Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Queensland Murray-Darling and Bulloo River Basins

Groundwater Environmental Values and Water Quality Objectives

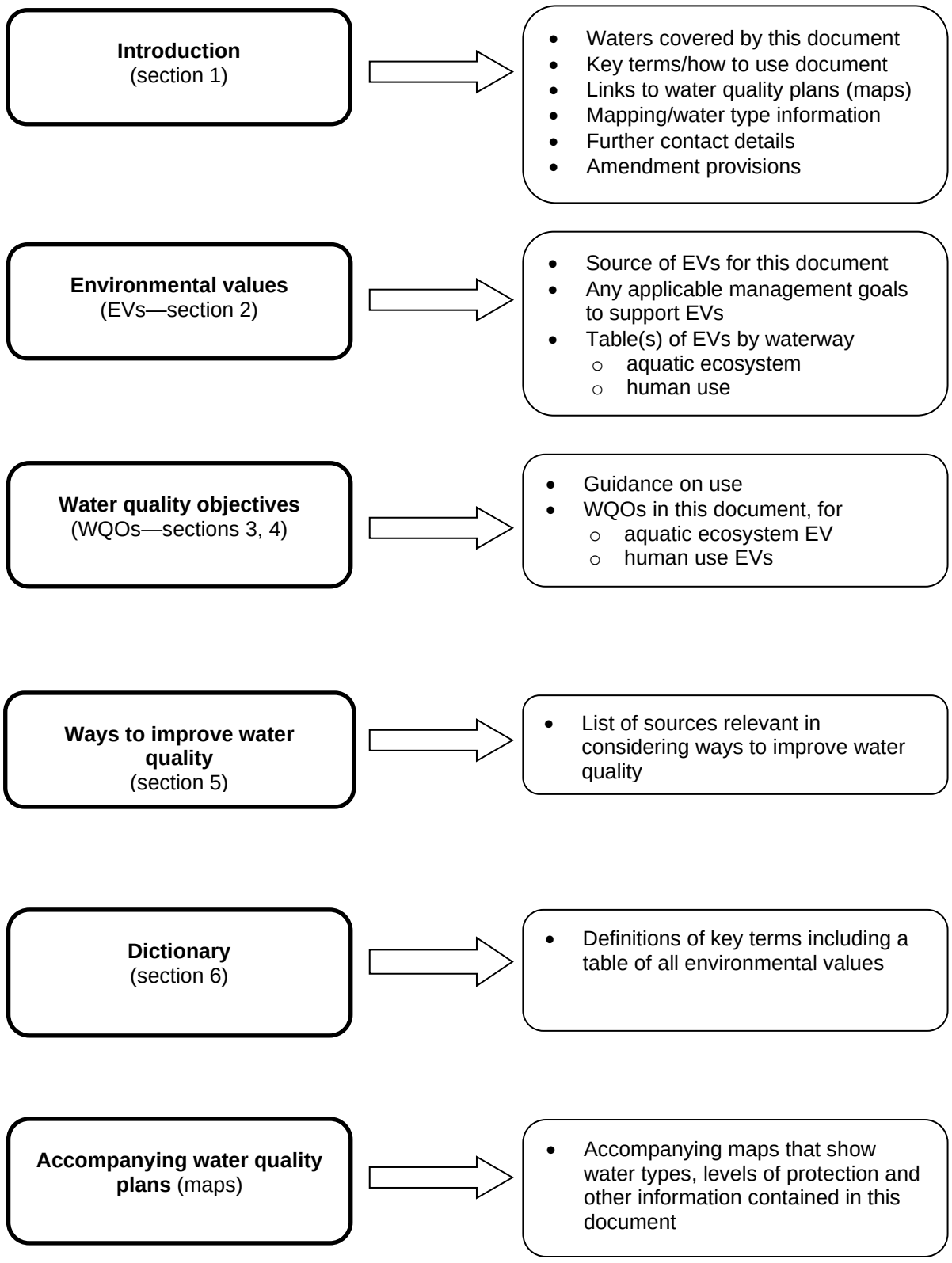
All groundwaters of the Queensland Murray-Darling and Bulloo River basins

Queensland Government

Prepared by: Environmental Policy and Planning Division, Department of Environment and Science

October 2020

Main parts of this document and what they contain



Contents

List of tables

1 Introduction

This document is made pursuant to the provisions of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP [*Water and Wetland Biodiversity*]), which is subordinate legislation under the *Environmental Protection Act 1994*. The EPP (Water and Wetland Biodiversity) provides a framework for:

- identifying environmental values (EVs) for Queensland waters and wetlands
- identifying management goals for waters
- stating water quality objectives (WQOs) to protect or enhance EVs for waters (WQOs are long-term goals for receiving waters, not individual point source emission objectives.)
- including the identified EVs, management goals and WQOs for waters under Schedule 1 of the EPP (Water and Wetland Biodiversity).

This document contains EVs and WQOs for groundwaters in the Queensland Murray-Darling and Bulloo River basins and is listed under schedule 1 of the EPP (Water and Wetland Biodiversity). For information on wetland EVs, refer to Section 7 of the EPP (Water and Wetland Biodiversity).

1.1 Purpose

The purpose of this document is to identify locally relevant environmental values (EVs) and water quality objectives (WQOs) for ground waters in the QMDB. EVs and WQOs are used to help set development conditions, influence local government planning schemes, and underpin report card grades for ecosystem health monitoring programs. Aquatic ecosystem water quality objectives have, where possible, been established using local data, and present a truer picture of the values and water quality of local waterways than national and state water quality guidelines. This ensures the values the community holds for its waterways can be maintained and improved, without imposing unrealistic standards from national guidelines that may be inappropriate for local conditions.

1.2 Queensland waters to which this document applies

This document applies to fresh groundwaters draining the QMDB (basins 416, 417, 422, 423, 424 and 011[1]) as indicated in the accompanying plans (GWQ4161 to GWQ4169 QMDB and Bulloo basins groundwaters)[2].

1.3 Water Quality 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).

In Queensland, Healthy Waters Management Plans (HWMPs) prepared under the EPP (Water and Wetland Biodiversity) contribute to meeting the requirements of a Water Quality Management Plan (WQM Plan) under Chapter 10, Part 7 of the Basin Plan. The HWMPs for the Queensland Murray-Darling and Bulloo River basins can be found on the department's website.

The EVs and WQOs stated in this document are based on the information included in the HWMPs for the Queensland Murray-Darling and Bulloo River basins. Contents of this document have been updated where necessary to reflect the most up-to-date information. For example, aquaculture water quality objectives have been updated in collaboration with the Department of Agriculture and Fisheries to include objectives based on best available knowledge.

Note: The Bulloo drainage basin is external to the Murray–Darling Basin and is therefore not subject to the Basin Plan. In addition, the Great Artesian Basin (GAB) aquifers are separately managed under the Water Plan (Great

[1] Australia's River Basins 1997—Product User Guide. Published by Geoscience Australia. Canberra, ACT (3rd edition, 2004).

[2] This document and the accompanying plans are available from the department's website. The boundaries in the accompanying plans GWQ4161 to GWQ4169 are indicative only. EVs, water types and aquatic ecosystem management intent (level of protection) depicted in the accompanying plans are stored in electronic form as part of the Queensland Environmental Values Schedule 1 Geodatabase, and held at the department's offices at 400 George Street Brisbane. Spatial (GIS) datasets can be downloaded free of charge from the Queensland Spatial Catalogue (QSpatial) at http://qldspatial.information.qld.gov.au/catalogue/custom/index.page. For further information, email the department at epa.ev@des.qld.gov.au.

Artesian Basin and Other Regional Aquifers) 2017 and the Water Management Protocol for the Great Artesian Basin and Other Regional Aquifers 2017. GAB groundwaters have been included for Queensland legislative and planning purposes.

1.4 Guidance on using this document

1.4.1 Key terms (refer to dictionary for additional terms)

ADWG means the Australian Drinking Water Guidelines (2011, as amended), available on the National Health and Medical Research Council (NHMRC) website.

ANZG means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018, as amended), available from the Australian Government's Water Quality Australia website.

Environmental values (EVs) for water means the EVs specified in EVs tables of this document for the corresponding water. 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. A range of EVs that can potentially apply to all groundwaters are listed below, and further details are provided in the dictionary.

List of EVs

Environmental value (EV)
Protection of aquatic ecosystems (aquatic ecosystem EV) Protection or enhancement of aquatic ecosystem values, under four possible levels of ecosystem conditions: • high ecological value (effectively unmodified) waters • slightly disturbed waters • moderately disturbed waters • highly disturbed waters. (Suitability for wildlife habitat have also been specifically identified for some Queensland waters as a component of this EV).
EVs other than aquatic ecosystem EV (called human use EVs) Suitability for drinking water supplies Suitability for primary contact recreation (e.g. swimming) Suitability for secondary contact recreation (e.g. boating) Suitability for visual (no contact) recreation Suitability for human consumers of wild or stocked fish, shellfish or crustaceans (suitability for oystering has also been specifically identified for some Queensland waters) Protection of cultural and spiritual values, including Traditional Owner values of water Suitability for industrial use (including mining, minerals refining/processing) Suitability for aquaculture (e.g. red claw, barramundi) Suitability for crop irrigation Suitability for stock watering Suitability for farm supply/use

Level of protection for a water (aquatic ecosystem EV) means the level of aquatic ecosystem condition specified for waters in the Aquatic Ecosystem water quality objectives tables of this document that the corresponding WQOs for that water are intended to achieve (refer to management intent definition below for further information).

Management goal means the goal/s (if any) stated in this document to support the EVs for waters identified in the EVs tables.

Management intent for a water (aquatic ecosystem EV) is defined in s.15 of the EPP (Water and Wetland Biodiversity). It is the management intent for the waters that the decision to release waste water or contaminant to

waters must ensure that:

- 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 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.

Water quality guidelines (defined in the EPP (Water and Wetland Biodiversity)) are numerical concentration levels or statements for indicators that protect a stated environmental value. Under the EVs setting process contained in the EPP (Water and Wetland Biodiversity), 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) means the WQOs specified in Table 3 and Table 4 of this document to support the corresponding EVs for waters identified in Table 2.

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, economic).

Examples of WQOs for aquatic ecosystem EVs include:

- phosphate-phosphorus concentration less than 50 milligrams per litre (mg/L)
- electrical conductivity less than 5000 microsiemens per centimetre µS/cm
- pH less than 8.5
- Calcium less than 150 milligrams per litre

Water type means groupings of waters with similar characteristics, as shown in the accompanying plans. Water types can include fresh waters, lakes/reservoirs, wetlands and groundwaters. WQOs applying to different water types are outlined in this document.

1.4.2 Use of this document

Section 2 lists the identified EVs for protection for particular waters. The aquatic ecosystem EV is a default applying to all Queensland waters. Reference to tables in sections 3–4 provides the corresponding WQOs to protect the aquatic ecosystem EV, and human use EVs.

Where more than one EV applies to a given water, the adoption of the most stringent WQO for the identified EVs applies to each water quality indicator in order to protect all identified EVs.

This document also refers to a number of guidelines, codes and other reference sources on water quality.

1.5 Information about mapped areas and boundaries

The boundaries in the accompanying plans GWQ4161 to GWQ4169 are indicative only. EVs, water types and aquatic ecosystem management intent (level of protection) depicted in the accompanying plans are stored in electronic form as part of the Queensland Environmental Values Schedule 1 Geodatabase, and held at the department's offices at 400 George Street Brisbane. Spatial (GIS) datasets can be downloaded free of charge from the Queensland Spatial Catalogue (QSpatial) at

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page. For further information, email the department at epa.ev@des.qld.gov.au.

1.6 Water types and basis for boundaries

1.6.1 Aquifer Zones

The groundwaters of the Queensland Murray-Darling and Bulloo River basins were divided vertically into aquifer types; three subartesian types, five GAB layers and one layer underlying the GAB. Refer to the Regional groundwater chemistry zones: Queensland Murray-Darling Basin report[3] for further information.

[3] McNeil, V.H., Raymond, M.A.A., Bennett, L., McGregor, G.B. and Southwell, B. 2018. Regional groundwater chemistry zones: Queensland Murray-Darling Basin. Brisbane: Department of Environment and Science, Queensland Government.

Table 1 Queensland Murray-Darling and Bulloo River basins groundwater chemistry zone aquifer system descriptions

Aquifer system	Description	Plan reference
Alluvia	Recent alluvium divided into 22 zones based on water quality and factors such as extent of alluvium, and sub-catchment characteristics. Water quality is moderate to saline NaCl or $NaHCO_3$, generally hard with a tendency to scale. Northeast is richer in Ca and Mg due to basalts and other weatherable terrains. Data sufficiency very variable, with best in the Condamine region.	GWQ4161
Fractured rock	Aquifers in hard rock with water stored in fractures. Divided into eight zones on the basis of rock type, location and water quality, with four in basalt and four in granite or trap rock. Water quality in the basalts is moderately saline Mg then Na, with HCO_3 then Cl, hard with some scaling, based on reasonable amounts of data. There is little data for the other zones, but the water quality appears to be Na then Ca Cl, of moderate to high salinity, with recordings of high fluoride in the New England Granites and occurrences of acidic groundwater in the Texas Beds.	GWQ4162
Sediments overlying the GAB	The overlying sediments consist of Tertiary sediments (Glendower Formation), weathered Cainozoic alluvium surrounding and underlying recent alluvium, and sand dunes in the southwest corner of the region. Based on few data, the water quality is moderate to highly saline NaCl, with lower salinity and higher HCO_3 near streams. High fluoride has been recorded in the Glendower Formation, but no data is available for the sand dunes.	GWQ4163
Upper GAB	The Upper GAB comprises the top beds of the Rolling downs Group, namely the non-flowing Winton and Mackunda aquifers with contemporaneous Upper Cretaceous clayey deposits. It corresponds to the Gabora Winto Mackunda Groundwater Unit, with additional upper Cretaceous material but without the Allaru Mudstone aquitard. The Upper GAB is divided into five zones, based on lithology and location. There is little data, but the water quality appears to be mostly NaCl of variable but often high salinity.	GWQ4164
Main GAB aquitard	This is the lower layers of the Rolling Downs Group which form the main confining layer of the GAB. Mainly Wallumbilla Formation, with Allaru and Toolebuc in the northwest, Coreena aquifer in the central region, Doncaster in the northeast and Griman Creek in the southeast. It corresponds to the Gabora Rolling Downs and Normanton Units. The salinity is spatially variable, and this with the lithology is used to define nine zones, Although data is scarce, the prevailing chemistry is moderate to highly saline NaCl groundwater, with salinity lower to the north and west. Occasional high fluoride levels occur, mainly in the Wallumbillas.	GWQ4165
Mid GAB aquifers	This represents the main confined GAB aquifers, particularly the Hooray/Cadna-owie systems to the west, mostly within the Eromanga Basin, and the eastern (Surat) equivalents including the Bungil, Mooga, Orallo, and Gubberamunda, with the Kumbarilla in the east. It corresponds to the Gabora Hooray in the west and Cadna-owie and Mooga in the east. Water quality is complex and variable, particularly around the outcrops in the north and east, and this, with the lithology is used to define 14 zones. Data sufficiency is poor, but the water quality appears to be moderately saline $NaHCO_3$, over most of the west and southern central	GWQ4166

Aquifer system	Description	Plan reference
	area, but more variable around the north and eastern outcrops, with saline NaCl to the east, mainly around outcrops and thicker sequences of Bungil and Mooga, or sometimes associated with the Gubberamunda and Kumbarilla. High fluoride levels may also occur in the southeast, away from the outcrop areas.	
Lower GAB	This is a thick sequence of important aquifers and aquitards, including the Adori in the north west, Hutton, mostly in the west, Springbok in the central Surat and Boxvale aquifers, and the Injune Creek, Westbourne and Walloon aquitards. It corresponds to the Gabora Hutton and Springbok Walloon Units, except for the Evergreen Formation, and a number of other formations located mainly in the Clarence Moreton Basin. These were transferred to the Basal GAB to avoid excessive complexity in this division. Twelve zones were defined on the basis of water quality and lithology. Although data sufficiency is poor for most zones, it appears that most of the west and central area, away from the outcrops, has a fairly uniform, moderately saline $NaHCO_3$ water type. However, the outcrop areas in the north and east are much more variable, with those on the eastern edge are mostly high salinity NaCl, probably influenced by underlying or overlying Walloons.	GWQ4167
Basal GAB	This division represents the lowest beds in the GAB, mainly the Evergreen aquitard and underlying Precipice Sandstone. It also includes members of the Bundamba Group in the Clarence Moreton Basin. The Gabora equivalents are the Precipice Unit, and the Evergreen Fm. from the Hutton Unit. The division is absent from the southwest of the QMDB. Six zones have been defined, based on lithology and limited water quality data. The groundwater is generally moderately saline, dominated by HCO_3 with either Na, or mixed cations in northern outcrop area near basaltic remnants. Instances of high fluoride have been recorded in the central Surat area.	GWQ4168
Earlier basins partially underlying the GAB	These Permian-Triassic basins represent hydrological networks that pre-date the GAB and were eroded before GAB sedimentation commenced. The QMDB includes the Bowen Basin underlying the Surat, and the Galilee underlying the northern part of the Eromanga. The corresponding Gabora unit is the Clematis. Three units are identified on the basis of location and hydrological unit, but only the Bowen Basin Zone has water quality data, probably because of depth considerations. The available data indicates $NaHCO_3$ groundwater of relatively high salinity, with high fluoride occurrences.	GWQ4169

Source: McNeil, V.H., Raymond, M.A.A., Bennett, L., McGregor, G.B. and Southwell, B. 2018. Regional groundwater chemistry zones: Queensland Murray-Darling Basin. Brisbane: Department of Environment and Science, Queensland Government.

1.6.2 Water type boundaries

The boundaries of different groundwater aquifer types/zones have been mapped using a variety of attributes, including:

- geographic coordinates
- boundaries based on technical investigations.
- water quality chemistry
- lithology
- aquifer depth

Boundaries are shown on the accompanying plans. The boundaries of groundwater types may be confirmed or revised by site investigations.

1.7 Matters for amendment

Amendments of the following type may be made to this schedule 1 document (and accompanying plans) for the purposes of replacement under section 13(2)(b) of the EPP (Water and Wetland Biodiversity):

- changes to EVs
- changes to management goals
- changes to WQOs
- changes to management intent (level of protection) categories
- changes to groundwater type boundaries/descriptions
- updates to information/data sources, websites and email contact details, agency/departmental names, other institutional names, references.

ENVIRONMENTAL VALUES
&
MANAGEMENT GOALS

2 Environmental values and management goals

2.1 Environmental values

Table 2 and the accompanying plans GWQ4161 to GWQ4169 outline the EVs for groundwaters in the Queensland Murray-Darling and Bulloo River basins

The dictionary to this document provides further explanation of EVs (refer section 6)

Table 2 Environmental values: Queensland Murray-Darling and Bulloo River basins Groundwater

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
QUEENSLAND BORDER RIVERS AND MOONIE RIVER BASINS												
Alluvial Zones (refer to plan GWQ4161)												
Border Rivers	✓	✓	✓	✓	✓					✓	✓	✓
Upper Dumaresq	✓	✓	✓	✓	✓					✓	✓	✓
Macintyre Brook	✓	✓	✓	✓	✓					✓	✓	✓
Lower Balonne	✓	✓	✓	✓						✓	✓	✓
Moonie	✓		✓	✓								✓
Fractured Rock Zones (refer to plan GWQ4162)												
Border Rivers Headwaters	✓	✓	✓	✓						✓		✓
Glenlyon	✓	✓	✓	✓						✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
New England Granite	✓	✓	✓	✓						✓	✓	✓
Sediments Overlying the GAB Zones (refer to plan GWQ4163)												
Tertiary Sediments	✓		✓	✓								✓
Weathered Alluvium	✓	✓	✓	✓	✓					✓	✓	✓
Upper GAB Zones (refer to plan GWQ4164)												
Winton Mackunda Eastern	✓	✓	✓	✓						✓	✓	✓
Main GAB Aquitard Zones (refer to plan GWQ4165)												
Central Surat Mid Cretaceous	✓		✓	✓								✓
Eastern Wallumbilla Outcrop	✓		✓	✓						✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Mid GAB Aquifer Zones (refer to plan GWQ4166)												
Eastern Cretaceous Outcrop	✓		✓	✓						✓	✓	✓
Lower Balonne Gubberamunda	✓	✓	✓	✓						✓	✓	✓
Northern Surat Thickest Bungil and Mooga	✓	✓	✓	✓						✓		✓
South East Kumbarilla	✓	✓	✓	✓	✓					✓		✓
Lower GAB Zones (refer to plan GWQ4167)												
Central Surat Springbok Area (continued)	✓	✓	✓	✓	✓					✓		✓
Eastern Springbok Outcrop	✓		✓	✓						✓		✓
Saline South Eastern Hutton Outcrop	✓	✓	✓	✓						✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Basal GAB Zones (refer to plan GWQ4168)												
Eastern Central Area (continued)	✓	✓	✓	✓						✓	✓	✓
South Eastern Evergreen	✓	✓	✓	✓						✓	✓	✓
Earlier sedimentary Earlier sedimentary Earlier Basins Partially Underlying the GAB Zones (refer to plan GWQ4169)												
Bowen Basin (continued)	✓			✓								✓
CONDAMINE RIVER BASIN												
Alluvial Zones (refer to plan GWQ4161)												
Central Condamine	✓	✓	✓	✓	✓					✓	✓	✓
Hodgson	✓	✓	✓	✓						✓	✓	✓
Lower Condamine	✓	✓	✓	✓	✓					✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Myall	✓	✓	✓	✓						✓	✓	✓
North Branch	✓	✓	✓	✓						✓	✓	✓
North West Condamine	✓	✓	✓	✓	✓					✓	✓	✓
Oakey	✓	✓	✓	✓	✓					✓	✓	✓
Southern Condamine	✓	✓	✓	✓						✓	✓	✓
Wooloowins	✓	✓	✓	✓	✓					✓	✓	✓
Fractured Rock Zones (refer to plan GWQ4162)												
Border Rivers Headwaters	✓	✓	✓	✓						✓		✓
Lower Condamine basalts	✓	✓	✓	✓						✓	✓	✓
New England Granite	✓	✓	✓	✓						✓	✓	✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Toowoomba region basalts	✓	✓	✓	✓	✓					✓	✓	✓
Upper Condamine basalts	✓	✓	✓	✓	✓					✓	✓	✓
Sediments Overlying the GAB Zones (refer to plan GWQ4163)												
Tertiary sediments	✓		✓	✓								✓
Weathered alluvium	✓	✓	✓	✓	✓					✓	✓	✓
Upper GAB Zones (refer to plan GWQ4164)												
Probable Upper Cretaceous Aquitard	✓	✓	✓	✓						✓		✓
Mid GAB Aquifer Zones (refer to plan GWQ4166)												
Eastern Cretaceous Outcrop	✓		✓	✓						✓	✓	✓
South East Kumbarilla	✓	✓	✓	✓	✓					✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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 GAB Zones (refer to plan GWQ4167)												
Central Surat Springbok area (continued)	✓	✓	✓	✓	✓					✓		✓
Eastern Springbok Outcrop	✓		✓	✓						✓		✓
Fresh Hutton South Eastern Outcrop	✓	✓	✓	✓						✓		✓
North Eastern Hutton Outcrop (continued)	✓	✓	✓	✓						✓		✓
North East Walloons	✓	✓	✓	✓	✓					✓	✓	✓
Saline South Eastern Hutton Outcrop	✓	✓	✓	✓						✓		✓
South Eastern Hutton Outcrop	✓	✓	✓	✓						✓	✓	✓
South East Walloons	✓	✓	✓	✓	✓					✓	✓	✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Basal GAB Zones (refer to plan GWQ4168)												
Eastern Central area (continued)	✓	✓	✓	✓						✓	✓	✓
Eastern Evergreen Outcrop (continued)	✓	✓	✓	✓						✓		✓
South Eastern Evergreen	✓	✓	✓	✓						✓	✓	✓
Earlier Basins Partially Underlying the GAB Zones (refer to plan GWQ4169)												
Bowen Basin (continued)	✓			✓								✓
MARANOA-BALONNE RIVER BASIN												
Alluvial Zones (refer to plan GWQ4161)												
Lower Balonne	✓	✓	✓	✓						✓	✓	✓
Lower Condamine	✓	✓	✓	✓	✓					✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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 Maranoa	✓		✓	✓						✓		✓
Moonie	✓		✓	✓								✓
Upper Balonne	✓		✓	✓						✓		✓
Upper Maranoa	✓		✓	✓						✓		✓
Wallam	✓		✓	✓								✓
Fractured Rock Zones (refer to plan GWQ4162)												
Eastern Basement with Basalt Remnants (continued)	✓	✓	✓	✓						✓	✓	✓
Main Range Volcanics (continued)	✓	✓	✓	✓	✓					✓	✓	✓
Sediments Overlying the GAB Zones (refer to plan GWQ4163)												
Tertiary sediments	✓		✓	✓								✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Weathered alluvium	✓	✓	✓	✓	✓					✓	✓	✓
Upper GAB Zones (refer to plan GWQ4164)												
Central Upper Cretaceous Aquitard	✓	✓	✓	✓						✓	✓	✓
Winton Mackunda eastern	✓	✓	✓	✓						✓	✓	✓
Main GAB Aquitard Zones (refer to plan GWQ4165)												
Central Surat mid Cretaceous	✓		✓	✓								✓
Eastern Wallumbilla Outcrop	✓		✓	✓						✓		✓
Wallumbilla Doncaster Outcrop	✓		✓	✓						✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Mid GAB Aquifer Zones (refer to plan GWQ4166)												
Central Mooga and Orallo Outcrops	✓		✓	✓						✓		✓
Eastern Cretaceous Outcrop	✓		✓	✓						✓	✓	✓
Hooray Northern Outcrop	✓		✓	✓						✓		✓
Lower Balonne Gubberamunda	✓	✓	✓	✓						✓	✓	✓
North Wallumbilla Bungil and Mooga (continued)	✓		✓	✓						✓		✓
Northern Central Outcrop area	✓		✓	✓						✓	✓	✓
Northern Maranoa Bungils	✓		✓	✓						✓	✓	✓
Northern Surat thickest Bungil and Mooga	✓	✓	✓	✓						✓		✓
South East Kumbarilla	✓	✓	✓	✓	✓					✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Surat thicker Mooga saline area	✓		✓	✓						✓		✓
Western Hooray	✓		✓	✓						✓		✓
Lower GAB Zones (refer to plan GWQ4167)												
Central Surat Springbok area (continued)	✓	✓	✓	✓	✓					✓		✓
Eastern Springbok Outcrop	✓		✓	✓						✓		✓
Hutton Western Eromanga region	✓		✓	✓						✓		✓
North East Walloons	✓	✓	✓	✓	✓					✓	✓	✓
North Eastern Hutton Outcrop (continued)	✓	✓	✓	✓						✓		✓
Northern Hutton Outcrop (continued)	✓		✓	✓						✓		✓
Northern Walloons (continued)	✓	✓	✓	✓	✓					✓	✓	✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Basal GAB Zones (refer to plan GWQ4168)												
Eastern Central area (continued)	✓	✓	✓	✓						✓	✓	✓
Eastern Evergreen Outcrop (continued)	✓	✓	✓	✓						✓		✓
North Western Evergreen Outcrop	✓		✓	✓						✓		✓
Precipice Outcrop (continued)	✓	✓	✓	✓						✓		✓
Western Evergreen only	✓		✓	✓						✓		✓
Earlier Basins Partially Underlying the GAB Zones (refer to plan GWQ4169)												
Bowen Basin (continued)	✓			✓								✓
Upper Bowen Basin (continued)	✓			✓								✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Warrego, Paroo and Bullo Rivers and Nebine, Mungalla and Wallam Creeks Basins												
Alluvial Zones (refer to plan GWQ4161)												
Bulloo	✓		✓	✓								✓
Lower Warrego	✓		✓	✓						✓		✓
Upper Warrego	✓	✓	✓	✓						✓		✓
Paroo	✓		✓	✓								✓
Wallam	✓		✓	✓								✓
Sediments Overlying the GAB Zones (refer to plan GWQ4163)												
Sand Dunes	✓											✓
Tertiary Sediments	✓		✓	✓								✓
Weathered Alluvium	✓	✓	✓	✓	✓					✓	✓	✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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 GAB Zones (refer to plan GWQ4164)												
South West Upper Cretaceous Aquitard	✓		✓	✓						✓		✓
Central Upper Cretaceous Aquitard	✓	✓	✓	✓						✓	✓	✓
Winton Mackunda Western	✓		✓	✓						✓		✓
Winton Mackunda Central	✓		✓	✓	✓					✓		✓
Winton Mackunda Eastern	✓	✓	✓	✓						✓	✓	✓
Main GAB Aquitard Zones (refer to plan GWQ4165)												
South Western Eromanga Saline Zone	✓											✓
Southern Wallumbilla Fresh Zone	✓											✓
Northern Eromanga Allaru and Toolebuc	✓		✓	✓						✓		✓
Coreena and Doncaster Nebine Ridge	✓			✓	✓					✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
North Central Coreena	✓		✓	✓						✓		✓
Wallumbilla Doncaster Outcrop	✓		✓	✓						✓		✓
Wallum Nebine Unproductive Area	✓											✓
Central Surat Mid Cretaceous	✓		✓	✓								✓
Mid GAB Aquifer Zones (refer to plan GWQ4166)												
Western Hooray	✓		✓	✓						✓		✓
Northern Central Hooray	✓	✓	✓	✓	✓					✓	✓	✓
Southern Hooray Thinning Area	✓		✓	✓						✓		✓
South Saline Gubberamunda	✓		✓	✓						✓		✓
Lower Balonne Gubberamunda	✓	✓	✓	✓						✓	✓	✓
Hooray Northern Outcrop	✓		✓	✓						✓		✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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 GAB Zones (refer to plan GWQ4167)												
Hutton Western Eromanga Region	✓		✓	✓						✓		✓
Southern Limit of Adori	✓		✓	✓						✓		✓
Northern Hutton Outcrop (continued)	✓		✓	✓						✓		✓
Northern Walloons (continued)	✓	✓	✓	✓	✓					✓	✓	✓
Basal GAB Zones (refer to plan GWQ4168)												
Western Evergreen Only	✓		✓	✓						✓		✓
Precipice Outcrop (continued)	✓	✓	✓	✓						✓		✓
North Western Evergreen Outcrop	✓		✓	✓						✓		✓
Eastern Central Area (continued)	✓	✓	✓	✓						✓	✓	✓

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS	Environmental values[1–6]											
	Aquatic ecosystems	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												
Earlier Basins Partially Underlying the GAB Zones (refer to plan GWQ4169)												
Galilee Basin (continued)	✓			✓								✓

Sources: DES 2019. Healthy Waters Management Plan: Queensland Border Rivers and Moonie River Basins. Brisbane: Department of Environment and Science, Queensland Government.

DES 2019. Healthy Waters Management Plan: Condamine River Basin. Brisbane: Department of Environment and Science, Queensland Government.

DES 2019. Healthy Waters Management Plan: Queensland Maranoa and Balonne River Basin. Brisbane: Department of Environment and Science, Queensland Government.

EHP 2016. Healthy Waters Management Plan: Warrego, Paroo, Bulloo and Nebine Basins. Brisbane: Department of Environment and Heritage Protection, Queensland Government.

McNeil, V.H., Raymond, M.A.A., Bennett, L., McGregor, G.B. and Southwell, B. 2018. Regional groundwater chemistry zones: Queensland Murray-Darling Basin. Brisbane: Department of Environment and Science, Queensland Government.

Notes:

1. Refer to the accompanying plans GWQ4161 to GWQ4169 for locations of EVs
2. ✓ means the environmental value is selected for protection. Blank indicates that the environmental value is not selected for protection.
3. Refer to dictionary for further explanation of EVs.
4. Refer to Section 3 and 4 for WQOs applying to the EVs in this table.
5. The selection of human use EVs for waters does not mean that these waters are free of dangerous aquatic organisms. Direct contact with dangerous aquatic organisms should be avoided. Access restrictions may apply in certain locations (e.g. defence, Traditional Owner lands), or at certain times of the year. Restrictions on certain activities (e.g. fishing, camping) may also apply in particular areas. Check with relevant authorities.
6. The selection of EVs for waters does not mean that these are currently free of toxicants (including bio accumulative toxicants). Information about contaminated land can be accessed by searching the Environmental Management and Contaminated Land Registers. For information on per and poly-fluoroalkyl substances (PFAS), including alert areas and links to further health advice on water use in such areas, refer to PFAS in Queensland.
7. ‘Continued’ means the Groundwater aquifer zone continues past the Queensland Murray-Darling and Bulloo basins borders.

2.2 Management goals to support environmental values

2.2.1 Management intent for groundwaters

It is the management intent for all Queensland Murray-Darling and Bulloo River basins' groundwaters that the decision to release wastewater or contaminant to 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 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.

Note 1 — refer to accompanying plans for locations of waters and level of protection/management intent

Note 2 — see the Environmental Protection Regulation 2019, section 35.

Note 3 — see the EPP (Water and Wetland Biodiversity), section 15.

2.3 Management goals for Murray-Darling Basin Plan water resources (whole system)

2.3.1 Management goals to contribute to the achievement of the Murray-Darling Basin Plan

The relevant goals 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; and
b) productive and resilient water-dependent industries, and communities with confidence in their long-term future; and
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)

2.3.2 Management goals in relation to environmental outcomes

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

a) to maintain or improve water-dependent ecosystems of the Murray-Darling Basin; and
b) to maintain or improve the ecosystem functions of water-dependent ecosystems; and
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)

2.3.3 Management goals in relation to water quality and salinity

In the Queensland Murray-Darling and Bulloo River basins:

1. To maintain or improve the water quality objectives for the waters, including salinity levels, for environmental, social, cultural, and economic activity.
2. That water resources remain fit for purpose. (Reflects Basin Plan Section 5.04, 1-2)
3. If the value of a water quality indicator (for example, salinity, nutrients, pesticides, pH, turbidity) is at a level that is better than its water quality objective for a water type, the management goal is to maintain that level.
4. The management goal in relation to managing water flows for dissolved oxygen is to maintain dissolved oxygen at a target value of at least 60% saturation.

2.4 Management goals for the Queensland Murray-Darling and Bulloo River basins

The following goals apply to the Queensland Murray-Darling and Bulloo River basins.

2.4.1 Aquatic Ecosystem Environmental Value

Water Quality Objectives to support the management goals are located in Table 3 and Table 4.

2.4.1.1 Management goal for freshwater stygofauna

Stygofauna are generally adapted to stable environmental conditions, including water quality. Changes to water quality that are beyond the range of conditions normally experienced by stygofauna pose a threat to their survival.

2.4.2 Management Goals for Human Use Environmental Values

WQOs to support the following management goals are located in Table 5.

2.4.2.1 Irrigation water quality

The management goal for irrigation water is that the quality of 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 . Refer to ANZG, 2018 for guidance on how to assess the interactions of irrigation water salinity, sodicity and soil properties to prevent soil degradation. WQOs to support irrigation water quality are provided in Table 10 and Table 11.

(Reflects Basin Plan Section 9.06)

2.4.2.2 Farm Supply Use

The management goal for farm supply use is that the quality of water provided for farm use is suitable for produce preparation and for domestic household uses other than drinking.

2.4.2.3 Stock water quality

The management goal for stock watering is that the quality of water provided to stock watering does not cause deterioration in stock health or condition (noting that water quality requirements may differ by stock type). WQOs to support this management goal are provided in Table 12 and Table 13

2.4.2.4 Aquaculture

The management goal for aquaculture is that the quality of water provided to aquaculture does not cause deterioration in stocked fish, shellfish or crustacean health or condition and human health when consumed (noting that water quality requirements may differ between species). WQOs to support this management goal are provided in Table 7 to Table 9.

2.4.2.5 Raw water for drinking water consumption

The management goals are to:

- minimise the risk that the quality of raw water taken for treatment for human consumption results in adverse human health effects
- maintain the palatability rating of water taken for treatment for human consumption at the level of 'good' as set out in the ADWG
- 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.

WQOs to support this management goal are provided in Table 6.

(Reflects Basin Plan Section 9.05, a-c)

2.4.2.6 Industrial Use

The management goal for industrial use is that the quality of water provided to industry is suitable for use, with an appropriate level of treatment. Industries usually treat water supplies to meet their specific needs. Accordingly, no WQOs are specified in this schedule document for industrial use.

2.4.2.7 Cultural and spiritual values and uses of water

The management goal 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)

WATER QUALITY OBJECTIVES TO PROTECT AQUATIC ECOSYSTEM ENVIRONMENTAL VALUE

3 Water quality objectives to protect aquatic ecosystem environmental values

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.

Where more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the most stringent WQO for each water quality indicator applies, which will then protect all identified EVs. Refer to the following example on selection of most stringent WQOs.

Example: (Note that this is an example only and should not be directly adopted for use)

For groundwater with aquatic ecosystem and drinking water EVs, the respective Sodium (Na) WQOs are:

- aquatic ecosystem groundwater: less than 160 mg/L
- Drinking water: less than 180 mg/L.

In this case the aquatic ecosystem WQO for sodium in groundwater (less than 160 mg/L) is the more stringent, and its adoption therefore supports both the aquatic ecosystem and drinking water EVs.

3.1 Aquatic ecosystem water quality objectives

This section provides physical, chemical and where available, biological water quality objectives (WQOs) to support and protect the aquatic ecosystem EV. (Human use EVs, including, stock watering etc., are addressed in section 4).

The aquatic ecosystem EV is a default applying to all Queensland waters, and therefore the WQOs for aquatic ecosystems form the minimum WQOs for all waters. Where no human use EVs are identified, the WQOs identified for aquatic ecosystem protection remain applicable.

WQOs for specified indicators are listed in the following tables by basin, water type/catchment, management intent, and flow regime/season where indicated.

- Table 3: Queensland Murray-Darling and Bulloo River basins Groundwater Water Quality Objectives: Physicochemical (nutrients, minerals, ions)
- Table 4: Queensland Murray-Darling and Bulloo River basins Groundwater Water Quality Objectives: Additional indicators

Details on management intent are included in the tables and notes supporting tables. Links to wetland, riparian and State Planning Policy (state interest – water quality) mechanisms are provided in and after the tables. Sources used in deriving WQOs are provided in and after the tables. WQOs for metals and other toxicants, where not stated in this document, are referred to in the ANZG guidelines (2018, as amended).

3.1.1 Comparison of test data with water quality objectives

The following protocols are recommended when comparing water quality (at a ‘test’ site) with the corresponding aquatic ecosystem water quality objective (WQO). The management intent for groundwaters is that there should be ‘no change’ to existing water quality, i.e. no change in the natural range of values. No change is deemed to have occurred if there are no detectable changes to the 20th, 50th and 80th percentiles of the natural distribution of values.

For HEV and SD waters:

- Where the WQO is expressed as a 20^{th}–50^{th}–80^{th} percentile range of values (e.g. Total N: 0.065–0.1–0.125 mg/L), the 20^{th}–50^{th}–80^{th} percentile distributions of the test data should meet the specified range of values. Ideally, the sample number is a minimum of 24 test values over the relevant period (12 months if a continuous activity or alternatively a shorter period for activities where discharge occurs for only part of the year).

For MD and HD waters:

- The median value (e.g. concentration) of preferably five or more independent samples at a monitoring (test) site should be compared against the corresponding aquatic ecosystem WQO (WQOs in these waters are typically expressed as a single figure).

For toxicants in water: unless otherwise stated, WQOs for toxicants are derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) default guideline values for the corresponding level of species protection. The ANZG (2018) recommends that the 95th percentile of test data is compared against the default guideline value. As the proportion of test values that is required to be less than the default guideline value is high, the ANZG indicates that a single observation greater than the default guideline value is considered an exceedance.

Further information: Refer to the QWQG, the Queensland Monitoring and Sampling Manual (2018), and the ANZG (2018) for more details.

AQUATIC ECOSYSTEM WATER QUALITY OBJECTIVES

QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS

Table 3: Aquatic ecosystem water quality objectives – Queensland Murray-Darling and Bulloo River basins groundwaters[1-4]

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)														
	Note: BDL – below detection limit, ID – insufficient data														
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Alluvium															
1 - Southern Condamine	20th	48	36	27	295	56	1	BDL	728	222	7.5	256	27	BDL	BDL
	50th	82	54	48	424	100	4	1	1000	340	7.9	369	35	0.207	0.033
	80th	159	77	77	590	220	12	8.3	1450	490	8.3	500	43.8	1.804	0.216
1 - Southern Condamine near stream	20th	47	37	28	300	55	1	BDL	731	229	7.5	265	27	BDL	BDL
	50th	81	55	50	437	100	4	0.9	1000	346	7.9	384	35	0.196	0.033
	80th	160	78	78	598	223	12	8	1450	495	8.3	506	43	1.739	0.229
2 - Central Condamine	20th	82	19	13	239	68	5	0.2	606	105	7.4	196	28	0.043	BDL
	50th	207	32	22	380	161	19	0.5	1150	174	7.9	320	34	0.109	0.033
	80th	407	56	45	464	447	70	2	2050	315	8.3	388	40	0.435	0.144
2 - Central Condamine near stream	20th	64	20	15	215	65	4	0.3	600	117	7.3	175	26	0.054	BDL
	50th	153	34	24	369	130	15	0.5	980	185	7.9	308	32	0.109	0.033
	80th	369	55	43	445	403	76	2.5	2000	315	8.3	373	37	0.543	0.163
3 - North Branch	20th	82	27	17	280	54	4	BDL	660	145	7.5	240	29	BDL	BDL
	50th	104	37	26	378	77	9	0.5	800	199	7.9	318	36	0.109	0.033
	80th	146	51	33	445	125	24	1	1000	250	8.3	371	40	0.217	0.098

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
3 - North Branch near stream	20th	66	26	15	237	51	2	0.1	610	134	7.4	204	28	0.022	ID
	50th	92	36	21	335	70	5	0.5	720	177	7.9	280	34	0.109	0.098
	80th	117	62	33	426	111	11	1.1	970	265	8.2	359	39.4	0.239	ID
4 - Hodgson	20th	389	31	47	352	401	70	0.5	2200	293	7.4	306	20	0.109	ID
	50th	620	58	81	456	825	200	1.8	3815	478	7.8	392	27.5	0.391	0
	80th	1178	106	183	560	1901	447	5	7280	887	8.3	500	32	1.087	ID
5 - Oakey	20th	306	20	32	363	270	33	0.5	1800	198	7.6	307	25	0.109	BDL
	50th	456	37	50	460	556	90	1.4	2485	308	8	385	29	0.304	BDL
	80th	774	77	96	630	1200	168	4.6	4396	572	8.4	532	34	0.991	0.033
5 - Oakey near stream	20th	229	19	23	362	218	21	0.1	1264	151	7.52	299	25.4	0.026	ID
	50th	380	37	49	455	550	75	1.3	2460	301	8	380	32	0.288	0.016
	80th	620	59	67	509	755	143	3	3428	392	8.3	439	37	0.652	ID
6 - Myall	20th	294	30	35	382	329	14	0.5	1848	216	7.4	330	24	0.109	ID
	50th	374	47	52	445	500	44	1	2240	342	8	382	29	0.207	ID
	80th	594	65	69	561	798	90	4.4	3300	454	8.4	500	32.4	0.957	ID
6 - Myall near stream	20th	422	31	34	358	426	43	0.5	2264	226	7.58	318	23	0.109	ID
	50th	560	50	51	465	790	68	0.5	3150	384	8.1	390	29	0.109	ID
	80th	870	76	99	616	1300	147	3.8	5056	615	8.5	559	33	0.826	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
7 - Northwest Condamine	20th	496	36	41	326	636	44	0.1	2700	300	7.4	305	25	0.022	BDL
	50th	843	84	92	450	1395	120	1.3	4800	596	7.8	390	37	0.283	BDL
	80th	1548	182	216	568	3058	185	5.3	9264	1313	8.2	476	49	1.157	0.033
7 - Northwest Condamine near stream	20th	266	21	19	260	210	8	ID	1460	136	7.32	236	ID	ID	ID
	50th	544	42	41	477	680	20	5.6	2700	321	7.9	405	26	1.207	ID
	80th	1795	142	181	552	3414	208	ID	10900	1049	8.3	497	ID	ID	ID
8 - Lower Condamine	20th	78	11	11	168	86	8	0.2	580	75	7.2	139	13	0.035	ID
	50th	402	41	39	311	450	52	0.5	2020	256	7.8	260	23	0.109	ID
	80th	1854	110	185	573	3210	224	1	10180	1088	8.1	494	56.8	0.222	ID
8 - Lower Condamine near stream	20th	79	12	13	160	87	15	0.1	578	87	7.16	135	12.8	0.022	ID
	50th	393	44	44	310	522	62	0.4	2100	290	7.7	259	28.5	0.087	ID
	80th	1949	114	185	478	3350	231	0.7	10600	1098	8	400	62.2	0.148	ID
9 - Wooloowins	20th	161	44	51	311	320	8	0.5	1519	351	7.6	265	30	0.109	BDL
	50th	261	74	76	402	485	14	2.2	2050	496	7.9	336	37	0.478	BDL
	80th	382	125	115	557	799	30	5.4	2962	750	8.2	465	43	1.165	0.033
9 - Wooloowins near stream	20th	185	43	56	292	345	9	0.5	1485	371	7.64	246	30	0.109	BDL
	50th	275	83	99	415	613	16	2.3	2300	636	8	348	36	0.5	BDL
	80th	400	140	145	573	1016	37	6	3650	893	8.2	489	43	1.304	0.033

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
10 - Upper Balonne	Insufficient Data														
10 - Upper Balonne near stream	Insufficient Data														
11 - Border Rivers	20th	163	14	12	110	128	15	0.4	816	92	6.5	123	31	0.091	ID
	50th	389	36	24	259	504	62	2.5	2040	187	7.3	220	60	0.543	0.049
	80th	4902	800	668	523	9774	1170	12.5	26060	4710	8	433	82.6	2.717	ID
11 - Border Rivers near stream	20th	95	11	9	141	83	15	0.3	691	61	7.2	151	34.8	0.063	ID
	50th	236	35	21	309	185	43	4.2	1500	177	7.5	283	54	0.913	ID
	80th	3414	525	398	553	6542	926	12.5	21180	3002	8.12	456	70.8	2.717	ID
12 - Upper Maranoa	Insufficient Data														
12 - Upper Maranoa near stream	Insufficient Data														
13 - Upper Dumaresq	20th	58	18	9	140	42	5	BDL	508	83	7.1	115	20.6	BDL	BDL
	50th	112	33	16	248	86	16	0.5	843	153	7.7	207	34	0.109	BDL
	80th	147	58	27	411	150	34	2.2	1102	249	8.1	341	46.4	0.478	BDL
13 - Upper Dumaresq near stream	20th	58	18	9	140	41	5	BDL	499	83	7.1	116	20.4	BDL	BDL
	50th	112	32	16	249	86	16	0.5	833	150	7.7	207	34	0.109	BDL
	80th	147	58	27	415	150	32	2.1	1101	247	8.1	347	46	0.465	BDL

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
14 - Macintyre Brook	20th	Insufficient Data													
	50th	206	6	3	344	133	7	0.3	1343	18	7.7	327	43	0.054	ID
	80th	Insufficient Data													
14 - Macintyre Brook near stream	20th	Insufficient Data													
	50th	206	6	3	344	133	7	0.3	1342.5	18	7.7	327	43	0.05	ID
	80th	Insufficient Data													
15 - Lower Maranoa	20th	53	17	10	163	52	5	0.2	354	87	6.64	138	51	0.033	ID
	50th	157	26	38	196	125	37	0.3	1185	220	8	165	54	0.054	ID
	80th	873	116	77	259	1459	254	2.5	4700	608	8.2	214	74.6	0.543	ID
15 - Lower Maranoa near stream	20th	56	19	13	163	57	9	0.2	346	110	6.72	140	51	0.033	ID
	50th	163	45	41	201	129	41	0.3	1188	273	7.95	167	54	0.054	ID
	80th	929	129	81	270	1541	263	2.5	4940	656	8.2	223	74.6	0.543	ID
16 - Lower Balonne	20th	85	6	4	135	62	14	0.2	512	30	7.2	114	29.4	0.048	BDL
	50th	261	13	9	299	110	40	3	1090	62	7.8	251	42	0.652	BDL
	80th	824	47	37	640	876	141	12.2	3600	256	8.2	541	67.6	2.652	BDL
16 - Lower Balonne near stream	20th	285	9	7	339	188	33	0.3	1110	49	7.74	313	52.6	0.054	ID
	50th	410	41	32	560	511	98	4.8	2140	231	8.2	482	65	1.043	ID
	80th	907	58	47	854	1020	158	12.7	4259	361	8.4	701	72	2.77	ID

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
17 - Moonie	Insufficient Data														
18 - Wallam	Insufficient Data														
19 - Upper Warrego	20th	58	17	7	78	52	17	BDL	480	76	7.1	100	ID	BDL	ID
	50th	157	26	18	145	195	47	1.9	1125	137	7.7	138	61.5	0.413	ID
	80th	357	59	38	213	386	86	4	2368	317	8.2	203	ID	0.87	ID
19 - Upper Warrego near stream	20th	61	16	7	72	52	14	BDL	482	75	7.1	104	48.8	BDL	BDL
	50th	157	26	18	145	195	47	1.9	1125	137	7.7	143	61	0.413	BDL
	80th	336	56	36	223	357	81	4.4	2260	294	8.16	208	65	0.957	BDL
20 - Lower Warrego	Insufficient Data														
20 - Lower Warrego near stream	Insufficient Data														
21 - Paroo	Insufficient Data														
22 - Bulloo	Insufficient Data														

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Fractured rock															
1 - Upper Condamine Basalts	20th	50	18	16	293	45	BDL	BDL	675	124	7.6	242	23	BDL	BDL
	50th	77	46	65	513	98	4	2.5	1021	412	7.9	425	36	0.543	BDL
	80th	120	73	115	653	205	9	23	1500	640	8.3	536	45.6	5	0.082
2 - Toowoomba Region Basalts	20th	67	16	6	182	87	4	0.4	665	77	7.5	153	19.8	0.087	BDL
	50th	98	53	61	359	180	10	4.9	1200	402	7.9	298	34	1.054	BDL
	80th	145	100	120	540	355	22	34	1700	720	8.2	450	45	7.391	BDL
3 - Lower Condamine Basalts	20th	100	17	9	274	94	7	BDL	810	87	7.6	229	36	BDL	BDL
	50th	158	51	50	427	196	16	0.6	1320	379	8	370	51	0.13	BDL
	80th	290	105	104	553	550	27	17.3	2600	649	8.3	465	60	3.761	BDL
4 - Eastern Basement With Basalt Remnants (merged with Fitzroy River basin, Zone 3)	20th	157	10	4	361	104	12	BDL	1035	51	8	308	18	BDL	0.01
	50th	225	32	52	519	275	30	0.3	1500	331	8.3	432	25	0.065	0.033
	80th	664	106	128	715	884	130	3.2	2870	727	8.5	594	54.8	0.687	0.082
5 - Main Range Volcanics (continues as Fitzroy River basin, Zone 7)	20th	72	15	13	302	35	4	0.4	695	104	7.5	248	25	0.087	BDL
	50th	122	38	44	460	80	12	2.6	1038	291	8	383	45	0.554	0.082
	80th	237	68	80	602	245	46	20	1871	488	8.3	500	61	4.348	0.082
6 - Border Rivers Headwaters	20th	90	41	22	170	100	11	BDL	854	235	7.32	156	21	BDL	ID
	50th	246	75	52	400	348	54	0.5	2025	448	7.7	335	28	0.109	ID
	80th	430	138	160	622	1116	200	3	4486	925	8.1	515	35.8	0.652	ID

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
7 - Glenlyon	20th	Insufficient Data													
	50th	163	143	58	463	119	235	1.3	2050	530	7.45	313	35.5	0.272	ID
	80th	Insufficient Data													
8 - New England Granite	20th	32	6	3	20	30	3	0.2	272	45	6.6	16	33.6	0.043	ID
	50th	58	20	8	61	67	11	1	550	105	7.1	50	52.5	0.217	ID
	80th	176	42	21	152	329	27	19	1230	166	7.58	128	67.8	4.13	ID

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
Sediments overlying the GAB															
1 - Weathered Alluvium	20th	219	18	10	50	167	41	BDL	1316	92	7.2	103	31	BDL	ID
	50th	624	64	37	247	929	248	0.1	3650	427	7.6	244	57	0.011	0
	80th	4164	318	268	474	6816	1422	12.5	24040	2399	8.06	449	75	2.717	ID
1 - Weathered Alluvium near stream	Insufficient Data														
2 - Sand Dunes	Insufficient Data														
3 - Tertiary Sediments	Insufficient Data														

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
Upper GAB															
1 - Winton Mackunda Western	20th	334	22	10	BDL	402	9	BDL	1322	105	7.2	107	18	BDL	ID
	50th	864	64	27	BDL	1301	129	2.2	4940	262	7.7	180	20.5	0.467	ID
	80th	1814	184	94	171	2995	449	8	8880	871	8.16	282	43.4	1.739	ID
2 - Winton Mackunda Central	Insufficient Data														
3 - Winton Mackunda Eastern	20th	276	21	13	BDL	171	22	BDL	1342	101	7.4	129	16.4	BDL	BDL
	50th	1025	59	40	240	1260	138	0.5	5100	291	7.85	283	38	0.109	BDL
	80th	1577	139	97	524	2465	406	6.9	9000	714	8.2	510	53	1.491	BDL
4 - South West Upper Cretaceous Aquitard	Insufficient Data														
5 - Central Upper Cretaceous Aquitard	20th	Insufficient Data													
	50th	460	14	11	259	455	37	ID	2350	70	7.95	310	ID	ID	ID
	80th	Insufficient Data													
6 - Probable Upper Cretaceous Aquitard	20th	202	21	21	165	345	18	12	1284	140	7.78	136	ID	ID	ID
	50th	655	79	77	342	913	60	20.6	3150	520	8	300	ID	ID	ID
	80th	1552	144	187	536	2980	145	29.2	8750	1415	8.2	440	ID	ID	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)														
	Note: BDL – below detection limit, ID – insufficient data														
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Main GAB Aquitard															
1 - Eastern Wallumbilla Outcrop	20th	440	3	1	55	158	BDL	BDL	1620	10	7.1	151	13	BDL	ID
	50th	660	14	6	506	650	9	BDL	3000	53	8.1	567	17	BDL	ID
	80th	3318	479	317	857	5729	742	2.2	13288	2411	8.5	760	49.8	0.483	ID
2 - Wallumbilla Doncaster Outcrop	20th	158	10	2	BDL	199	53	BDL	1135	35	7.4	109	12.6	BDL	BDL
	50th	279	74	16	82	360	140	BDL	1830	271	7.6	155	17	BDL	BDL
	80th	777	301	161	240	1616	962	1.7	7692	1314	8.12	229	23.6	0.37	BDL
3 - Central Surat Mid Cretaceous	20th	468	29	14	90	365	45	BDL	3746	151	6.8	101	35.8	BDL	BDL
	50th	2010	256	169	253	3282	465	1.3	26400	1322	7.5	222	56	0.272	BDL
	80th	6017	1104	1006	452	12572	1876	12.5	50980	6782	8	373	78.2	2.717	BDL
4 - Wallum Nebine Unproductive Area	20th	293	7	2	128	180	38	BDL	1311	23	7.6	140	15	BDL	ID
	50th	333	18	7	247	291	175	0.5	1550	69	8.2	219	17	0.109	BDL
	80th	679	137	68	381	978	285	1.6	3288	613	8.4	327	22	0.352	ID
5 - Coreena and Doncaster Nebine Ridge	20th	270	5	1	163	122	BDL	BDL	1057	19	7.8	170	17	BDL	ID
	50th	485	18	7	325	617	2	0.6	2190	72	8.2	300	19	0.136	ID
	80th	996	76	44	495	1550	22	2.6	4784	340	8.5	429	20	0.557	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
6 - Southern Wallumbilla Fresh Zone	20th	203	2	0.2	268	57	BDL	BDL	836	9	8	305	17	BDL	BDL
	50th	230	4	1	432	80	BDL	BDL	930	14	8.3	371	20	BDL	BDL
	80th	398	14	4	506	348	2	1	1437	70	8.5	440	23.6	0.217	BDL
7 - South Western Eromanga Saline Zone	20th	375	24	6	BDL	400	31	0.1	1587	109	7	98	19	0.011	BDL
	50th	713	57	14	98	958	165	2.1	3580	208	7.6	157	22	0.457	BDL
	80th	1220	150	40	248	2204	384	7.8	5636	577	8	285	30	1.696	BDL
8 - Northern Eromanga Allaru and Toolebuc	20th														
	50th	339	10	4	383	242	30	0.4	1711	42	7.9	351	ID	0.082	ID
	80th														
9 - North Central Coreena	20th	178	11	4	BDL	157	29	0.4	942	50	7.2	83	19	0.096	ID
	50th	441	54	24	124	615	93	1.4	1486	259	7.8	129	55	0.304	ID
	80th	1637	194	82	292	2502	527	5.9	4214	774	8.1	272	63.2	1.283	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Mid GAB Aquifers															
1 - Northern Maranoa Bungils	20th	210	6	1	BDL	125	47	BDL	940	20	7.2	88	13	BDL	BDL
	50th	443	28	5	BDL	443	120	0.5	1500	122	7.9	191	16	0.109	BDL
	80th	1150	202	57	276	1338	807	2.2	4552	783	8.4	301	20	0.487	0.013
2 - Central Mooga and Orallo Outcrops	20th	199	3	0.4	BDL	102	20	BDL	965	11	7.6	239	11	BDL	ID
	50th	356	13	4	316	220	76	0.5	1320	55	8.2	334	15.5	0.109	0.016
	80th	587	50	21	452	660	226	2	2732	211	8.6	453	21	0.435	ID
3 - Eastern Cretaceous Outcrop	20th	157	3	1	120	89	1	0.1	922	13	7.3	101	13.2	0.026	BDL
	50th	386	9	4	257	331	8	0.5	1650	44	8.05	219	16	0.109	BDL
	80th	998	73	19	624	1501	96	1.3	4160	242	8.5	540	32.4	0.283	0.065
4 - Hooray Northern Outcrop	20th	77	20	6	BDL	75	32	BDL	590	85	7.3	89	ID	BDL	ID
	50th	115	42	15	169	156	66	BDL	900	185	7.6	168	28.5	BDL	ID
	80th	261	132	41	248	326	350	0.5	1920	519	8.1	214	ID	0.109	ID
5 - Lower Balonne Gubberamunda	20th	255	2	BDL	416	88	BDL	BDL	1070	5	8	352	21	BDL	BDL
	50th	341	2	0.3	561	130	5	0.3	1360	8	8.4	496	26	0.054	BDL
	80th	508	4	1	862	260	29	1	2022	15	8.6	761	29	0.217	BDL
6 - North Wallumbilla Bungil and Mooga (merged with Fitzroy River basin, Zone '3 Bungil and Mooga Outcrops')	20th	480	5	1	BDL	355	10	BDL	2093	20	7.3	143	13	BDL	ID
	50th	872	24	6	195	1170	117	0.5	4070	94	8.1	287	15	0.109	0.016
	80th	1842	112	42	442	2651	575	3.3	9140	426	8.5	461	16	0.722	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)														
	Note: BDL – below detection limit, ID – insufficient data														
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
7 - Northern Central Hooray	20th	244	3	0.2	27	164	64	BDL	1120	9	7.6	138	14.2	BDL	ID
	50th	330	10	2	226	240	102	0.5	1525	37	8.1	215	18	0.109	BDL
	80th	535	58	13	341	708	210	2.5	2720	189	8.5	335	21	0.543	ID
8 - Northern Surat Thickest Bungil and Mooga	20th	355	1	BDL	520	120	BDL	BDL	1480	5	8.1	496	14	BDL	BDL
	50th	444	2	1	763	154	1	0.5	1750	11	8.4	680	17	0.109	BDL
	80th	521	4	1	988	251	24	0.5	2050	16	8.7	874	20	0.109	0.049
9 - Northern Central Outcrop Area	20th	47	11	2	BDL	46	18	BDL	594	42	7.26	69	14	BDL	ID
	50th	225	47	7	73	180	100	0.5	1420	156	7.7	150	18.5	0.109	ID
	80th	460	80	18	293	494	235	1.1	2200	273	8	283	29	0.239	ID
10 - South Saline Gubberamunda	20th	216	3	0.1	159	87	BDL	BDL	914	9	7.6	149	15	BDL	ID
	50th	619	20	6	305	847	BDL	BDL	2949	77	8.1	255	19	BDL	ID
	80th	1108	63	20	481	1755	4	2.1	5284	259	8.4	410	24	0.465	ID
11 – South East Kumbarilla	20th	320	2	0.1	470	72	BDL	BDL	1260	6	8	533	13	BDL	BDL
	50th	425	3	1	728	120	2	0.5	1670	10	8.4	674	15	0.109	BDL
	80th	532	4	2	970	258	7	1.3	2100	19	8.6	878	18	0.283	0.033
12 - Southern Hooray Thinning Area	20th	183	2	0.1	324	59	BDL	BDL	750	6	8	290	18	BDL	ID
	50th	214	4	1	417	70	BDL	BDL	878	12	8.3	362	21	BDL	BDL
	80th	274	7	2	490	151	2	0.7	1050	26	8.5	421	23	0.152	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
13 - Surat Thicker Mooga Saline Area	20th	430	4	0.1	403	275	BDL	BDL	1900	9	8.2	335	16	BDL	ID
	50th	506	4	0.3	543	439	3	0.5	2308	11	8.4	492	18	0.109	ID
	80th	570	6	1	660	530	75	1	2550	19	8.52	561	21	0.226	ID
14 - Western Hooray	20th	171	2	0.1	313	55	BDL	BDL	730	7	8	274	20	BDL	BDL
	50th	223	3	0.3	430	74	1	BDL	928	10	8.3	372	23	BDL	BDL
	80th	291	5	1	555	135	8	1.1	1200	18	8.6	473	26	0.239	BDL

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Lower GAB															
1 - Central Surat Springbok Area (continues as Fitzroy River basin, Zone 1)	20th	234	2	0.1	353	80	1	BDL	1035	6	7.9	321	14	BDL	BDL
	50th	315	3	1	544	120	10	0.5	1300	12	8.3	475	18	0.109	BDL
	80th	521	10	4	754	360	34	1.2	2000	38	8.6	668	28	0.261	BDL
2 - Eastern Springbok Outcrop	20th	246	5	2	201	186	1	BDL	1420	19	7.5	195	13	BDL	ID
	50th	677	20	11	345	737	8	0.7	3175	96	8	309	18	0.152	BDL
	80th	1821	86	82	826	2939	47	2.5	9480	602	8.4	790	52	0.543	ID
3 - Fresh Hutton South-eastern Outcrop	20th	175	25	24	325	232	7	0.2	1400	185	7.7	277	16.2	0.035	ID
	50th	361	59	57	504	412	25	1.5	2150	380	8	420	24.5	0.326	BDL
	80th	590	121	90	663	948	50	21.4	3780	672	8.3	561	36.6	4.652	ID
4 - North East Walloons	20th	339	12	6	249	339	4	BDL	1850	58	7.5	230	12	BDL	BDL
	50th	750	53	41	390	968	36	1	3700	308	8	345	15	0.217	BDL
	80th	1548	154	134	613	2922	134	5	9100	859	8.4	538	27.6	1.087	0.033
5 – North Eastern Hutton Outcrop (continues ad Fitzroy River basin, Zone 5)	20th	420	7	1	64	466	BDL	BDL	2000	26	7.5	149	12	BDL	ID
	50th	669	24	8	243	894	18	0.5	3000	116	7.9	232	15	0.109	BDL
	80th	1250	83	77	522	1904	84	3.1	5680	533	8.4	485	40	0.674	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
6 - Northern Hutton Outcrop (merged with Fitzroy River basin, Zone 9)	20th	40	21	5	BDL	40	10	BDL	456	94	7	135	12	BDL	ID
	50th	78	36	15	213	65	26	0.3	590	162	8	185	19.5	0.054	ID
	80th	135	62	27	262	189	63	0.7	951	257	8.3	218	35.8	0.152	ID
7 - Northern Walloons (continues as Fitzroy River basin, Zone 4)	20th	239	3	1	181	176	BDL	BDL	1100	11	7.9	218	12	BDL	ID
	50th	510	9	3	323	580	6	0.6	2200	32	8.2	308	15	0.13	ID
	80th	1280	53	14	496	1890	40	2.9	5600	189	8.6	438	20	0.622	ID
8 - Saline South Eastern Hutton Outcrop	20th	235	23	12	210	304	4	BDL	1558	101	7.4	180	12.6	BDL	ID
	50th	579	56	38	385	766	27	0.5	2880	307	7.9	333	18	0.109	BDL
	80th	1490	142	127	634	2482	166	6.2	7450	810	8.2	522	37.4	1.348	ID
9 - South East Walloons	20th	122	10	4	290	101	4	BDL	910	46	7.7	250	12	BDL	BDL
	50th	225	39	28	456	234	14	1	1510	225	8	391	17	0.217	BDL
	80th	428	89	89	664	568	45	6.1	2600	562	8.4	563	30.4	1.317	0.033
10 – South Eastern Hutton Outcrop	20th	140	26	14	227	165	9	BDL	1128	142	7.4	190	13	BDL	BDL
	50th	260	65	48	410	380	20	0.7	1825	391	7.8	346	20	0.152	BDL
	80th	506	140	145	580	1051	53	3.6	3912	958	8.2	485	30	0.783	0.026
11 - Southern Limit of Adori	20th	93	2	0.3	78	59	8	ID	517	7	7.76	112	ID	BDL	ID
	50th	132	18	4	176	80	13	0.5	567	61	8.1	180	18.5	0.109	ID
	80th	285	42	8	221	361	20	ID	1450	143	8.6	194	ID	0.217	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
12 - Hutton Western Eromanga Region	20th	121	2	BDL	186	52	2	BDL	602	6	7.88	162	22	BDL	ID
	50th	177	3	0	311	71	12	BDL	814	8	8.3	270	29.5	BDL	BDL
	80th	254	6	2	420	105	24	0.5	1406	22	8.6	384	38	0.109	ID

	QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)													
	Note: BDL – below detection limit, ID – insufficient data													
Zone	**%ile**	**Na**	**Ca**	**Mg**	**HCO_3**	**Cl**	**SO_4**	**NO_3**	**EC**	**Hardness**	**pH**	**Alkalinity**	**SiO_2**	**NO_3-N**	**PO_4-P**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µS/cm**	**mg/L**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
Basal GAB															
1 - Precipice Outcrop (merged with Fitzroy River basin, Zone 3)	20th	17	15	6	102	16	4	BDL	268	76	7.04	90	11.2	BDL	ID
	50th	23	24	12	136	25	10	BDL	345	110	7.5	133	13	BDL	BDL
	80th	34	38	18	189	35	14	0.5	446	157	8.1	188	20.2	0.109	ID
2 - Eastern Central Area (merged with Fitzroy River basin, Zone 5)	20th	87	2	0.2	157	40	BDL	BDL	390	6	7.5	163	14	BDL	ID
	50th	255	3	1	420	99	5	0.3	1055	11	8.2	347	19	0.054	BDL
	80th	342	8	5	673	163	28	1	1484	32	8.6	568	26	0.217	ID
3 – Eastern Evergreen Outcrop (merged with Fitzroy River basin, Zone 2)	20th	300	8	2	183	201	1	BDL	1684	34	7.3	172	14.2	BDL	ID
	50th	700	20	7	421	656	12	0.8	3320	85	7.75	357	17	0.174	ID
	80th	1472	108	98	620	1740	31	3	5585	588	8.3	522	20	0.652	ID
4 – South Eastern Evergreen	20th	157	10	6	201	163	2	BDL	1060	43	7.4	173	14	BDL	ID
	50th	380	40	29	452	480	21	0.5	2373	230	7.9	380	26	0.109	ID
	80th	722	123	88	603	961	70	3	3760	673	8.2	525	41.6	0.652	ID
5 – North Western Evergreen Outcrop	20th	16	7	6	24	22	7	BDL	188	44	6.28	38	11	BDL	ID
	50th	22	13	10	68	35	13	0.1	305	81	7.05	65	12	0.011	ID
	80th	53	63	21	177	134	50	0.5	918	224	7.82	147	13	0.109	ID
6 - Western Evergreen Only	20th	36	3	0.1	95	16	5	ID	435	9	7.9	85	ID	ID	ID
	50th	104	7	1	177	53	19	BDL	520	22	8.2	158	28	BDL	ID
	80th	118	8	1	192	56	21	ID	543	38	8.5	165	ID	ID	ID

Zone	%ile	Na	Ca	Mg	HCO_3	Cl	SO_4	NO_3	EC	Hardness	pH	Alkalinity	SiO_2	NO_3-N	PO_4-P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L		mg/L	mg/L	mg/L	mg/L
QUEENSLAND MURRAY-DARLING AND BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives (Also refer to WQOs in Table 4)															
Note: BDL – below detection limit, ID – insufficient data															
Basins Underlying GAB															
1 - Bowen Basin (merged with Fitzroy River basin zone '8 Lower Bowen')	20th	46	2	0.2	109	10	BDL	BDL	200	5	7.4	92	13	BDL	ID
	50th	435	2	0.3	644	98	BDL	BDL	1660	7	8.2	564	17	BDL	BDL
	80th	833	5	1	1300	223	2	0.5	2960	18	8.6	1123	22	0.109	ID
2 - Upper Bowen Basin (merged with Fitzroy River basin zone '8 Lower Bowen')	20th	46	2	0.2	109	10	BDL	BDL	200	5	7.4	92	13	BDL	ID
	50th	435	2	0.3	644	98	BDL	BDL	1660	7	8.2	564	17	BDL	BDL
	80th	833	5	1	1300	223	2	0.5	2960	18	8.6	1123	22	0.109	ID
2 - Galilee Basin (merged with Fitzroy River basin zone '2 Southern Galilee Clematis')	20th	105	3	1	16	31	BDL	ID	514	13	7.2	182	ID	ID	ID
	50th	124	5	2	253	50	BDL	1	595	17	8	218	13	0.217	ID
	80th	143	9	4	300	89	5	ID	1272	39	8.2	250	ID	ID	ID

Notes:

1. Indicators: Na: Sodium, Ca: Calcium, Mg: Magnesium, HCO_3: Bicarbonate, Cl: Chloride, SO_4: Sulfate, NO_3: Nitrate, EC: Electrical conductivity, SiO_2: Silica, NO_3-N: nitrate nitrogen, PO_4-P: phosphate phosphorus. **Units:** mg/L – milligrams per litre, µS/cm – microsiemens/centimetre, meq/L – milliequivalents/L Abbreviations: BDL – below detection limit, ID – insufficient data

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, 50th 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 (20th, 50th and 80th 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. 40th percentile) value.

3. Low PO_4-P values (e.g. recordings of zero) may be due to concentrations below detection limits. Concentrations of PO_4-P 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).

4. 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 plans GWQ4161-GWQ4169 accompanying this report, available on the department's website.

Reference: Holman, IP, Whelan, MJ, Howden, NJK, Bellamy, PH, Willby, NJ, Rivas-Casado, M & McConvey, P. 2008, 'Phosphorus in groundwater – an overlooked contributor to eutrophication?'. Hydrological Processes, vol. 22, no: 5121–5127.

Table 4 Queensland Murray-Darling & Bulloo River basins Groundwaters Water Quality Objectives: Additional indicators for aquatic ecosystem environmental value

Water type	Management intent /Level of protection	QUEENSLAND MURRAY-DARLING & BULLOO RIVER BASINS GROUNDWATERS Aquatic ecosystem water quality objectives
		Sources: S1: Local datasets/reporting; S2: Murray-Darling Basin Plan 2012, Schedule 11 (A2, B2, C2)
TOXICANTS (INCLUDING PESTICIDES, HERBICIDES)		
All basins - HEV, SD groundwaters: **Toxicants (s2)**	**HEV/SD**	• Toxicants (including pesticides, herbicides) in water: refer to ANZG 'toxicant default guideline values for water quality in aquatic ecosystems' 99% species protection values • Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'
All basins - groundwaters: **Toxicants (s2)**	**MD**	• Toxicants (including pesticides, herbicides) in water: refer to ANZG 'toxicant default guideline values for water quality in aquatic ecosystems' MD level of protection typically corresponds to protection of 95% species (in a small number of cases where bioaccumulation may occur, the ANZG recommends 99% species protection level). • Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'
END OF VALLEY SALINITY TARGETS		
All basins - groundwaters	**All**	Refer to section 3.1
WETLANDS		
Ramsar wetlands		In Ramsar wetlands of international significance, the management goal is that the quality of water is sufficient to maintain the ecological character of the wetlands.
Wetlands other than Ramsar wetlands	**All**	To protect the aquatic ecosystem values of lakes, they should be protected against threats of secondary salinity and sedimentation, refer to Section 5 for ways to prevent sedimentation and to *Queensland Murray-Darling & Bulloo region surface water schedule documents* (available on the department's website) for End-of-Basin Salinity Targets. As additional data becomes available, it is recommended that water quality targets are developed for wetlands.
Wetlands extent	**All**	Refer to *Queensland Murray-Darling & Bulloo region surface water schedule documents* (available on the department's website) for wetland extents relevant to each basin.

Sources:

Australian Government (2013) Guidelines for groundwater quality protection in Australia: National Water Quality Management Strategy, Department of Agriculture and Water Resources, Canberra, March. CC BY 3.0. Further information available from the water quality Australia website.

WATER QUALITY OBJECTIVES
for
HUMAN USE ENVIRONMENTAL VALUES

4 Water quality objectives for human use environmental values (EVs)

This section outlines water quality objectives (WQOs) to protect human use environmental values (EVs), which comprise those EVs (e.g. recreation, stock watering, aquaculture and crop irrigation) other than the aquatic ecosystem EV. The tables in section 2 of this document outline the EVs that have been identified for different waters. Where a human use EV has been identified, the following tables can be used to identify the WQOs to support that EV. Where more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the adoption of the most stringent WQO for each water quality indicator will then protect all identified EVs.

WQOs in this section are, unless otherwise specified, based on relevant national water quality guidelines including ANZG (2018, as amended) and the Australian Drinking Water Guidelines (ADWG). Where national guidelines or other codes remain the primary source for WQOs, reference to those national guidelines or codes is necessary to obtain comprehensive listings of all indicators and corresponding WQOs.

The following table summarises WQOs for human use EVs. More details are provided in subsequent sections by human use EV.

Table 5 Human use EVs water quality objectives

Environmental value	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for drinking water supply	The Australian Drinking Water Guidelines (NHMRC, 2011, as amended) provides a framework for catchment management and source water protection for drinking water supplies. Quality of raw water (prior to treatment) should consider the requirements of water supply operators, and their capacity to treat the water to make it safe for human consumption. Also refer to Table 6. Note: For water quality after treatment or at point of use refer to legislation and guidelines, including: • *Public Health Act 2005* and Regulation • *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water quality management plan under the Act • *Water Fluoridation Act 2008* and Regulation • *Australian Drinking Water Guidelines* (ADWG, 2011, as amended). • Safe Water on Rural Properties guideline (Queensland Health, 2015) Whether water is drawn from surface catchments or underground sources, it is important that the local catchment or aquifer is understood, and that the activities that could lead to water contamination are identified and managed. Effective catchment management and source water protection include development of a catchment management plan, with the commitment of land use planning authorities to prevent inappropriate development and to enforce relevant planning regulations.
Protection of the human consumer	As per ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended.
Protection of cultural and spiritual values	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.
Suitability for industrial use	None provided. Water quality requirements for industry vary within and between industries. The ANZG do not provide guidelines to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This EV is usually protected by other values, such as the aquatic ecosystem EV.
Suitability for aquaculture	As per: • Tables 7–9 • ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended
Suitability for irrigation	Pathogens and metal WQOs are provided in Tables 10 and 11 (based on ANZG). For all other indicators, such as salinity, sodicity, sodium adsorption ratio (SAR), and herbicides, refer ANZG.

Environmental value	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for stock watering	As per ANZG, including median faecal coliforms <100 organisms per 100 mL. For total dissolved solids and metals, refer Tables 12 and 13, based on ANZG. For other indicators, such as cyanobacteria and pathogens, see ANZG.
Suitability for farm supply/use	As per ANZG.
Suitability for primary contact recreation	Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines. As per NHMRC (2008 – refer NHMRC website) including: • water free of physical (floating and submerged) hazards. Where permanent hazards exist (e.g. rips and sandbars), appropriate warning signs should be clearly displayed. • 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. • direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms (e.g. box jellyfish and bluebottles) • waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
Suitability for primary contact recreation	Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines. • cyanobacteria/algae: 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 - where *Cylindrospermopsis caciborskii* is the dominant species present, advice should be sought for an appropriate guideline for cylindrospermopsin or - cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and Table 14.
Suitability for secondary contact recreation	As per NHMRC (2008), including: • intestinal enterococci: refer primary recreation above • cyanobacteria/algae—refer primary recreation, NHMRC (2008) and Table 14.
Suitability for visual recreation	As per 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. • cyanobacteria/algae—see, NHMRC (2008) and Table 14.

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).

Sources:

The WQOs were determined from a combination of sources, including:

- Australian Drinking Water Guidelines (NHMRC, 2011 as updated 2016), available from NHMRC website
- Australia New Zealand Food Standards Code (Australian Government: Food Standards Australia New Zealand), available from Food Standards Australia New Zealand website
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018, as amended)
- Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), available from NHMRC website. At time of publication the NHMRC guidelines were under review. Refer to NHMRC website for latest information and updated guidelines.
- Safe Water on Rural Properties Guideline (Queensland Health, 2015)
- Technical review and advice from Queensland Health and Department of Natural Resources Mines and Energy (2020)

4.1 Drinking water EV water quality objectives

Table 6 Drinking water EV: Priority water quality objectives for drinking water supply in the vicinity of off-takes, before treatment

Indicator	Water quality objective [1]
Giardia	No guideline value set (ADWG) If *Giardia* is detected in drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
Cryptosporidium	No guideline value set (ADWG) If *Cryptosporidium* is detected in treated drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
E. coli	Well designed treatment plants with effective treatment 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 (ADWG). <1 cfu/100ml (Public Health Regulation 2018) and upstream sewage effluent discharges need to be known (catchment management).
Algal toxin	<1.3 µg/L Microcystin (ADWG)
pH	6.5–8.5 (ADWG)
Total dissolved solids (TDS)	<600mg/L The concentration of total dissolved solids in treated drinking water should not exceed 600 mg/L (ADWG, based on taste considerations).
Sodium	General [2]: The concentration of sodium in reticulated drinking water supplies should not exceed 180 mg/L (ADWG, based on threshold at which taste becomes appreciable). At-risk groups (medical) [2]: The concentration of sodium in water supplies for at-risk groups should not exceed 20 mg/L (ADWG).
Sulfate	The concentration of sulfate in drinking water should not exceed 250 mg/L (ADWG 2011, based on taste/aesthetic considerations). ADWG 2011 health guideline: <500mg/L
Dissolved oxygen	>85% saturation (ADWG)
Pesticides	Raw supplies: Below detectable limits. Treated drinking water: Refer to ADWG.
Other indicators (including physico-chemical indicators) e.g. turbidity	Refer to ADWG. <1 NTU is the target to facilitate for effective disinfection of drinking water (as turbidity of ≥ 1 NTU inhibits the performance of chlorination (ADWG))

Notes:

1. This table outlines WQOs for water **before treatment**, unless otherwise stated (e.g. ADWG). 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*, the Australian Drinking Water Guidelines (ADWG, 2011 updated December 2013), and the Safe Water on Rural Properties guideline (Queensland Health, 2015).
2. The ADWG notes that 50 mg/L is a '*typical value*' in reticulated supplies. The ADWG value for sodium is 180 mg/L (based on level at which taste become appreciable) however '*sodium salts cannot be easily removed from drinking water*' and '*any steps to reduce sodium concentrations are encouraged'*. It further notes that '*medical practitioners treating people with severe hypertension or congestive heart failure should be aware if the sodium concentration in the patient's drinking water exceeds 20 mg/L*' (ADWG; sodium factsheet).

Source: Australian Drinking Water Guidelines (NHMRC, 2011 as updated 2018). Technical review and advice from Queensland Health and Department of Natural Resources Mines and Energy (2020).

4.2 Aquaculture EV water quality objectives

The following table outlines WQOs for aquaculture, depending on species.

Table 7 Aquaculture EV: Water quality objectives for optimal growth of particular freshwater species

WATER QUALITY OBJECTIVES VALUES FOR AQUACULTURE						
Water parameter	**Barramundi**	**Eel**	**Silver perch**	**Jade perch**	**Sleepy cod**	**Redclaw**
Dissolved oxygen	4–9 mg/L	>3 mg/L	>4 mg/L	>3 mg/L	>4.0 mg/L	>4.0 mg/L
Temperature	26–32˚C	23–28˚C	23–28˚C	23–28˚C	22–31˚C	23–31˚C
pH	7.5–8.5	7.0–8.5	6.5–8.5	6.5–8.5	7.0–8.5	7.0–8.5
Ammonia (TAN, Total ammonia–nitrogen)	ID	<1.0 mg/L	ID	ID	<1.0 mg/L	<1.0 mg/L
Ammonia (NH_3, un–ionised form)	<0.46 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO_3)	ID	ID	<100 mg/L	ID	ID	ID
Nitrite (NO_2)	<1.5 mg/L	<1.0 mg/L	<0.1 mg/L	ID	<1.0 mg/L	<1.0 mg/L
Salinity (extended periods)	0–35 psu	ID	<5 psu	<5 psu	ID	<4 psu
Salinity bath (short term treatment)	0–35 psu	ID	5–10 psu for 1 hour	ID	max. 20 psu for 1 hour	ID
Hardness ($CaCO_3$)	50-100 mg/L	ID	>50 mg/L	>50 mg/L	>40 mg/L	>40 mg/L
Alkalinity	>50 mg/L	ID	100–400 mg/L	100–400mg/L	>40 mg/L	>40 mg/L
Chlorine	<0.04 mg/L	ID	ID	ID	<0.04 mg/L	ID
Hydrogen sulphide	<0.3 mg/L	ID	ID	ID	<0.3 mg/L	ID
Iron	<0.1 mg/L	ID	<0.5 mg/L	<0.5 mg/L	<0.1 mg/L	<0.1 mg/L
Spawning temperature	marine	ID	23–28	23–28	>24 for more than 3 days	ID

Indicator: psu – practical salinity unit, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019-2020 technical review and advice.

Table 8 Aquaculture EV: General WQOs for a range of tropical freshwater aquaculture species

Water parameter	Recommended range		Water parameter	Recommended range
	Fresh water	Marine		General aquatic
Dissolved oxygen	>4 mg/L	>4 mg/L	**Arsenic**	<0.05 mg/L
Temperature	21–32˚C	24–33˚C	**Cadmium**	<0.003 mg/L
pH	6.8–9.5	7–9.0	**Calcium/Magnesium**	10–160 mg/L
Ammonia (TAN, total ammonia-nitrogen)	<1.0 mg/L	<1.0 mg/L	**Chromium**	<0.1 mg/L
Ammonia (NH_3, un-ionised form)	<0.1 mg/L	<0.1 mg/L	**Copper**	<0.006 mg/L in soft water
Nitrate (NO_3)	1–100 mg/L	1–100 mg/L	**Cyanide**	<0.005 mg/L
Nitrite (NO_2)	<0.1 mg/L	<1.0 mg/L	**Iron**	<0.5 mg/L
Salinity	0–5 psu	15–35 psu	**Lead**	<0.03 mg/L
Hardness	20–450 mg/L	ID	**Manganese**	<0.01 mg/L
Alkalinity	20–400 mg/L	>100 mg/L	**Mercury**	<0.00005 mg/L
Turbidity	<80 NTU	ID	**Nickel**	<0.01 mg/L in soft water <0.04 mg/L in hard water
Chlorine	<0.003 mg/L	ID	**Tin**	<0.001 mg/L
Hydrogen sulphide	<0.002 mg/L	ID	**Zinc**	0.03–0.06 mg/L in soft water 1–2 mg/L in hard water

Indicator: psu – practical salinity unit, NTU - nephelometric turbidity units, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019-2020 technical review and advice.

Table 9 Aquaculture EV: Water quality objectives for optimal growth of particular marine species

Water parameter	Barramundi		Giant Tiger prawn (*Penaeus monodon*)	
	Hatchery	**Grow out**	**Hatchery**	**Grow out**
Dissolved oxygen	saturation	>4 mg/L	>4 mg/L	>3.5 mg/L
Temperature	28–30˚C optimum 25–31˚C range	28–30˚C optimum	28-30˚C	26–32˚C
pH	approx. 8	approx. 8	7.8-8.2	7.5–8.5
Ammonia (TAN, total ammonia-nitrogen)	ID	0.1–0.5 mg/L	ID	<3 mg/L
Ammonia (NH_3, un-ionised form)	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO_3)	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L
Nitrite (NO_2)	<0.2 mg/L	<1.0 mg/L	<0.2 mg/L	<0.2 mg/L
Salinity	28–31psu	0–35psu	30-35psu	10–25 psu optimum
Alkalinity	ID	105–125 mg/L $CaCO_3$	ID	>80 mg/L
Clarity	ID	<10mg/L	ID	30–40cm secchi disk
Hydrogen sulphide	ID	<0.3 mg/L	<0.1 mg/L	<0.1 mg/L
Iron	ID	<0.02 mg/L	<1 mg/L	<1.0 mg/L
Spawning temperature	ID	28–32˚C	ID	27–32˚C

Indicator: psu – practical salinity unit, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019-2020 technical review and advice.

4.3 Irrigation EV water quality objectives

The following tables outline WQOs for irrigation, based on relevant national guidelines.

Table 10 Irrigation EV: Water quality objectives 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/100 mL
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/100 mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100 mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, such as cattle, sheep and goats)	<1000 cfu/100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100 mL

Notes:

1. Adapted from ARMCANZ, ANZECC and NHMRC (1999).
2. Refer to AWQG, Volume 1, Section 4.2.3.3 for advice on testing protocols. Source: AWQG, Volume 1, Section 4.2.3.3, Table 4.2.2.

Table 11 Irrigation EV: Water quality objectives for heavy metals and metalloids in agricultural irrigation water— soil cumulative contamination loading limit (CCL), long-term trigger value (LTV) and short-term trigger value (STV)[1]

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 AWQG, 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 AWQG, Volume 3, Section 9.2.5).

2. ND = Not determined; insufficient background data to calculate CCL.

Source: AWQG, Volume 1, Section 4.2.6, Table 4.2.10.

4.4 Stock watering EV water quality objectives

The following tables outline WQOs for stock watering, according to stock type (cattle, sheep etc.).

Table 12 Stock watering EV: Water quality objectives for tolerances of livestock to salinity, as total dissolved solids, 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 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, ARMCANZ (2000), Volume 1, Section 4.3.3.5, Table 4.3.1. Note that a review of stock watering tolerances under the ANZG (2018) may lead to revised values from those in this table. Refer to ANZG (2018) for further details.

Table 13 Stock watering EV: Water quality objectives (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, ARMCANZ (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, ARMCANZ (2000), Volume 1, Section 4.3.4, Table 4.3.2. Note that a review of stock watering tolerances under the ANZG (2018) may lead to revised values from those in this table. Refer to ANZG (2018) for further details.

4.5 Recreation EV water quality objectives - cyanobacteria

When cyanobacteria are present in large numbers, they can present a significant hazard, particularly to primary contact users of waters. Water quality guidelines for cyanobacteria in recreational waters are provided below. Monitoring and 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 sections 6 and 7 of the NHMRC guidelines.

Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines.

Table 14 Recreational waters: Alert levels and corresponding actions for management of cyanobacteria

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. Similar actions are outlined for coastal/estuarine waters in NHMRC Table 7.6):
   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 per cent 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 (mycrocystins, nodularian, cylindrospermopsin or saxitoxin).
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: Based on NHMRC (2008) Guideline for Managing Risks in Recreational Water (tables 6.2, 6.6, 7.3).

5 Ways to improve water quality

The following sources are relevant in considering ways to improve water quality. The list below is additional to the plans, guidelines and other sources referred to in previous sections, **and is provided for information only.**

Local plans, studies

- Council planning scheme and supporting codes, policies, available from DSDMIP website and council websites

State plans, policies, guidelines, agreements

- Healthy Waters Management Plan: Condamine River Basin
- Healthy Waters Management Plan: Queensland Border Rivers and Moonie River Basins
- Healthy Waters Management Plan: Queensland Maranoa and Balonne River Basin
- Healthy Waters Management Plan: Warrego, Paroo, Bulloo and Nebine Basins
- State Planning Policy (state interest – water quality), including SPP code – water quality, and supporting SPP guidelines, available from the DSDMIP website
- *Water Act 2000* – Water Plan (Border Rivers and Moonie) 2019
- *Water Act 2000* – Water Plan (Condamine and Balonne) 2019
- *Water Act 2000* – Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017
- *Water Act 2000* – Water Plan (Warrego, Paroo, Bulloo and Nebine) 2016

Federal plans, policies, guidelines, agreements

- Basin Salinity Management 2030 (BSM2030) - Licensed from the Murray–Darling Basin Authority under a Creative Commons Attribution 3.0 Australia Licence
- Water Act 2007 – Basin Plan 2012
- Water Act 2007 - Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin

Water quality guidelines

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)*
- Monitoring and Sampling Manual, available from the department's website
- Queensland Water Quality Guidelines (QWQG), available from the department's website

Other supporting technical information

- Healthy Waterways Incorporated – Water by Design: resources and information available on the Water by Design website
- Information on PFAS in Queensland, including access to PFAS national environmental management plan
- Water Connections: Aboriginal People’s water needs in the Queensland Murray-Darling Basin, A guide to the water plans in the Condamine and Balonne, Border Rivers and Moonie catchments, February 2019

6 Dictionary

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 ecosystem (defined in the ANZG) any watery environment from small to large, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment.

Aquatic ecosystem (defined in the EPP (Water and Wetland Biodiversity)) means a community of organisms living within or adjacent to water, including riparian or foreshore areas.

Basin means the basin name and number provided by Geoscience Australia, Canberra (3rd edition, 2004).

Basin Plan means the *Basin Plan 2012*, prepared under the Commonwealth *Water Act 2007*.

Biological Integrity (defined in the EPP (Water and Wetland Biodiversity)) for water or a wetland, means the ability of the water or wetland to support and maintain a balanced, integrative, adaptive community of organisms having a species composition, diversity and functional organisation comparable to that of the natural habitat of the locality in which the water or wetland is situated.

Catchment means the total area draining into a river, creek, reservoir or other body of water. The limits of a given catchment are the heights of land (such as hills or mountains) separating it from neighbouring catchments. Catchments can be made up of smaller sub-catchments.

Ecological integrity (health) (defined in the ANZG) means the 'health' or 'condition' of an ecosystem. 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.

Environmental value (EV) means:

(a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or

(b) another quality of the environment identified and declared to be an environmental value under an Environmental Protection Policy or Regulation (e.g. water suitable for swimming in or drinking).

The EVs for water that can be identified for protection are outlined in the accompanying table.

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.

Sub-basin means part of a basin.

Sub-catchment means part of a catchment.

Toxicant (defined in the ANZG): means a substance capable of producing an adverse response (effect) in a biological system, which may seriously injure structure or function or produce death at sufficiently high concentration.

Table 15 Environmental values that can be identified for protection

Environmental values and definitions	ICON (as shown on plans)
Aquatic ecosystem 'A community of organisms living within or adjacent to water, including riparian or foreshore area.' (EPP (Water and Wetland Biodiversity), schedule 2 - Dictionary) The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways. (This EV incorporates the 'wildlife habitat' EV used in the South East Queensland Regional Water Quality Management Strategy). See below for more details on aquatic ecosystems, based on the EPP (Water and Wetland Biodiversity).	
High ecological/conservation value waters 'Waters in which the biological integrity of the water is effectively unmodified or highly valued.' (EPP (Water and Wetland Biodiversity), schedule 2).	None
Slightly disturbed waters 'Waters that have the biological integrity of high ecological value waters with slightly modified physical or chemical indicators but effectively unmodified biological indicators.' (EPP (Water and Wetland Biodiversity), schedule 2).	None
Moderately disturbed waters 'Waters in which the biological integrity of the water is adversely affected by human activity to a relatively small but measurable degree.' (EPP (Water and Wetland Biodiversity), schedule 2).	None
Highly disturbed waters 'Waters that are significantly degraded by human activity and have lower ecological value than high ecological value waters or slightly or moderately disturbed waters.' (EPP (Water and Wetland Biodiversity), schedule 2).	None

Environmental values and definitions	ICON (as shown on plans)
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, molluscs and crustaceans) from commercial ventures.	
Human consumers of aquatic foods The suitability of the water for producing aquatic foods for human consumption such as fish, crustaceans and shellfish from natural waterways.	
Primary recreation Means a use that involves the following types of contact with the water—full body contact, frequent immersion by the face and trunk, frequent contact with spray by the face where it is likely some water will be swallowed or inhaled, or come into contact with ears, nasal passages, mucous membranes or cuts in the skin. Examples–diving, swimming, surfing (EPP (Water and Wetland Biodiversity), section 6).	
Secondary recreation Means a use that involves the following types of contact with the water—contact in which only the limbs are regularly wet, and other contact, including the swallowing of water, is unusual (examples—boating, fishing, wading) or occasional inadvertent immersion resulting from slipping or being swept into the water by a wave. (EPP (Water and Wetland Biodiversity), section 6).	
Visual recreation Means a use that does not ordinarily involve any contact with the water—for example angling from the shore, sunbathing near water (EPP (Water and Wetland Biodiversity), section 6).	
Drinking water supply Suitability of the water for supply as drinking water having regard to the level of treatment of the water.	
Industrial use Suitability of water supply for industrial purposes, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.	

Environmental values and definitions	ICON (as shown on plans)
Cultural and spiritual values Means scientific, social or other significance to the present generation or past or future generations, including Aboriginal people or Torres Strait Islanders (EPP (Water and Wetland Biodiversity)), section 6), for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities • symbols, landmarks and icons (such as waterways, turtles and frogs) • lifestyles (such as agriculture and fishing).