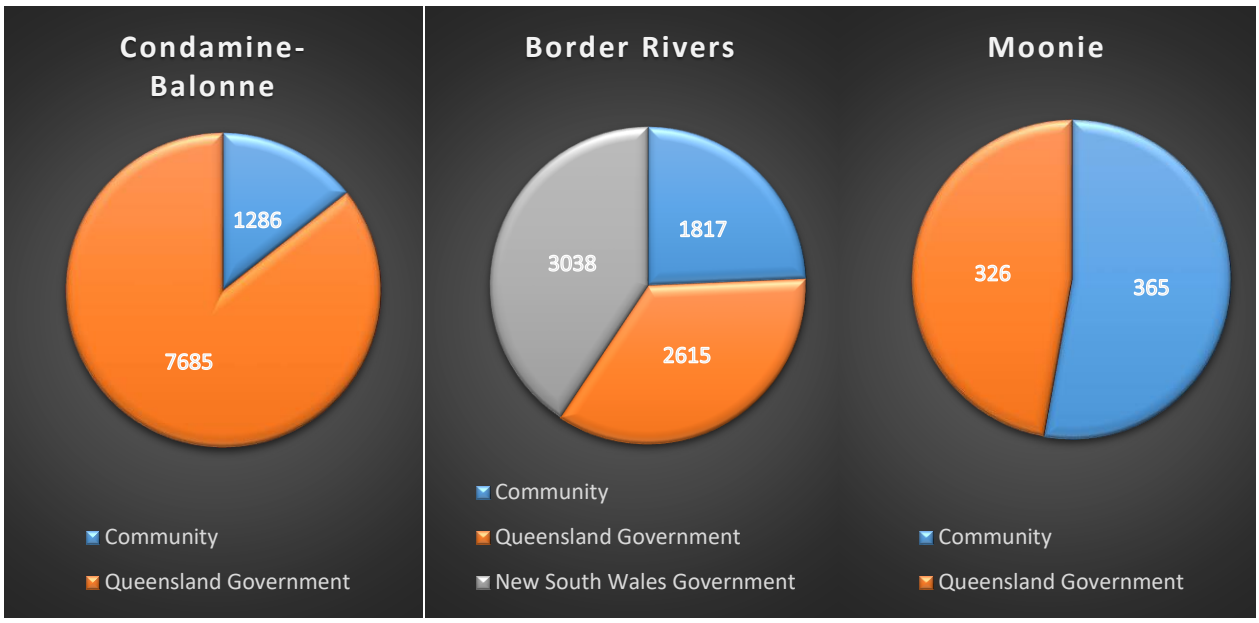

Figure 4: Quantity of data analysed for the assessment of likelihood of risks occurring for the Condamine-Balonne, Border Rivers and Moonie basins, broken down by data source.

The water quality data was sourced from the Queensland Government's water quality database, as well as from local water quality monitoring programs including those conducted by natural resource management and industry groups. The water quality database is a highly comprehensive historical record of water quality for this area. Figure 4 displays the amount of data analysed during the assessment of the likelihood of risks occurring for each of the WRP areas, broken down into sources of data. The large quantity of data used in the analysis, which ranged from 1952-2016, shows the rigour behind this risk assessment process. The statistical analysis supported the qualitative information provided by participants at the risk assessment workshops, as well as highlighting additional risks not previously identified.

***TABLE 2:* LIKELIHOOD TABLE**

Likelihood categories	Definition	Score
Rare	Occurs only in exceptional circumstances (occurrence probability < 15%)	1
Unlikely	Uncommon, could occur but not expected (occurrence probability 15–34%)	2
Possible	Could occur in the assessment area (occurrence probability 35–64%)	3
Likely	Will probably occur in most circumstances (occurrence probability 65–84%)	4
Almost certain	Is expected to occur in most circumstances – will be evident throughout the assessment area (occurrence probability > 85%)	5

Level of risk

The level of risk is determined using the definitions identified in the consequence and likelihood tables and the matrix shown in **Table 3**. The AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines states the following:

- consequences may be expressed qualitatively or quantitatively,
- the risk can escalate though knock-on effects
- likelihood can be defined, measured or determined objectively or subjectively, qualitatively or quantitatively and described using general terms or mathematically.

TABLE 3: **CONSEQUENCE AND LIKELIHOOD SCORING**

		Consequence				
Likelihood		Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Rare	1	1	2	3	4	5
Unlikely	2	2	4	6	8	10
Possible	3	3	6	9	12	15
Likely	4	4	8	12	16	20
Almost certain	5	5	10	15	20	25

Based on table 3, the level of risk is categorised into low, medium, high or very high as per the scoring in **Table 4**.

TABLE 4: **LEVEL OF RISK**

Risk ranking	Scores
High	12–25
Medium	8–11
Low	1–7

As per section 10.43 of the Basin Plan, any risk identified as medium or above must be addressed by management strategies within a water resource plan. The exception to this is if it can be explained why the risk cannot be addressed by the water resource plan in a manner commensurate with the level of risk. It is important therefore to clearly explain why a risk would be considered low and therefore tolerable without need for mitigation measures. The following is an explanation of the reasoning behind the 'low' level of risk identified in Table 4.

- Any risk that has a consequence of insignificant is considered a low risk because the consequences of the event occurring, irrespective of the likelihood of occurrence, would have undetectable impacts (refer to Table 1).
- A risk that has a consequence of minor and a likelihood of possible or less is considered a low risk because even if the event were to occur the consequences of the event are minimal and are recoverable in the short-term. This reasoning also applies to a risk that has a consequence of moderate but a likelihood of unlikely.
- A risk that has a likelihood of rare is ranked as low because it is only likely to occur in exceptional circumstances. The water resource plan accreditation package will include measures to manage extreme events, as required under section 10.51 of the Basin Plan.

Uncertainty rating for level of risk

In accordance with section 10.41(8) of the Basin Plan, the risk assessment must describe any quantified uncertainty in the level of risk attributed to each risk. To do so, an uncertainty score for each risk was assigned as per **Table 5** (based on the approach used by DNRME and DES). Uncertainty scoring was applied to both the likelihood and consequence ranking.

TABLE 5: **UNCERTAINTY SCORES**

Category	Definition	Score
High	Inferred, very little evidence; some information known but not directly relevant to the region	1
Medium	Have some confidence in the score based on local knowledge but this may be limited	2
Low	Adequate high-quality evidence to support scores; process has been documented at a local or regional scale	3

Step 5: Evaluate and treat risks

This step determines which risks require treatment or whether the risk can be tolerated without treatment.

Options are identified to treat intolerable risks and ensure the most appropriate treatment/s for reducing the level of risk is implemented.

Section 10.43 of the Basin Plan states that if the level of risk is medium or higher, the water resource plan must either—

- describe a strategy for the management of the water resources of the water resource plan area that will address the risk, in a manner commensurate with the level of risk; or
- explain why the risk cannot be addressed by the water resource plan in a manner commensurate with the level of risk.

In addition, section 10.31 of the Basin Plan applies to the preparation of a Water Quality Management Plan. If any kind of risk (low, medium or high) has been identified in relation to elevated levels of salinity or other types of water quality degradation, the Water Quality Management Plan must explain why measures addressing the risk have or have not been included in the water resource plan.

For the purposes of the accreditation package, the index will direct the reader to the various instruments that make up the water resource plan as defined under section 10.04 of the Basin Plan. The instruments will include measures and strategies to address risks.

Step 6: Monitor and review

Section 10.46 of the Basin Plan states that a water resource plan must specify the monitoring of the water resources of the water resource plan area that will be done to enable the Basin State to fulfil its reporting obligations under section 13.14. There will also be the opportunity for a formal review of water resource plans, including the Water Quality Management Plans, at five (5) and 10 year intervals under the Basin Plan.

Appendix 4— Persistent Waterholes in the Maranoa and Balonne

Source: Persistent Waterhole Classification – Ozius Spatial on behalf of Water Planning Ecology, Department of Science, Information Technology and Innovation, 2017.

Table 72: Persistent waterholes in the Maranoa and Balonne River basin.

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Hebel	-28.98203	147.6893
Maranoa Balonne Rivers	Hebel	-28.98122	147.6874
Maranoa Balonne Rivers	Hebel	-28.96898	147.7967
Maranoa Balonne Rivers	Hebel	-28.93752	147.7573
Maranoa Balonne Rivers	Hebel	-28.93699	147.7558
Maranoa Balonne Rivers	Hebel	-28.93673	147.7546
Maranoa Balonne Rivers	Hebel	-28.93657	147.7576
Maranoa Balonne Rivers	Hebel	-28.93291	147.7592
Maranoa Balonne Rivers	Hebel	-28.92393	147.7663
Maranoa Balonne Rivers	Hebel	-28.92311	147.7689
Maranoa Balonne Rivers	Dirranbandi	-28.92072	148.0779
Maranoa Balonne Rivers	Dirranbandi	-28.91949	148.0786
Maranoa Balonne Rivers	Dirranbandi	-28.91828	148.0788
Maranoa Balonne Rivers	Hebel	-28.90705	147.8288
Maranoa Balonne Rivers	Hebel	-28.89335	147.5573
Maranoa Balonne Rivers	Hebel	-28.8933	147.5518
Maranoa Balonne Rivers	Hebel	-28.86836	147.7301
Maranoa Balonne Rivers	Hebel	-28.84448	147.7751
Maranoa Balonne Rivers	Hebel	-28.84318	147.7773
Maranoa Balonne Rivers	Hebel	-28.84291	147.7779
Maranoa Balonne Rivers	Dirranbandi	-28.80646	148.0773
Maranoa Balonne Rivers	Dirranbandi	-28.80644	148.0798
Maranoa Balonne Rivers	Dirranbandi	-28.80617	148.0807
Maranoa Balonne Rivers	Dirranbandi	-28.80615	148.0826
Maranoa Balonne Rivers	Dirranbandi	-28.80534	148.0822
Maranoa Balonne Rivers	Dirranbandi	-28.80425	148.0828
Maranoa Balonne Rivers	Dirranbandi	-28.80424	148.0838
Maranoa Balonne Rivers	Dirranbandi	-28.8037	148.0844
Maranoa Balonne Rivers	Dirranbandi	-28.80261	148.0853
Maranoa Balonne Rivers	Dirranbandi	-28.80179	148.0865

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Dirranbandi	-28.80125	148.0862
Maranoa Balonne Rivers	Dirranbandi	-28.79361	147.626
Maranoa Balonne Rivers	Dirranbandi	-28.79252	147.6269
Maranoa Balonne Rivers	Dirranbandi	-28.79198	147.6275
Maranoa Balonne Rivers	Dirranbandi	-28.78343	147.6305
Maranoa Balonne Rivers	Dirranbandi	-28.78206	148.0811
Maranoa Balonne Rivers	Dirranbandi	-28.78194	147.6303
Maranoa Balonne Rivers	Dirranbandi	-28.78167	147.6311
Maranoa Balonne Rivers	Dirranbandi	-28.78058	147.6329
Maranoa Balonne Rivers	Dirranbandi	-28.78003	147.6336
Maranoa Balonne Rivers	Dirranbandi	-28.77895	147.6342
Maranoa Balonne Rivers	Dirranbandi	-28.7784	147.6345
Maranoa Balonne Rivers	Dirranbandi	-28.76058	148.0234
Maranoa Balonne Rivers	Dirranbandi	-28.75761	148.1246
Maranoa Balonne Rivers	Dirranbandi	-28.7219	148.0542
Maranoa Balonne Rivers	Dirranbandi	-28.7183	148.0644
Maranoa Balonne Rivers	Dirranbandi	-28.69735	148.1742
Maranoa Balonne Rivers	Dirranbandi	-28.66398	148.1821
Maranoa Balonne Rivers	Dirranbandi	-28.65362	148.1903
Maranoa Balonne Rivers	Dirranbandi	-28.65361	148.1918
Maranoa Balonne Rivers	Dirranbandi	-28.64312	148.0867
Maranoa Balonne Rivers	Dirranbandi	-28.64284	148.0873
Maranoa Balonne Rivers	Dirranbandi	-28.64256	148.0881
Maranoa Balonne Rivers	Dirranbandi	-28.61744	148.2098
Maranoa Balonne Rivers	Dirranbandi	-28.61479	148.2033
Maranoa Balonne Rivers	Dirranbandi	-28.61398	148.2024
Maranoa Balonne Rivers	Dirranbandi	-28.61289	148.203
Maranoa Balonne Rivers	Dirranbandi	-28.61128	148.2014
Maranoa Balonne Rivers	Dirranbandi	-28.61059	148.0032
Maranoa Balonne Rivers	Dirranbandi	-28.60991	148.0035
Maranoa Balonne Rivers	Dirranbandi	-28.60867	148.0069
Maranoa Balonne Rivers	Dirranbandi	-28.60776	148.2014
Maranoa Balonne Rivers	Dirranbandi	-28.60744	148.0077
Maranoa Balonne Rivers	Dirranbandi	-28.60641	148.2014

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Dirranbandi	-28.60608	148.0266
Maranoa Balonne Rivers	Dirranbandi	-28.60548	148.0164
Maranoa Balonne Rivers	Dirranbandi	-28.60499	148.0096
Maranoa Balonne Rivers	Dirranbandi	-28.60485	148.0292
Maranoa Balonne Rivers	Dirranbandi	-28.60445	148.0099
Maranoa Balonne Rivers	Dirranbandi	-28.60426	148.0351
Maranoa Balonne Rivers	Dirranbandi	-28.60425	148.2007
Maranoa Balonne Rivers	Dirranbandi	-28.60404	148.0283
Maranoa Balonne Rivers	Dirranbandi	-28.6038	148.0246
Maranoa Balonne Rivers	Dirranbandi	-28.60371	148.036
Maranoa Balonne Rivers	Dirranbandi	-28.60361	148.013
Maranoa Balonne Rivers	Dirranbandi	-28.60336	148.0105
Maranoa Balonne Rivers	Dirranbandi	-28.60208	148.2007
Maranoa Balonne Rivers	Dirranbandi	-28.60176	148.2072
Maranoa Balonne Rivers	Dirranbandi	-28.60152	148.203
Maranoa Balonne Rivers	Dirranbandi	-28.6015	148.205
Maranoa Balonne Rivers	Dirranbandi	-28.59661	148.2075
Maranoa Balonne Rivers	Dirranbandi	-28.59597	148.0572
Maranoa Balonne Rivers	Dirranbandi	-28.59491	148.0543
Maranoa Balonne Rivers	Dirranbandi	-28.59487	148.0586
Maranoa Balonne Rivers	Dirranbandi	-28.59366	148.2041
Maranoa Balonne Rivers	Dirranbandi	-28.59066	148.2061
Maranoa Balonne Rivers	Dirranbandi	-28.58906	148.2038
Maranoa Balonne Rivers	Dirranbandi	-28.58743	148.0579
Maranoa Balonne Rivers	Dirranbandi	-28.58569	148.2018
Maranoa Balonne Rivers	Dirranbandi	-28.57968	148.0627
Maranoa Balonne Rivers	Dirranbandi	-28.57835	148.2055
Maranoa Balonne Rivers	Dirranbandi	-28.57426	148.2239
Maranoa Balonne Rivers	Dirranbandi	-28.57301	148.2124
Maranoa Balonne Rivers	Dirranbandi	-28.57293	148.2207
Maranoa Balonne Rivers	Dirranbandi	-28.57215	148.2168
Maranoa Balonne Rivers	Dirranbandi	-28.57181	148.2255
Maranoa Balonne Rivers	Dirranbandi	-28.57125	148.2266
Maranoa Balonne Rivers	Dirranbandi	-28.57072	148.2288

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Dirranbandi	-28.57013	148.2315
Maranoa Balonne Rivers	Dirranbandi	-28.57013	148.2335
Maranoa Balonne Rivers	Dirranbandi	-28.56929	148.2344
Maranoa Balonne Rivers	Dirranbandi	-28.56631	148.2341
Maranoa Balonne Rivers	Dirranbandi	-28.56333	148.2347
Maranoa Balonne Rivers	Dirranbandi	-28.56221	148.2384
Maranoa Balonne Rivers	Dirranbandi	-28.55891	148.2444
Maranoa Balonne Rivers	Dirranbandi	-28.55865	148.243
Maranoa Balonne Rivers	Dirranbandi	-28.55712	148.2475
Maranoa Balonne Rivers	Dirranbandi	-28.54696	148.2479
Maranoa Balonne Rivers	Dirranbandi	-28.54502	148.2528
Maranoa Balonne Rivers	Dirranbandi	-28.5438	148.2534
Maranoa Balonne Rivers	Dirranbandi	-28.54271	148.2537
Maranoa Balonne Rivers	Dirranbandi	-28.53357	148.2613
Maranoa Balonne Rivers	Dirranbandi	-28.533	148.0764
Maranoa Balonne Rivers	Dirranbandi	-28.53276	148.261
Maranoa Balonne Rivers	Dirranbandi	-28.53127	148.261
Maranoa Balonne Rivers	Dirranbandi	-28.52544	148.2619
Maranoa Balonne Rivers	Dirranbandi	-28.43299	148.2754
Maranoa Balonne Rivers	St George	-28.42503	148.2686
Maranoa Balonne Rivers	St George	-28.42248	148.2699
Maranoa Balonne Rivers	St George	-28.42111	148.2715
Maranoa Balonne Rivers	St George	-28.41973	148.2738
Maranoa Balonne Rivers	St George	-28.4185	148.2754
Maranoa Balonne Rivers	St George	-28.41781	148.2764
Maranoa Balonne Rivers	St George	-28.41753	148.2775
Maranoa Balonne Rivers	St George	-28.41725	148.2786
Maranoa Balonne Rivers	St George	-28.41516	148.2847
Maranoa Balonne Rivers	St George	-28.4133	148.2865
Maranoa Balonne Rivers	St George	-28.40859	148.2922
Maranoa Balonne Rivers	St George	-28.40174	148.3007
Maranoa Balonne Rivers	St George	-28.39611	148.3095
Maranoa Balonne Rivers	St George	-28.39448	148.3104
Maranoa Balonne Rivers	St George	-28.39366	148.3111

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	St George	-28.38947	148.3172
Maranoa Balonne Rivers	St George	-28.38873	148.3171
Maranoa Balonne Rivers	St George	-28.38574	148.3181
Maranoa Balonne Rivers	St George	-28.3841	148.3198
Maranoa Balonne Rivers	St George	-28.32789	148.3901
Maranoa Balonne Rivers	St George	-28.28996	148.419
Maranoa Balonne Rivers	St George	-28.27757	148.4518
Maranoa Balonne Rivers	St George	-28.24282	148.4722
Maranoa Balonne Rivers	St George	-28.2401	148.4733
Maranoa Balonne Rivers	St George	-28.22937	148.4899
Maranoa Balonne Rivers	St George	-28.22933	148.4934
Maranoa Balonne Rivers	St George	-28.22932	148.494
Maranoa Balonne Rivers	St George	-28.22927	148.4983
Maranoa Balonne Rivers	St George	-28.22897	148.5012
Maranoa Balonne Rivers	St George	-28.22883	148.5019
Maranoa Balonne Rivers	St George	-28.22868	148.5029
Maranoa Balonne Rivers	St George	-28.22852	148.505
Maranoa Balonne Rivers	St George	-28.22657	148.5101
Maranoa Balonne Rivers	St George	-28.22602	148.5112
Maranoa Balonne Rivers	St George	-28.2245	148.514
Maranoa Balonne Rivers	St George	-28.18328	148.5193
Maranoa Balonne Rivers	St George	-28.15613	148.5266
Maranoa Balonne Rivers	St George	-28.15455	148.5278
Maranoa Balonne Rivers	St George	-28.15225	148.5296
Maranoa Balonne Rivers	St George	-28.15121	148.5302
Maranoa Balonne Rivers	St George	-28.13505	148.5706
Maranoa Balonne Rivers	St George	-28.1348	148.5693
Maranoa Balonne Rivers	St George	-28.13471	148.5563
Maranoa Balonne Rivers	St George	-28.13433	148.5623
Maranoa Balonne Rivers	St George	-28.13279	148.5788
Maranoa Balonne Rivers	St George	-28.12671	148.5778
Maranoa Balonne Rivers	St George	-28.12575	148.5791
Maranoa Balonne Rivers	St George	-28.12519	148.5805
Maranoa Balonne Rivers	St George	-28.11822	148.5981

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	St George	-28.11643	148.6013
Maranoa Balonne Rivers	St George	-28.1136	148.6057
Maranoa Balonne Rivers	St George	-28.10396	148.6133
Maranoa Balonne Rivers	St George	-28.09535	148.6222
Maranoa Balonne Rivers	St George	-28.08696	148.5375
Maranoa Balonne Rivers	St George	-28.08506	148.6086
Maranoa Balonne Rivers	St George	-28.08333	148.618
Maranoa Balonne Rivers	St George	-28.08251	148.5952
Maranoa Balonne Rivers	St George	-28.07745	148.5819
Maranoa Balonne Rivers	St George	-28.07646	148.5801
Maranoa Balonne Rivers	St George	-28.07645	148.5808
Maranoa Balonne Rivers	St George	-28.07486	148.5783
Maranoa Balonne Rivers	St George	-28.07287	148.5749
Maranoa Balonne Rivers	St George	-28.07042	148.5709
Maranoa Balonne Rivers	St George	-28.06532	148.5649
Maranoa Balonne Rivers	St George	-28.05597	148.5625
Maranoa Balonne Rivers	St George	-28.03593	148.5725
Maranoa Balonne Rivers	St George	-28.03485	148.5728
Maranoa Balonne Rivers	St George	-28.02364	148.5938
Maranoa Balonne Rivers	St George	-28.00411	148.6315
Maranoa Balonne Rivers	St George	-27.98181	148.6623
Maranoa Balonne Rivers	St George	-27.96591	148.678
Maranoa Balonne Rivers	St George	-27.96396	148.683
Maranoa Balonne Rivers	St George	-27.96127	148.6815
Maranoa Balonne Rivers	St George	-27.95531	148.6814
Maranoa Balonne Rivers	St George	-27.94996	148.6758
Maranoa Balonne Rivers	St George	-27.94001	148.4815
Maranoa Balonne Rivers	St George	-27.93807	148.674
Maranoa Balonne Rivers	St George	-27.92762	148.6653
Maranoa Balonne Rivers	St George	-27.90064	148.6464
Maranoa Balonne Rivers	St George	-27.89666	148.6402
Maranoa Balonne Rivers	St George	-27.8326	148.6443
Maranoa Balonne Rivers	St George	-27.83193	148.6636
Maranoa Balonne Rivers	St George	-27.83084	148.6389

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	St George	-27.81132	148.5857
Maranoa Balonne Rivers	St George	-27.81106	148.5845
Maranoa Balonne Rivers	St George	-27.81072	148.5908
Maranoa Balonne Rivers	St George	-27.80944	148.6646
Maranoa Balonne Rivers	St George	-27.80704	148.5814
Maranoa Balonne Rivers	St George	-27.80662	148.6054
Maranoa Balonne Rivers	St George	-27.80525	148.6082
Maranoa Balonne Rivers	St George	-27.80488	148.5804
Maranoa Balonne Rivers	St George	-27.80334	148.6107
Maranoa Balonne Rivers	St George	-27.80141	148.6111
Maranoa Balonne Rivers	St George	-27.79937	148.6117
Maranoa Balonne Rivers	St George	-27.79883	148.612
Maranoa Balonne Rivers	St George	-27.79761	148.6123
Maranoa Balonne Rivers	St George	-27.79584	148.6132
Maranoa Balonne Rivers	St George	-27.79366	148.6139
Maranoa Balonne Rivers	St George	-27.79066	148.6166
Maranoa Balonne Rivers	St George	-27.78881	148.6802
Maranoa Balonne Rivers	St George	-27.78327	148.6848
Maranoa Balonne Rivers	St George	-27.76578	148.7144
Maranoa Balonne Rivers	St George	-27.76417	148.7133
Maranoa Balonne Rivers	St George	-27.76303	148.7073
Maranoa Balonne Rivers	St George	-27.75722	148.7173
Maranoa Balonne Rivers	St George	-27.7553	148.7188
Maranoa Balonne Rivers	St George	-27.75394	148.7194
Maranoa Balonne Rivers	St George	-27.75299	148.7197
Maranoa Balonne Rivers	St George	-27.7519	148.7203
Maranoa Balonne Rivers	St George	-27.75067	148.7215
Maranoa Balonne Rivers	St George	-27.74985	148.7217
Maranoa Balonne Rivers	St George	-27.74499	148.7316
Maranoa Balonne Rivers	St George	-27.7448	148.736
Maranoa Balonne Rivers	St George	-27.74452	148.7367
Maranoa Balonne Rivers	St George	-27.74424	148.7376
Maranoa Balonne Rivers	St George	-27.74402	148.7335
Maranoa Balonne Rivers	St George	-27.74395	148.7387

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	St George	-27.74367	148.7397
Maranoa Balonne Rivers	St George	-27.72825	148.7171
Maranoa Balonne Rivers	St George	-27.72796	148.7184
Maranoa Balonne Rivers	St George	-27.72768	148.719
Maranoa Balonne Rivers	St George	-27.72741	148.7196
Maranoa Balonne Rivers	St George	-27.70947	148.7353
Maranoa Balonne Rivers	St George	-27.69275	148.7413
Maranoa Balonne Rivers	St George	-27.69083	148.7433
Maranoa Balonne Rivers	St George	-27.69028	148.7436
Maranoa Balonne Rivers	St George	-27.68746	148.7417
Maranoa Balonne Rivers	Wycombe	-27.6442	148.74
Maranoa Balonne Rivers	St George	-27.64076	148.741
Maranoa Balonne Rivers	St George	-27.61853	148.733
Maranoa Balonne Rivers	St George	-27.61705	148.7321
Maranoa Balonne Rivers	St George	-27.61544	148.7309
Maranoa Balonne Rivers	Wycombe	-27.61342	148.7296
Maranoa Balonne Rivers	St George	-27.61071	148.7305
Maranoa Balonne Rivers	St George	-27.60687	148.7298
Maranoa Balonne Rivers	Wycombe	-27.60423	148.7289
Maranoa Balonne Rivers	Wycombe	-27.60397	148.7167
Maranoa Balonne Rivers	Wycombe	-27.6036	148.7029
Maranoa Balonne Rivers	Wycombe	-27.60231	148.7202
Maranoa Balonne Rivers	Wycombe	-27.60147	148.7222
Maranoa Balonne Rivers	St George	-27.60118	148.7234
Maranoa Balonne Rivers	Wycombe	-27.60114	148.7264
Maranoa Balonne Rivers	Wycombe	-27.6009	148.7243
Maranoa Balonne Rivers	Wycombe	-27.60089	148.7253
Maranoa Balonne Rivers	Wycombe	-27.59406	148.6974
Maranoa Balonne Rivers	Wycombe	-27.59097	148.6953
Maranoa Balonne Rivers	Wycombe	-27.58936	148.694
Maranoa Balonne Rivers	Wycombe	-27.58726	148.6888
Maranoa Balonne Rivers	Wycombe	-27.58725	148.6897
Maranoa Balonne Rivers	Wycombe	-27.58701	148.6873
Maranoa Balonne Rivers	Wycombe	-27.58696	148.6909

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Wycombe	-27.58675	148.6862
Maranoa Balonne Rivers	Wycombe	-27.58667	148.6924
Maranoa Balonne Rivers	Wycombe	-27.58595	148.6848
Maranoa Balonne Rivers	Wycombe	-27.58515	148.6836
Maranoa Balonne Rivers	Wycombe	-27.58408	148.6827
Maranoa Balonne Rivers	Wycombe	-27.58112	148.6817
Maranoa Balonne Rivers	Wycombe	-27.5799	148.6817
Maranoa Balonne Rivers	Wycombe	-27.57855	148.6814
Maranoa Balonne Rivers	Wycombe	-27.57747	148.6811
Maranoa Balonne Rivers	Wycombe	-27.57666	148.6807
Maranoa Balonne Rivers	Wycombe	-27.57572	148.6804
Maranoa Balonne Rivers	Wycombe	-27.57356	148.6798
Maranoa Balonne Rivers	Wycombe	-27.57347	148.4203
Maranoa Balonne Rivers	Wycombe	-27.55691	148.6906
Maranoa Balonne Rivers	Wycombe	-27.55665	148.6896
Maranoa Balonne Rivers	Wycombe	-27.55658	148.6953
Maranoa Balonne Rivers	Wycombe	-27.55613	148.688
Maranoa Balonne Rivers	Wycombe	-27.55533	148.6868
Maranoa Balonne Rivers	Wellesley	-27.55461	148.7014
Maranoa Balonne Rivers	Wycombe	-27.55454	148.685
Maranoa Balonne Rivers	Wycombe	-27.55428	148.6841
Maranoa Balonne Rivers	Wycombe	-27.55406	148.7023
Maranoa Balonne Rivers	Wellesley	-27.55378	148.7029
Maranoa Balonne Rivers	Wycombe	-27.55296	148.7038
Maranoa Balonne Rivers	Wellesley	-27.55192	148.9474
Maranoa Balonne Rivers	Wycombe	-27.55186	148.705
Maranoa Balonne Rivers	Wellesley	-27.55164	148.9483
Maranoa Balonne Rivers	Wellesley	-27.55135	148.9494
Maranoa Balonne Rivers	Wellesley	-27.55105	148.9518
Maranoa Balonne Rivers	Wycombe	-27.54823	148.7098
Maranoa Balonne Rivers	Wellesley	-27.54195	148.7179
Maranoa Balonne Rivers	Wellesley	-27.53984	148.9208
Maranoa Balonne Rivers	Begonia	-27.53635	148.3548
Maranoa Balonne Rivers	Parknook	-27.48055	149.134

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Hannaford	-27.48037	150.1066
Maranoa Balonne Rivers	Hannaford	-27.47424	149.9464
Maranoa Balonne Rivers	Hannaford	-27.47029	150.0204
Maranoa Balonne Rivers	Meandarra	-27.4511	149.7666
Maranoa Balonne Rivers	Meandarra	-27.44552	149.902
Maranoa Balonne Rivers	Hannaford	-27.44181	149.9551
Maranoa Balonne Rivers	Wycombe	-27.44165	148.7706
Maranoa Balonne Rivers	Wellesley	-27.40721	148.8274
Maranoa Balonne Rivers	Wellesley	-27.40573	148.8262
Maranoa Balonne Rivers	Wellesley	-27.40469	148.8232
Maranoa Balonne Rivers	Wellesley	-27.40418	148.8204
Maranoa Balonne Rivers	Wellesley	-27.39868	148.8167
Maranoa Balonne Rivers	Wellesley	-27.39644	148.8121
Maranoa Balonne Rivers	Teelba	-27.39392	149.4097
Maranoa Balonne Rivers	The Gums	-27.38848	150.24
Maranoa Balonne Rivers	Wellesley	-27.3834	148.8153
Maranoa Balonne Rivers	The Gums	-27.37923	150.2037
Maranoa Balonne Rivers	The Gums	-27.3776	150.1832
Maranoa Balonne Rivers	Wellesley	-27.3764	148.8231
Maranoa Balonne Rivers	Hannaford	-27.37432	150.1156
Maranoa Balonne Rivers	The Gums	-27.37416	150.1737
Maranoa Balonne Rivers	Wellesley	-27.37057	148.8253
Maranoa Balonne Rivers	Glenmorgan	-27.36982	149.6477
Maranoa Balonne Rivers	The Gums	-27.36695	150.1519
Maranoa Balonne Rivers	Hannaford	-27.36346	150.1138
Maranoa Balonne Rivers	Glenmorgan	-27.33813	149.6805
Maranoa Balonne Rivers	Glenmorgan	-27.33389	149.5613
Maranoa Balonne Rivers	Glenmorgan	-27.32882	149.5423
Maranoa Balonne Rivers	Glenmorgan	-27.32829	149.5427
Maranoa Balonne Rivers	Glenmorgan	-27.31901	149.554
Maranoa Balonne Rivers	Wellesley	-27.31284	148.8485
Maranoa Balonne Rivers	Weribone	-27.3126	148.8465
Maranoa Balonne Rivers	Weribone	-27.31255	148.8498
Maranoa Balonne Rivers	Weribone	-27.31199	148.8515

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Wellesley	-27.3118	148.845
Maranoa Balonne Rivers	Weribone	-27.31087	148.854
Maranoa Balonne Rivers	Wellesley	-27.30993	148.8434
Maranoa Balonne Rivers	Wellesley	-27.30834	148.841
Maranoa Balonne Rivers	Wellesley	-27.30807	148.8402
Maranoa Balonne Rivers	Wellesley	-27.30782	148.8391
Maranoa Balonne Rivers	Wellesley	-27.3073	148.8374
Maranoa Balonne Rivers	Weribone	-27.3068	148.834
Maranoa Balonne Rivers	Parknook	-27.30662	149.2056
Maranoa Balonne Rivers	Glenmorgan	-27.30656	149.6842
Maranoa Balonne Rivers	Glenmorgan	-27.30627	149.6833
Maranoa Balonne Rivers	Glenmorgan	-27.30598	149.6827
Maranoa Balonne Rivers	Glenmorgan	-27.30595	149.6815
Maranoa Balonne Rivers	Glenmorgan	-27.30088	149.5393
Maranoa Balonne Rivers	Glenmorgan	-27.27805	149.5188
Maranoa Balonne Rivers	Tara	-27.27538	150.4636
Maranoa Balonne Rivers	Hannaford	-27.26908	150.0332
Maranoa Balonne Rivers	Wellesley	-27.26612	148.9003
Maranoa Balonne Rivers	Weribone	-27.26558	148.8997
Maranoa Balonne Rivers	Hannaford	-27.26421	150.0293
Maranoa Balonne Rivers	Parknook	-27.2607	149.2392
Maranoa Balonne Rivers	Parknook	-27.25973	149.2655
Maranoa Balonne Rivers	Hannaford	-27.25594	150.0069
Maranoa Balonne Rivers	Parknook	-27.24828	149.2954
Maranoa Balonne Rivers	Glenmorgan	-27.24812	149.6674
Maranoa Balonne Rivers	Parknook	-27.24642	149.2865
Maranoa Balonne Rivers	Hannaford	-27.23664	150.0002
Maranoa Balonne Rivers	Hannaford	-27.23408	149.9972
Maranoa Balonne Rivers	Hannaford	-27.23297	149.9959
Maranoa Balonne Rivers	Weribone	-27.23293	148.7673
Maranoa Balonne Rivers	Weribone	-27.23265	148.7682
Maranoa Balonne Rivers	Meandarra	-27.23053	149.8484
Maranoa Balonne Rivers	Wellesley	-27.22906	148.966
Maranoa Balonne Rivers	Noorindoo	-27.22696	149.4081

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Begonia	-27.22686	148.5479
Maranoa Balonne Rivers	Weribone	-27.22559	148.914
Maranoa Balonne Rivers	Glenmorgan	-27.22383	149.4981
Maranoa Balonne Rivers	Wellesley	-27.20381	148.9806
Maranoa Balonne Rivers	Wellesley	-27.20271	148.982
Maranoa Balonne Rivers	Wellesley	-27.20108	148.987
Maranoa Balonne Rivers	Glenmorgan	-27.20022	149.6614
Maranoa Balonne Rivers	Wellesley	-27.19928	148.9561
Maranoa Balonne Rivers	Wellesley	-27.19827	148.951
Maranoa Balonne Rivers	Wellesley	-27.19824	148.9533
Maranoa Balonne Rivers	Wellesley	-27.19815	148.9597
Maranoa Balonne Rivers	Wellesley	-27.19802	148.9496
Maranoa Balonne Rivers	Wellesley	-27.19786	148.9607
Maranoa Balonne Rivers	Wellesley	-27.19758	148.9615
Maranoa Balonne Rivers	Wellesley	-27.19749	148.9483
Maranoa Balonne Rivers	Wellesley	-27.1973	148.9621
Maranoa Balonne Rivers	Wellesley	-27.19639	148.9899
Maranoa Balonne Rivers	Wellesley	-27.1946	148.9905
Maranoa Balonne Rivers	Noorindoo	-27.19356	149.2811
Maranoa Balonne Rivers	Glenmorgan	-27.19127	149.7523
Maranoa Balonne Rivers	Meandarra	-27.18978	149.9509
Maranoa Balonne Rivers	Wellesley	-27.1883	148.9865
Maranoa Balonne Rivers	Meandarra	-27.18474	149.9435
Maranoa Balonne Rivers	Hannaford	-27.18198	150.083
Maranoa Balonne Rivers	Noorindoo	-27.17797	149.2987
Maranoa Balonne Rivers	Meandarra	-27.17416	149.8566
Maranoa Balonne Rivers	Meandarra	-27.17391	149.8575
Maranoa Balonne Rivers	Meandarra	-27.17282	149.8452
Maranoa Balonne Rivers	Meandarra	-27.17192	149.8594
Maranoa Balonne Rivers	Meandarra	-27.17116	149.8434
Maranoa Balonne Rivers	Meandarra	-27.17044	149.8597
Maranoa Balonne Rivers	Meandarra	-27.1701	149.992
Maranoa Balonne Rivers	Meandarra	-27.17008	149.9787
Maranoa Balonne Rivers	Meandarra	-27.16937	149.8604

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Meandarra	-27.16847	149.8805
Maranoa Balonne Rivers	Meandarra	-27.16844	149.861
Maranoa Balonne Rivers	Meandarra	-27.16838	149.8763
Maranoa Balonne Rivers	Meandarra	-27.16805	149.8739
Maranoa Balonne Rivers	Meandarra	-27.1673	149.8887
Maranoa Balonne Rivers	Meandarra	-27.16711	149.862
Maranoa Balonne Rivers	Meandarra	-27.1664	149.9963
Maranoa Balonne Rivers	Meandarra	-27.16595	149.8644
Maranoa Balonne Rivers	Meandarra	-27.16588	149.9101
Maranoa Balonne Rivers	Wellesley	-27.16175	148.9684
Maranoa Balonne Rivers	Meandarra	-27.16166	149.8907
Maranoa Balonne Rivers	Wellesley	-27.16103	148.9612
Maranoa Balonne Rivers	Weribone	-27.15967	148.9814
Maranoa Balonne Rivers	Weribone	-27.15943	148.979
Maranoa Balonne Rivers	Weribone	-27.15919	148.977
Maranoa Balonne Rivers	Weribone	-27.15883	148.9847
Maranoa Balonne Rivers	Weribone	-27.15867	148.9752
Maranoa Balonne Rivers	Weribone	-27.1579	148.9726
Maranoa Balonne Rivers	Glenmorgan	-27.15752	149.6523
Maranoa Balonne Rivers	Meandarra	-27.15746	149.8965
Maranoa Balonne Rivers	Weribone	-27.1574	148.9883
Maranoa Balonne Rivers	Noorindoo	-27.15705	149.3763
Maranoa Balonne Rivers	Meandarra	-27.15684	149.9052
Maranoa Balonne Rivers	Weribone	-27.15683	148.9906
Maranoa Balonne Rivers	Meandarra	-27.15658	149.9058
Maranoa Balonne Rivers	Meandarra	-27.15642	149.9105
Maranoa Balonne Rivers	Weribone	-27.15627	148.992
Maranoa Balonne Rivers	Meandarra	-27.15567	149.9013
Maranoa Balonne Rivers	Weribone	-27.15544	148.993
Maranoa Balonne Rivers	Meandarra	-27.15525	149.9068
Maranoa Balonne Rivers	Weribone	-27.15405	148.9954
Maranoa Balonne Rivers	Meandarra	-27.15372	149.9111
Maranoa Balonne Rivers	Wellesley	-27.15294	149.0168
Maranoa Balonne Rivers	Wellesley	-27.15243	149.0146

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Wellesley	-27.15238	149.0179
Maranoa Balonne Rivers	Wellesley	-27.1519	149.0134
Maranoa Balonne Rivers	Wellesley	-27.15111	149.0121
Maranoa Balonne Rivers	Surat	-27.15055	149.069
Maranoa Balonne Rivers	Surat	-27.15052	149.071
Maranoa Balonne Rivers	Surat	-27.15031	149.0672
Maranoa Balonne Rivers	Surat	-27.1498	149.0648
Maranoa Balonne Rivers	Noorindoo	-27.14966	149.0743
Maranoa Balonne Rivers	Wellesley	-27.14962	149.0215
Maranoa Balonne Rivers	Wellesley	-27.14933	149.0227
Maranoa Balonne Rivers	Wellesley	-27.14905	149.0236
Maranoa Balonne Rivers	Surat	-27.14889	149.0623
Maranoa Balonne Rivers	Weribone	-27.14877	149.0242
Maranoa Balonne Rivers	Wellesley	-27.14875	149.0251
Maranoa Balonne Rivers	Wellesley	-27.14846	149.0266
Maranoa Balonne Rivers	Wellesley	-27.14845	149.0272
Maranoa Balonne Rivers	Wellesley	-27.14817	149.0278
Maranoa Balonne Rivers	Surat	-27.14796	149.0608
Maranoa Balonne Rivers	Wellesley	-27.14677	149.0314
Maranoa Balonne Rivers	Noorindoo	-27.14662	149.0786
Maranoa Balonne Rivers	Noorindoo	-27.14593	149.0792
Maranoa Balonne Rivers	Weribone	-27.14511	149.0335
Maranoa Balonne Rivers	Noorindoo	-27.1447	149.0798
Maranoa Balonne Rivers	Glenmorgan	-27.14197	149.6582
Maranoa Balonne Rivers	The Gums	-27.14155	150.1413
Maranoa Balonne Rivers	Noorindoo	-27.14087	149.0831
Maranoa Balonne Rivers	Ballaroo	-27.13837	148.6672
Maranoa Balonne Rivers	Noorindoo	-27.13729	149.0869
Maranoa Balonne Rivers	Noorindoo	-27.13496	149.0981
Maranoa Balonne Rivers	Noorindoo	-27.13466	149.0999
Maranoa Balonne Rivers	Noorindoo	-27.13435	149.1023
Maranoa Balonne Rivers	Noorindoo	-27.13403	149.1056
Maranoa Balonne Rivers	Glenmorgan	-27.1339	149.4455
Maranoa Balonne Rivers	Noorindoo	-27.13375	149.1062

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Noorindoo	-27.13325	149.3102
Maranoa Balonne Rivers	Noorindoo	-27.1321	149.1083
Maranoa Balonne Rivers	Noorindoo	-27.13043	149.1111
Maranoa Balonne Rivers	Noorindoo	-27.1293	149.1143
Maranoa Balonne Rivers	Noorindoo	-27.12737	149.1164
Maranoa Balonne Rivers	Noorindoo	-27.12656	149.1162
Maranoa Balonne Rivers	Noorindoo	-27.123	149.3726
Maranoa Balonne Rivers	Noorindoo	-27.12279	149.254
Maranoa Balonne Rivers	Glenmorgan	-27.12214	149.6552
Maranoa Balonne Rivers	Noorindoo	-27.11923	149.1175
Maranoa Balonne Rivers	Noorindoo	-27.11855	149.118
Maranoa Balonne Rivers	Noorindoo	-27.1161	149.128
Maranoa Balonne Rivers	Barramornie	-27.11556	150.1411
Maranoa Balonne Rivers	Noorindoo	-27.11555	149.1286
Maranoa Balonne Rivers	Noorindoo	-27.11538	149.1219
Maranoa Balonne Rivers	Noorindoo	-27.11473	149.1286
Maranoa Balonne Rivers	Noorindoo	-27.11278	149.0874
Maranoa Balonne Rivers	Noorindoo	-27.11228	149.1294
Maranoa Balonne Rivers	Yulabilla	-27.112	149.8003
Maranoa Balonne Rivers	Noorindoo	-27.11067	149.1376
Maranoa Balonne Rivers	Noorindoo	-27.11065	149.1303
Maranoa Balonne Rivers	Meandarra	-27.10939	149.8046
Maranoa Balonne Rivers	Noorindoo	-27.10914	149.1403
Maranoa Balonne Rivers	Noorindoo	-27.10909	149.1439
Maranoa Balonne Rivers	Noorindoo	-27.1084	149.1445
Maranoa Balonne Rivers	Yulabilla	-27.10716	149.8494
Maranoa Balonne Rivers	Yulabilla	-27.10668	149.8522
Maranoa Balonne Rivers	Glenmorgan	-27.10519	149.4604
Maranoa Balonne Rivers	Yulabilla	-27.10425	149.8525
Maranoa Balonne Rivers	Glenmorgan	-27.09958	149.6168
Maranoa Balonne Rivers	Yulabilla	-27.0956	149.865
Maranoa Balonne Rivers	Tara	-27.09199	150.3322
Maranoa Balonne Rivers	Yulabilla	-27.09061	149.8417
Maranoa Balonne Rivers	Glenmorgan	-27.08861	149.555

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Yulabilla	-27.07992	149.7003
Maranoa Balonne Rivers	Yulabilla	-27.07843	149.8717
Maranoa Balonne Rivers	Yulabilla	-27.07665	149.7108
Maranoa Balonne Rivers	Noorindoo	-27.07571	149.1127
Maranoa Balonne Rivers	Glenmorgan	-27.07571	149.6033
Maranoa Balonne Rivers	Glenmorgan	-27.07501	149.6872
Maranoa Balonne Rivers	Yulabilla	-27.07488	149.7046
Maranoa Balonne Rivers	Glenmorgan	-27.07467	149.6049
Maranoa Balonne Rivers	Yulabilla	-27.0741	149.7059
Maranoa Balonne Rivers	Glenmorgan	-27.07305	149.6388
Maranoa Balonne Rivers	Glenmorgan	-27.07276	149.6382
Maranoa Balonne Rivers	Yulabilla	-27.07269	149.715
Maranoa Balonne Rivers	Glenmorgan	-27.07248	149.6376
Maranoa Balonne Rivers	Glenmorgan	-27.07219	149.6367
Maranoa Balonne Rivers	Glenmorgan	-27.07162	149.6358
Maranoa Balonne Rivers	Yulabilla	-27.07148	149.7153
Maranoa Balonne Rivers	Glenmorgan	-27.07084	149.6709
Maranoa Balonne Rivers	Noorindoo	-27.07036	149.1085
Maranoa Balonne Rivers	Noorindoo	-27.06907	149.1758
Maranoa Balonne Rivers	Ballaroo	-27.06876	148.5925
Maranoa Balonne Rivers	Dunkeld	-27.06566	148.0779
Maranoa Balonne Rivers	Glenmorgan	-27.06517	149.5591
Maranoa Balonne Rivers	Ballaroo	-27.06487	148.6011
Maranoa Balonne Rivers	Noorindoo	-27.06456	149.1872
Maranoa Balonne Rivers	Yulabilla	-27.06439	149.9224
Maranoa Balonne Rivers	Glenmorgan	-27.06437	149.5599
Maranoa Balonne Rivers	Yulabilla	-27.06419	149.7569
Maranoa Balonne Rivers	Yulabilla	-27.06393	149.9135
Maranoa Balonne Rivers	Noorindoo	-27.06348	149.1609
Maranoa Balonne Rivers	Glenmorgan	-27.06304	149.719
Maranoa Balonne Rivers	Glenmorgan	-27.06302	149.7183
Maranoa Balonne Rivers	Glenmorgan	-27.063	149.7174
Maranoa Balonne Rivers	Glenmorgan	-27.06289	149.7243
Maranoa Balonne Rivers	Noorindoo	-27.06199	149.1605

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Noorindoo	-27.06104	149.1608
Maranoa Balonne Rivers	Yulabilla	-27.0605	149.9112
Maranoa Balonne Rivers	Yulabilla	-27.06046	149.8187
Maranoa Balonne Rivers	Yulabilla	-27.06046	149.6782
Maranoa Balonne Rivers	Noorindoo	-27.06036	149.1611
Maranoa Balonne Rivers	Noorindoo	-27.05954	149.1615
Maranoa Balonne Rivers	Condamine	-27.05954	149.9109
Maranoa Balonne Rivers	Yulabilla	-27.05912	149.8979
Maranoa Balonne Rivers	Condamine	-27.05873	149.9109
Maranoa Balonne Rivers	Noorindoo	-27.05792	149.2977
Maranoa Balonne Rivers	Yulabilla	-27.0571	149.8983
Maranoa Balonne Rivers	Condamine	-27.0553	149.9274
Maranoa Balonne Rivers	Yulabilla	-27.05497	149.8999
Maranoa Balonne Rivers	Yulabilla	-27.05393	149.9265
Maranoa Balonne Rivers	Condamine	-27.05393	149.9114
Maranoa Balonne Rivers	Glenmorgan	-27.05314	149.7588
Maranoa Balonne Rivers	Yulabilla	-27.05278	149.9111
Maranoa Balonne Rivers	Yulabilla	-27.05262	149.7597
Maranoa Balonne Rivers	Glenmorgan	-27.05105	149.5226
Maranoa Balonne Rivers	Noorindoo	-27.05102	149.2048
Maranoa Balonne Rivers	Noorindoo	-27.05091	149.2287
Maranoa Balonne Rivers	Glenmorgan	-27.05089	149.767
Maranoa Balonne Rivers	Noorindoo	-27.04582	149.2507
Maranoa Balonne Rivers	Ballaroo	-27.04558	148.5846
Maranoa Balonne Rivers	Yulabilla	-27.04345	149.7376
Maranoa Balonne Rivers	Yulabilla	-27.04194	149.9227
Maranoa Balonne Rivers	Yulabilla	-27.04063	149.9249
Maranoa Balonne Rivers	Noorindoo	-27.04026	149.2171
Maranoa Balonne Rivers	Noorindoo	-27.03965	149.2644
Maranoa Balonne Rivers	Dunkeld	-27.03883	148.097
Maranoa Balonne Rivers	Glenmorgan	-27.03811	149.5259
Maranoa Balonne Rivers	Condamine	-27.03646	149.9569
Maranoa Balonne Rivers	Condamine	-27.03638	149.9409
Maranoa Balonne Rivers	Condamine	-27.0361	149.9403

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Warkon	-27.03493	149.5071
Maranoa Balonne Rivers	Dunkeld	-27.0307	148.1148
Maranoa Balonne Rivers	Dunkeld	-27.02961	148.1163
Maranoa Balonne Rivers	Noorindoo	-27.02951	149.244
Maranoa Balonne Rivers	Warkon	-27.02723	149.448
Maranoa Balonne Rivers	Noorindoo	-27.02634	149.4396
Maranoa Balonne Rivers	Glenmorgan	-27.02554	149.4613
Maranoa Balonne Rivers	Noorindoo	-27.02529	149.2903
Maranoa Balonne Rivers	Noorindoo	-27.02248	149.271
Maranoa Balonne Rivers	Noorindoo	-27.02098	149.2719
Maranoa Balonne Rivers	Condamine	-27.0209	149.9757
Maranoa Balonne Rivers	Condamine	-27.02064	149.989
Maranoa Balonne Rivers	Condamine	-27.02055	149.9848
Maranoa Balonne Rivers	Condamine	-27.02051	149.9827
Maranoa Balonne Rivers	Noorindoo	-27.01962	149.3056
Maranoa Balonne Rivers	Noorindoo	-27.01937	149.3042
Maranoa Balonne Rivers	Warkon	-27.01861	149.3825
Maranoa Balonne Rivers	Noorindoo	-27.01844	149.4214
Maranoa Balonne Rivers	Warkon	-27.01625	149.4095
Maranoa Balonne Rivers	Warkon	-27.01566	149.5749
Maranoa Balonne Rivers	Noorindoo	-27.01483	149.4285
Maranoa Balonne Rivers	Noorindoo	-27.01473	149.2056
Maranoa Balonne Rivers	Condamine	-27.01468	150.0271
Maranoa Balonne Rivers	Noorindoo	-27.01391	149.2059
Maranoa Balonne Rivers	Noorindoo	-27.01296	149.2061
Maranoa Balonne Rivers	Warkon	-27.01212	149.35
Maranoa Balonne Rivers	Warkon	-27.01159	149.3494
Maranoa Balonne Rivers	Warkon	-27.01106	149.3483
Maranoa Balonne Rivers	Noorindoo	-27.01054	149.347
Maranoa Balonne Rivers	Noorindoo	-27.01029	149.346
Maranoa Balonne Rivers	Noorindoo	-27.01021	149.1741
Maranoa Balonne Rivers	Noorindoo	-27.01003	149.3454
Maranoa Balonne Rivers	Barramornie	-27.01003	150.076
Maranoa Balonne Rivers	Warkon	-27.00977	149.3447

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Noorindoo	-27.00958	149.3398
Maranoa Balonne Rivers	Barramornie	-27.00927	150.0918
Maranoa Balonne Rivers	Dunkeld	-27.00887	148.1525
Maranoa Balonne Rivers	Warkon	-27.00883	149.5513
Maranoa Balonne Rivers	Noorindoo	-27.00815	149.2103
Maranoa Balonne Rivers	Warkon	-27.00741	149.3236
Maranoa Balonne Rivers	Noorindoo	-27.00701	149.171
Maranoa Balonne Rivers	Warkon	-27.00569	149.2716
Maranoa Balonne Rivers	Noorindoo	-27.00485	149.17
Maranoa Balonne Rivers	Warkon	-27.00474	149.2719
Maranoa Balonne Rivers	Noorindoo	-27.00418	149.2392
Maranoa Balonne Rivers	Noorindoo	-27.00408	149.2111
Maranoa Balonne Rivers	Noorindoo	-27.00404	149.17
Maranoa Balonne Rivers	Warkon	-27.00351	149.2725
Maranoa Balonne Rivers	Warkon	-27.00305	149.259
Maranoa Balonne Rivers	Warkon	-27.00281	149.257
Maranoa Balonne Rivers	Warkon	-27.00242	149.273
Maranoa Balonne Rivers	Condamine	-27.00235	150.0584
Maranoa Balonne Rivers	Warkon	-27.00133	149.2736
Maranoa Balonne Rivers	Condamine	-27.00132	150.0479
Maranoa Balonne Rivers	Warkon	-27.00071	149.2531
Maranoa Balonne Rivers	Noorindoo	-27.00064	149.2742
Maranoa Balonne Rivers	Noorindoo	-27.00026	149.2473
Maranoa Balonne Rivers	Noorindoo	-26.99956	149.2905
Maranoa Balonne Rivers	Noorindoo	-26.99913	149.2754
Maranoa Balonne Rivers	Condamine	-26.99895	150.0642
Maranoa Balonne Rivers	Condamine	-26.99869	150.0773
Maranoa Balonne Rivers	Condamine	-26.99859	150.1053
Maranoa Balonne Rivers	Noorindoo	-26.998	149.2357
Maranoa Balonne Rivers	Noorindoo	-26.99762	149.2766
Maranoa Balonne Rivers	Noorindoo	-26.99749	149.2929
Maranoa Balonne Rivers	Noorindoo	-26.99745	149.3122
Maranoa Balonne Rivers	Noorindoo	-26.99708	149.2769
Maranoa Balonne Rivers	Noorindoo	-26.99695	149.2342

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Noorindoo	-26.99582	149.3039
Maranoa Balonne Rivers	Noorindoo	-26.99557	149.3031
Maranoa Balonne Rivers	Noorindoo	-26.99543	149.278
Maranoa Balonne Rivers	Condamine	-26.995	150.1085
Maranoa Balonne Rivers	Noorindoo	-26.99451	149.3013
Maranoa Balonne Rivers	Noorindoo	-26.99346	149.2995
Maranoa Balonne Rivers	Noorindoo	-26.99324	149.2798
Maranoa Balonne Rivers	Warkon	-26.9929	149.3576
Maranoa Balonne Rivers	Noorindoo	-26.99131	149.2819
Maranoa Balonne Rivers	Noorindoo	-26.99047	149.2838
Maranoa Balonne Rivers	Noorindoo	-26.99042	149.2865
Maranoa Balonne Rivers	Noorindoo	-26.99036	149.2899
Maranoa Balonne Rivers	Warkon	-26.98974	149.4085
Maranoa Balonne Rivers	Warkon	-26.98867	149.4078
Maranoa Balonne Rivers	Warkon	-26.98851	149.4897
Maranoa Balonne Rivers	Warkon	-26.98793	149.4882
Maranoa Balonne Rivers	Warkon	-26.98662	149.4792
Maranoa Balonne Rivers	Warkon	-26.98638	149.4803
Maranoa Balonne Rivers	Warkon	-26.98622	149.4812
Maranoa Balonne Rivers	Condamine	-26.98525	150.0951
Maranoa Balonne Rivers	Warkon	-26.98415	149.4456
Maranoa Balonne Rivers	Condamine	-26.98384	150.112
Maranoa Balonne Rivers	Condamine	-26.97602	150.1071
Maranoa Balonne Rivers	Condamine	-26.97588	150.0033
Maranoa Balonne Rivers	Condamine	-26.9755	150.1079
Maranoa Balonne Rivers	Condamine	-26.97443	150.1087
Maranoa Balonne Rivers	Condamine	-26.97284	150.0063
Maranoa Balonne Rivers	Condamine	-26.97188	150.1293
Maranoa Balonne Rivers	Condamine	-26.97162	150.11
Maranoa Balonne Rivers	Condamine	-26.96816	150.1327
Maranoa Balonne Rivers	Condamine	-26.96758	150.1113
Maranoa Balonne Rivers	Yulabilla	-26.9674	149.808
Maranoa Balonne Rivers	Condamine	-26.96218	150.1114
Maranoa Balonne Rivers	Warkon	-26.96186	149.5835

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Condamine	-26.9563	150.1152
Maranoa Balonne Rivers	Condamine	-26.953	150.1195
Maranoa Balonne Rivers	Condamine	-26.95089	150.1223
Maranoa Balonne Rivers	Condamine	-26.94858	150.1284
Maranoa Balonne Rivers	Condamine	-26.94724	150.129
Maranoa Balonne Rivers	Condamine	-26.94276	150.1282
Maranoa Balonne Rivers	Condamine	-26.93979	150.1284
Maranoa Balonne Rivers	Condamine	-26.93754	150.1312
Maranoa Balonne Rivers	Condamine	-26.93568	150.1326
Maranoa Balonne Rivers	Condamine	-26.9338	150.1333
Maranoa Balonne Rivers	Dunkeld	-26.92536	148.0611
Maranoa Balonne Rivers	Condamine	-26.9251	150.1314
Maranoa Balonne Rivers	Condamine	-26.9235	150.1329
Maranoa Balonne Rivers	Dunkeld	-26.92298	148.0603
Maranoa Balonne Rivers	Condamine	-26.92272	150.1344
Maranoa Balonne Rivers	Condamine	-26.9222	150.1354
Maranoa Balonne Rivers	Dunkeld	-26.92158	148.0598
Maranoa Balonne Rivers	Dunkeld	-26.92104	148.0594
Maranoa Balonne Rivers	Condamine	-26.92012	150.1394
Maranoa Balonne Rivers	Dunkeld	-26.91969	148.0588
Maranoa Balonne Rivers	Dunkeld	-26.91915	148.0585
Maranoa Balonne Rivers	Condamine	-26.91881	150.1415
Maranoa Balonne Rivers	Dunkeld	-26.91834	148.0579
Maranoa Balonne Rivers	Condamine	-26.91802	150.1427
Maranoa Balonne Rivers	Condamine	-26.91749	150.1433
Maranoa Balonne Rivers	Condamine	-26.91697	150.1443
Maranoa Balonne Rivers	Condamine	-26.9163	150.1446
Maranoa Balonne Rivers	Condamine	-26.91254	150.1462
Maranoa Balonne Rivers	Condamine	-26.90516	150.1763
Maranoa Balonne Rivers	V Gate	-26.90186	147.9779
Maranoa Balonne Rivers	V Gate	-26.89648	147.9321
Maranoa Balonne Rivers	V Gate	-26.89438	147.9212
Maranoa Balonne Rivers	Tingun	-26.89314	148.849
Maranoa Balonne Rivers	Condamine	-26.88799	150.2389

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Dunkeld	-26.88334	148.0488
Maranoa Balonne Rivers	Dunkeld	-26.88212	148.0491
Maranoa Balonne Rivers	Dunkeld	-26.88103	148.0494
Maranoa Balonne Rivers	Condamine	-26.87984	150.1687
Maranoa Balonne Rivers	Dunkeld	-26.86817	148.1024
Maranoa Balonne Rivers	Dunkeld	-26.86678	148.0532
Maranoa Balonne Rivers	Dunkeld	-26.8661	148.0535
Maranoa Balonne Rivers	Tingun	-26.86453	148.735
Maranoa Balonne Rivers	Tingun	-26.86259	148.7384
Maranoa Balonne Rivers	V Gate	-26.86251	148.0185
Maranoa Balonne Rivers	V Gate	-26.86203	148.0175
Maranoa Balonne Rivers	Pine Hills	-26.86086	149.9088
Maranoa Balonne Rivers	V Gate	-26.85917	148.0015
Maranoa Balonne Rivers	Miles	-26.85291	150.1893
Maranoa Balonne Rivers	Mount Abundance	-26.8521	148.4169
Maranoa Balonne Rivers	Miles	-26.84724	150.1898
Maranoa Balonne Rivers	Dunkeld	-26.84191	148.1519
Maranoa Balonne Rivers	Nangram	-26.84131	150.2602
Maranoa Balonne Rivers	Drillham South	-26.84014	150.1127
Maranoa Balonne Rivers	Eurella	-26.83966	148.1945
Maranoa Balonne Rivers	Nangram	-26.8392	150.2857
Maranoa Balonne Rivers	Condamine	-26.83846	150.1167
Maranoa Balonne Rivers	Condamine	-26.83843	150.1154
Maranoa Balonne Rivers	Eurella	-26.83672	148.1067
Maranoa Balonne Rivers	V Gate	-26.83263	148.0008
Maranoa Balonne Rivers	Drillham South	-26.83223	150.1234
Maranoa Balonne Rivers	Drillham South	-26.83043	150.1211
Maranoa Balonne Rivers	Drillham South	-26.82987	150.1205
Maranoa Balonne Rivers	Eurella	-26.82897	148.1614
Maranoa Balonne Rivers	Drillham South	-26.82876	150.119
Maranoa Balonne Rivers	Yuleba South	-26.82841	149.4075
Maranoa Balonne Rivers	V Gate	-26.82827	148.0054
Maranoa Balonne Rivers	Drillham South	-26.82712	150.1181
Maranoa Balonne Rivers	Nangram	-26.82545	150.2587

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	V Gate	-26.82357	147.8086
Maranoa Balonne Rivers	Eurella	-26.82334	148.1867
Maranoa Balonne Rivers	V Gate	-26.8214	147.98
Maranoa Balonne Rivers	Tingun	-26.82072	148.8475
Maranoa Balonne Rivers	V Gate	-26.81956	148.0108
Maranoa Balonne Rivers	Eurella	-26.81952	148.1409
Maranoa Balonne Rivers	Miles	-26.81532	150.1236
Maranoa Balonne Rivers	Drillham South	-26.81351	150.128
Maranoa Balonne Rivers	Miles	-26.81305	150.1316
Maranoa Balonne Rivers	Miles	-26.81282	150.1339
Maranoa Balonne Rivers	Miles	-26.81135	150.2273
Maranoa Balonne Rivers	Dulacca	-26.80999	149.7407
Maranoa Balonne Rivers	V Gate	-26.80991	147.9739
Maranoa Balonne Rivers	Miles	-26.80948	150.1428
Maranoa Balonne Rivers	Miles	-26.80814	150.1432
Maranoa Balonne Rivers	V Gate	-26.80605	147.8845
Maranoa Balonne Rivers	Miles	-26.8043	150.1434
Maranoa Balonne Rivers	Miles	-26.80274	150.144
Maranoa Balonne Rivers	Dulacca	-26.80189	149.7414
Maranoa Balonne Rivers	Miles	-26.80113	150.1445
Maranoa Balonne Rivers	V Gate	-26.8001	147.9258
Maranoa Balonne Rivers	Miles	-26.79888	150.1946
Maranoa Balonne Rivers	Miles	-26.79844	150.1454
Maranoa Balonne Rivers	Eurella	-26.79807	148.0236
Maranoa Balonne Rivers	Miles	-26.7979	150.1458
Maranoa Balonne Rivers	Eurella	-26.79726	148.0242
Maranoa Balonne Rivers	Drillham South	-26.78	150.1037
Maranoa Balonne Rivers	Drillham South	-26.77947	150.1043
Maranoa Balonne Rivers	Dulacca	-26.77489	149.8092
Maranoa Balonne Rivers	V Gate	-26.76866	147.9287
Maranoa Balonne Rivers	Wallumbilla South	-26.76371	149.0455
Maranoa Balonne Rivers	Mount Abundance	-26.7615	148.6779
Maranoa Balonne Rivers	Yuleba South	-26.75372	149.4297
Maranoa Balonne Rivers	Tingun	-26.75244	148.7331

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Eurella	-26.74848	148.1004
Maranoa Balonne Rivers	Wallumbilla South	-26.7409	149.1948
Maranoa Balonne Rivers	Womalilla	-26.74079	147.9857
Maranoa Balonne Rivers	Drillham South	-26.73448	149.9342
Maranoa Balonne Rivers	Womalilla	-26.7324	148.004
Maranoa Balonne Rivers	Mungallala South	-26.73143	147.6322
Maranoa Balonne Rivers	Yuleba South	-26.73019	149.3231
Maranoa Balonne Rivers	Tingun	-26.73014	149.0074
Maranoa Balonne Rivers	Womalilla	-26.72932	147.9001
Maranoa Balonne Rivers	Yuleba South	-26.72879	149.3261
Maranoa Balonne Rivers	Mungallala South	-26.72737	147.7159
Maranoa Balonne Rivers	Dulacca	-26.72688	149.7158
Maranoa Balonne Rivers	Yuleba South	-26.72621	149.4155
Maranoa Balonne Rivers	Drillham South	-26.7211	150.0045
Maranoa Balonne Rivers	Womalilla	-26.72084	147.9106
Maranoa Balonne Rivers	Miles	-26.71994	150.2408
Maranoa Balonne Rivers	Wallumbilla South	-26.71761	149.0785
Maranoa Balonne Rivers	Wallumbilla South	-26.71342	149.257
Maranoa Balonne Rivers	Mount Abundance	-26.71303	148.7009
Maranoa Balonne Rivers	Womalilla	-26.71272	147.7966
Maranoa Balonne Rivers	Womalilla	-26.71232	147.95
Maranoa Balonne Rivers	Drillham	-26.71202	149.9238
Maranoa Balonne Rivers	Mungallala South	-26.71142	147.682
Maranoa Balonne Rivers	Miles	-26.71034	150.1793
Maranoa Balonne Rivers	Womalilla	-26.70946	147.7748
Maranoa Balonne Rivers	Eurella	-26.70407	148.1466
Maranoa Balonne Rivers	Mungallala South	-26.70023	147.6726
Maranoa Balonne Rivers	Womalilla	-26.69972	147.8659
Maranoa Balonne Rivers	Eurella	-26.69969	148.1397
Maranoa Balonne Rivers	Womalilla	-26.6984	147.9663
Maranoa Balonne Rivers	Womalilla	-26.69816	147.9012
Maranoa Balonne Rivers	Yuleba South	-26.6975	149.4321
Maranoa Balonne Rivers	Womalilla	-26.69582	148.0064
Maranoa Balonne Rivers	Tingun	-26.6945	148.9217

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Womalilla	-26.69355	148.0208
Maranoa Balonne Rivers	Womalilla	-26.69336	147.887
Maranoa Balonne Rivers	Miles	-26.69312	150.1776
Maranoa Balonne Rivers	Mungallala South	-26.69193	147.6507
Maranoa Balonne Rivers	Dulacca	-26.69091	149.8477
Maranoa Balonne Rivers	Womalilla	-26.69035	147.826
Maranoa Balonne Rivers	Mungallala South	-26.68905	147.6286
Maranoa Balonne Rivers	Miles	-26.68814	150.1792
Maranoa Balonne Rivers	Miles	-26.68706	150.1792
Maranoa Balonne Rivers	Drillham	-26.68606	149.8792
Maranoa Balonne Rivers	Miles	-26.6853	150.1793
Maranoa Balonne Rivers	Eurella	-26.68528	148.1114
Maranoa Balonne Rivers	Dulacca	-26.68357	149.7982
Maranoa Balonne Rivers	Miles	-26.68326	150.1787
Maranoa Balonne Rivers	Miles	-26.68244	150.1785
Maranoa Balonne Rivers	Eurella	-26.68178	148.2087
Maranoa Balonne Rivers	Miles	-26.68162	150.1779
Maranoa Balonne Rivers	Miles	-26.67648	150.178
Maranoa Balonne Rivers	Womalilla	-26.67605	147.8102
Maranoa Balonne Rivers	Miles	-26.67514	150.1789
Maranoa Balonne Rivers	Miles	-26.67476	150.1732
Maranoa Balonne Rivers	Drillham	-26.67245	149.9189
Maranoa Balonne Rivers	Eurella	-26.67204	148.1078
Maranoa Balonne Rivers	Wallumbilla South	-26.6646	149.2785
Maranoa Balonne Rivers	Wallumbilla South	-26.66446	149.2612
Maranoa Balonne Rivers	Columboola	-26.66434	150.3056
Maranoa Balonne Rivers	Eurella	-26.66126	148.0477
Maranoa Balonne Rivers	Jackson	-26.66004	149.6118
Maranoa Balonne Rivers	Wallumbilla South	-26.65912	149.2506
Maranoa Balonne Rivers	Miles	-26.65735	150.1417
Maranoa Balonne Rivers	Womalilla	-26.65659	147.9608
Maranoa Balonne Rivers	Womalilla	-26.65656	147.7889
Maranoa Balonne Rivers	Tingun	-26.65519	149.0419
Maranoa Balonne Rivers	Womalilla	-26.65096	147.7428

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Miles	-26.64911	150.1766
Maranoa Balonne Rivers	Eurella	-26.64573	148.1128
Maranoa Balonne Rivers	Eurella	-26.64296	148.1071
Maranoa Balonne Rivers	Jackson	-26.64082	149.6805
Maranoa Balonne Rivers	Yuleba	-26.63893	149.3981
Maranoa Balonne Rivers	Jackson	-26.63823	149.6739
Maranoa Balonne Rivers	Yuleba	-26.63637	149.3971
Maranoa Balonne Rivers	Dulacca	-26.6331	149.7445
Maranoa Balonne Rivers	Jackson	-26.62928	149.6612
Maranoa Balonne Rivers	Womalilla	-26.62888	147.9321
Maranoa Balonne Rivers	Yuleba	-26.6274	149.3993
Maranoa Balonne Rivers	Wallumbilla	-26.62314	149.2284
Maranoa Balonne Rivers	Eurella	-26.62254	148.2471
Maranoa Balonne Rivers	Jackson	-26.62247	149.6944
Maranoa Balonne Rivers	Wallumbilla	-26.6215	149.2296
Maranoa Balonne Rivers	Jackson	-26.62126	149.6348
Maranoa Balonne Rivers	Jackson	-26.62082	149.6356
Maranoa Balonne Rivers	Womalilla	-26.62027	147.8813
Maranoa Balonne Rivers	Jackson	-26.61946	149.6353
Maranoa Balonne Rivers	Dulacca	-26.61917	149.7624
Maranoa Balonne Rivers	Hookswood	-26.61816	150.2058
Maranoa Balonne Rivers	Eurella	-26.61485	148.2439
Maranoa Balonne Rivers	Wallumbilla South	-26.61396	149.2614
Maranoa Balonne Rivers	Dulacca	-26.61159	149.7588
Maranoa Balonne Rivers	Wallumbilla	-26.61086	149.1288
Maranoa Balonne Rivers	Womalilla	-26.61071	147.9363
Maranoa Balonne Rivers	Yuleba South	-26.60299	149.3178
Maranoa Balonne Rivers	Mount Abundance	-26.59736	148.4993
Maranoa Balonne Rivers	Womalilla	-26.59621	147.9578
Maranoa Balonne Rivers	Eurella	-26.59307	148.2257
Maranoa Balonne Rivers	Womalilla	-26.59281	147.8979
Maranoa Balonne Rivers	Amby	-26.5911	148.1868
Maranoa Balonne Rivers	Amby	-26.58194	148.1133
Maranoa Balonne Rivers	Drillham	-26.57786	149.9005

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Eurella	-26.57391	148.2339
Maranoa Balonne Rivers	Dulacca	-26.57369	149.7619
Maranoa Balonne Rivers	Amby	-26.57331	148.1335
Maranoa Balonne Rivers	Wallumbilla North	-26.57265	149.3045
Maranoa Balonne Rivers	Hookswood	-26.5677	150.3631
Maranoa Balonne Rivers	Womalilla	-26.56751	147.9146
Maranoa Balonne Rivers	Muckadilla	-26.56657	148.4382
Maranoa Balonne Rivers	Womalilla	-26.56482	147.9741
Maranoa Balonne Rivers	Womalilla	-26.56466	147.9363
Maranoa Balonne Rivers	Womalilla	-26.56394	147.8792
Maranoa Balonne Rivers	Wallumbilla North	-26.56247	149.2814
Maranoa Balonne Rivers	Hodgson	-26.56207	148.6184
Maranoa Balonne Rivers	Drillham	-26.56048	149.8727
Maranoa Balonne Rivers	Womalilla	-26.55835	147.6615
Maranoa Balonne Rivers	Jackson North	-26.55703	149.6731
Maranoa Balonne Rivers	Mitchell	-26.55179	147.9576
Maranoa Balonne Rivers	Drillham	-26.55125	149.835
Maranoa Balonne Rivers	Eurella	-26.5512	148.2439
Maranoa Balonne Rivers	Wallumbilla North	-26.55021	149.2857
Maranoa Balonne Rivers	Amby	-26.54906	148.1945
Maranoa Balonne Rivers	Jackson North	-26.54902	149.5859
Maranoa Balonne Rivers	Mitchell	-26.54588	147.9503
Maranoa Balonne Rivers	Yuleba North	-26.54466	149.4958
Maranoa Balonne Rivers	Mitchell	-26.54455	148.0067
Maranoa Balonne Rivers	Mitchell	-26.54306	148.0069
Maranoa Balonne Rivers	Jackson North	-26.54295	149.6382
Maranoa Balonne Rivers	Mitchell	-26.54251	148.0072
Maranoa Balonne Rivers	Eurella	-26.54207	148.2815
Maranoa Balonne Rivers	Mitchell	-26.542	147.9791
Maranoa Balonne Rivers	Eurella	-26.54125	148.2824
Maranoa Balonne Rivers	Amby	-26.5393	148.224
Maranoa Balonne Rivers	Amby	-26.53605	148.2111
Maranoa Balonne Rivers	Amby	-26.53584	148.2036
Maranoa Balonne Rivers	Womalilla	-26.53498	147.8764

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Amby	-26.53481	148.1307
Maranoa Balonne Rivers	Womalilla	-26.53479	147.6599
Maranoa Balonne Rivers	Glenaubyn	-26.53381	149.8785
Maranoa Balonne Rivers	Bogandilla	-26.53144	149.8022
Maranoa Balonne Rivers	Bogandilla	-26.53003	149.7791
Maranoa Balonne Rivers	Mitchell	-26.52956	148.0188
Maranoa Balonne Rivers	Womalilla	-26.52782	147.7791
Maranoa Balonne Rivers	Amby	-26.52526	148.1575
Maranoa Balonne Rivers	Amby	-26.52526	148.2248
Maranoa Balonne Rivers	Mitchell	-26.52509	148.0193
Maranoa Balonne Rivers	Mitchell	-26.52414	148.02
Maranoa Balonne Rivers	Mitchell	-26.52319	148.0205
Maranoa Balonne Rivers	Mitchell	-26.52046	148.0226
Maranoa Balonne Rivers	Bogandilla	-26.51322	149.7684
Maranoa Balonne Rivers	Womalilla	-26.51281	147.6387
Maranoa Balonne Rivers	Amby	-26.51113	148.2116
Maranoa Balonne Rivers	Womalilla	-26.5059	147.6399
Maranoa Balonne Rivers	Eurella	-26.5058	148.2636
Maranoa Balonne Rivers	Amby	-26.50451	148.2392
Maranoa Balonne Rivers	Amby	-26.49898	148.2066
Maranoa Balonne Rivers	Glenaubyn	-26.49798	149.8736
Maranoa Balonne Rivers	Eurella	-26.49784	148.3052
Maranoa Balonne Rivers	Womalilla	-26.49775	147.7076
Maranoa Balonne Rivers	Mitchell	-26.49607	147.986
Maranoa Balonne Rivers	Womalilla	-26.49603	147.765
Maranoa Balonne Rivers	Mitchell	-26.49581	147.9854
Maranoa Balonne Rivers	Mitchell	-26.49527	147.9845
Maranoa Balonne Rivers	Pickanjinnie	-26.4947	149.0923
Maranoa Balonne Rivers	Mount Bindango	-26.49305	148.3554
Maranoa Balonne Rivers	Mitchell	-26.49138	148.0558
Maranoa Balonne Rivers	Pickanjinnie	-26.48979	149.0766
Maranoa Balonne Rivers	Mitchell	-26.48667	147.9809
Maranoa Balonne Rivers	Amby	-26.48513	148.1948
Maranoa Balonne Rivers	Walhallow	-26.48313	148.1243

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Mitchell	-26.48132	148.0602
Maranoa Balonne Rivers	Walhallow	-26.47913	148.3375
Maranoa Balonne Rivers	Mitchell	-26.47877	147.9409
Maranoa Balonne Rivers	Yuleba North	-26.47742	149.5234
Maranoa Balonne Rivers	Wallumbilla North	-26.4768	149.149
Maranoa Balonne Rivers	Mitchell	-26.47514	147.9774
Maranoa Balonne Rivers	Walhallow	-26.47215	148.3159
Maranoa Balonne Rivers	Mitchell	-26.47041	147.9769
Maranoa Balonne Rivers	Mitchell	-26.46973	147.9764
Maranoa Balonne Rivers	Walhallow	-26.46966	148.2927
Maranoa Balonne Rivers	Mitchell	-26.46873	147.9639
Maranoa Balonne Rivers	Mitchell	-26.46825	147.9758
Maranoa Balonne Rivers	Mitchell	-26.4665	147.9706
Maranoa Balonne Rivers	Yuleba North	-26.46296	149.5743
Maranoa Balonne Rivers	Pickanjinnie	-26.46242	149.0594
Maranoa Balonne Rivers	Mitchell	-26.46217	148.0681
Maranoa Balonne Rivers	Walhallow	-26.45961	148.1864
Maranoa Balonne Rivers	Euthulla	-26.45936	148.8685
Maranoa Balonne Rivers	Womalilla	-26.45582	147.7714
Maranoa Balonne Rivers	Jackson North	-26.45557	149.616
Maranoa Balonne Rivers	Walhallow	-26.45123	148.1673
Maranoa Balonne Rivers	Walhallow	-26.45102	148.1771
Maranoa Balonne Rivers	Womalilla	-26.44932	147.7501
Maranoa Balonne Rivers	Jackson North	-26.44919	149.5579
Maranoa Balonne Rivers	Womalilla	-26.4489	147.7473
Maranoa Balonne Rivers	Walhallow	-26.44818	148.2564
Maranoa Balonne Rivers	Womalilla	-26.44139	147.696
Maranoa Balonne Rivers	Wallumbilla North	-26.43962	149.1725
Maranoa Balonne Rivers	Mitchell	-26.43957	147.9163
Maranoa Balonne Rivers	Mitchell	-26.43763	147.916
Maranoa Balonne Rivers	Mitchell	-26.43377	148.0978
Maranoa Balonne Rivers	Walhallow	-26.43025	148.1831
Maranoa Balonne Rivers	Womalilla	-26.43017	147.6748
Maranoa Balonne Rivers	Mooga	-26.42929	148.9994

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Walhallow	-26.42708	148.2684
Maranoa Balonne Rivers	Mitchell	-26.42622	148.063
Maranoa Balonne Rivers	Mooga	-26.42443	149.0078
Maranoa Balonne Rivers	Womalilla	-26.42343	147.7489
Maranoa Balonne Rivers	Pickanjinnie	-26.42319	149.1127
Maranoa Balonne Rivers	Womalilla	-26.4192	147.7292
Maranoa Balonne Rivers	Walhallow	-26.41706	148.3276
Maranoa Balonne Rivers	Walhallow	-26.41562	148.328
Maranoa Balonne Rivers	Walhallow	-26.41469	148.1312
Maranoa Balonne Rivers	Walhallow	-26.41428	148.1318
Maranoa Balonne Rivers	Bogandilla	-26.41196	149.7898
Maranoa Balonne Rivers	Bogandilla	-26.41115	149.7901
Maranoa Balonne Rivers	Womalilla	-26.40885	147.741
Maranoa Balonne Rivers	Wallumbilla North	-26.39902	149.1448
Maranoa Balonne Rivers	Walhallow	-26.39697	148.1451
Maranoa Balonne Rivers	Mitchell	-26.37714	148.009
Maranoa Balonne Rivers	Wallumbilla North	-26.37457	149.1897
Maranoa Balonne Rivers	Wallumbilla North	-26.36836	149.1493
Maranoa Balonne Rivers	Walhallow	-26.3683	148.1409
Maranoa Balonne Rivers	Walhallow	-26.36423	148.2705
Maranoa Balonne Rivers	Forestvale	-26.35665	147.9147
Maranoa Balonne Rivers	Walhallow	-26.35114	148.2647
Maranoa Balonne Rivers	Wallumbilla North	-26.35112	149.283
Maranoa Balonne Rivers	Walhallow	-26.34208	148.3083
Maranoa Balonne Rivers	Kilmorey Falls	-26.33208	148.1144
Maranoa Balonne Rivers	Kilmorey Falls	-26.32296	148.1028
Maranoa Balonne Rivers	Kilmorey Falls	-26.32262	148.1456
Maranoa Balonne Rivers	Forestvale	-26.31965	147.9998
Maranoa Balonne Rivers	Euthulla	-26.31032	148.8964
Maranoa Balonne Rivers	Kilmorey Falls	-26.30304	148.1143
Maranoa Balonne Rivers	Forestvale	-26.29659	147.9239
Maranoa Balonne Rivers	Forestvale	-26.29592	147.9239
Maranoa Balonne Rivers	Kilmorey Falls	-26.26843	148.0234
Maranoa Balonne Rivers	Walhallow	-26.25535	148.3082

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Pelham	-26.19596	150.2775
Maranoa Balonne Rivers	Pelham	-26.19549	150.2764
Maranoa Balonne Rivers	Forestvale	-26.1933	147.8734
Maranoa Balonne Rivers	Forestvale	-26.18301	147.938
Maranoa Balonne Rivers	Kilmorey Falls	-26.15329	148.1692
Maranoa Balonne Rivers	Forestvale	-26.14912	147.8789
Maranoa Balonne Rivers	Forestvale	-26.14817	147.8786
Maranoa Balonne Rivers	Forestvale	-26.14763	147.8783
Maranoa Balonne Rivers	Tyrconnel	-26.14378	147.601
Maranoa Balonne Rivers	Tyrconnel	-26.14225	147.61
Maranoa Balonne Rivers	Kilmorey Falls	-26.13469	148.286
Maranoa Balonne Rivers	Kilmorey Falls	-26.11878	148.2779
Maranoa Balonne Rivers	Kilmorey Falls	-26.11599	148.2719
Maranoa Balonne Rivers	Redford	-26.11165	147.6194
Maranoa Balonne Rivers	Redford	-26.10905	147.572
Maranoa Balonne Rivers	Forestvale	-26.10449	147.6561
Maranoa Balonne Rivers	Forestvale	-26.09	147.9932
Maranoa Balonne Rivers	Kilmorey Falls	-26.08537	148.1608
Maranoa Balonne Rivers	Bymount	-26.06309	148.5566
Maranoa Balonne Rivers	Redford	-26.05515	147.5881
Maranoa Balonne Rivers	Redford	-26.01615	147.6715
Maranoa Balonne Rivers	Redford	-26.01581	147.4866
Maranoa Balonne Rivers	Forestvale	-25.96265	148.1291
Maranoa Balonne Rivers	Forestvale	-25.9584	147.7845
Maranoa Balonne Rivers	Redford	-25.93386	147.4467
Maranoa Balonne Rivers	Forestvale	-25.92686	148.1311
Maranoa Balonne Rivers	Kilmorey Falls	-25.92361	148.2
Maranoa Balonne Rivers	Kilmorey Falls	-25.89405	148.1373
Maranoa Balonne Rivers	Forestvale	-25.88218	147.7025
Maranoa Balonne Rivers	Redford	-25.87729	147.6484
Maranoa Balonne Rivers	Redford	-25.85321	147.5053
Maranoa Balonne Rivers	Womblebank	-25.85205	148.1735
Maranoa Balonne Rivers	Redford	-25.85199	147.6671
Maranoa Balonne Rivers	Redford	-25.85152	147.5991

Basin	Locality	Longitude	Latitude
Maranoa Balonne Rivers	Forestvale	-25.81624	147.8516
Maranoa Balonne Rivers	Forestvale	-25.81297	147.8542
Maranoa Balonne Rivers	Forestvale	-25.81106	147.8566
Maranoa Balonne Rivers	Womblebank	-25.80714	148.1225
Maranoa Balonne Rivers	Womblebank	-25.80483	148.2338
Maranoa Balonne Rivers	Womblebank	-25.73926	148.1712
Maranoa Balonne Rivers	Womblebank	-25.72312	148.1564
Maranoa Balonne Rivers	Womblebank	-25.71984	148.1802
Maranoa Balonne Rivers	Womblebank	-25.70891	148.1032
Maranoa Balonne Rivers	Womblebank	-25.62681	148.069
Maranoa Balonne Rivers	Womblebank	-25.60425	148.2818
Maranoa Balonne Rivers	Womblebank	-25.54188	148.1351
Maranoa Balonne Rivers	Womblebank	-25.48622	147.6241
Maranoa Balonne Rivers	Womblebank	-25.47667	148.0759
Maranoa Balonne Rivers	Womblebank	-25.43921	147.8882
Maranoa Balonne Rivers	Mount Howe	-25.38805	148.2828
Maranoa Balonne Rivers	Mount Moffatt	-25.26822	147.8965
Maranoa Balonne Rivers	Mount Moffatt	-25.08383	147.8816