Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Jacky Jacky Creek, Olive-Pascoe, Lockhart and Stewart River Basins

Environmental Values and Water Quality Objectives

Basins 101, 102, 103 and 104, including all surface waters of the Jacky Jacky Creek, Olive-Pascoe, Lockhart and Stewart River Basins, and adjacent coastal waters

Queensland Government

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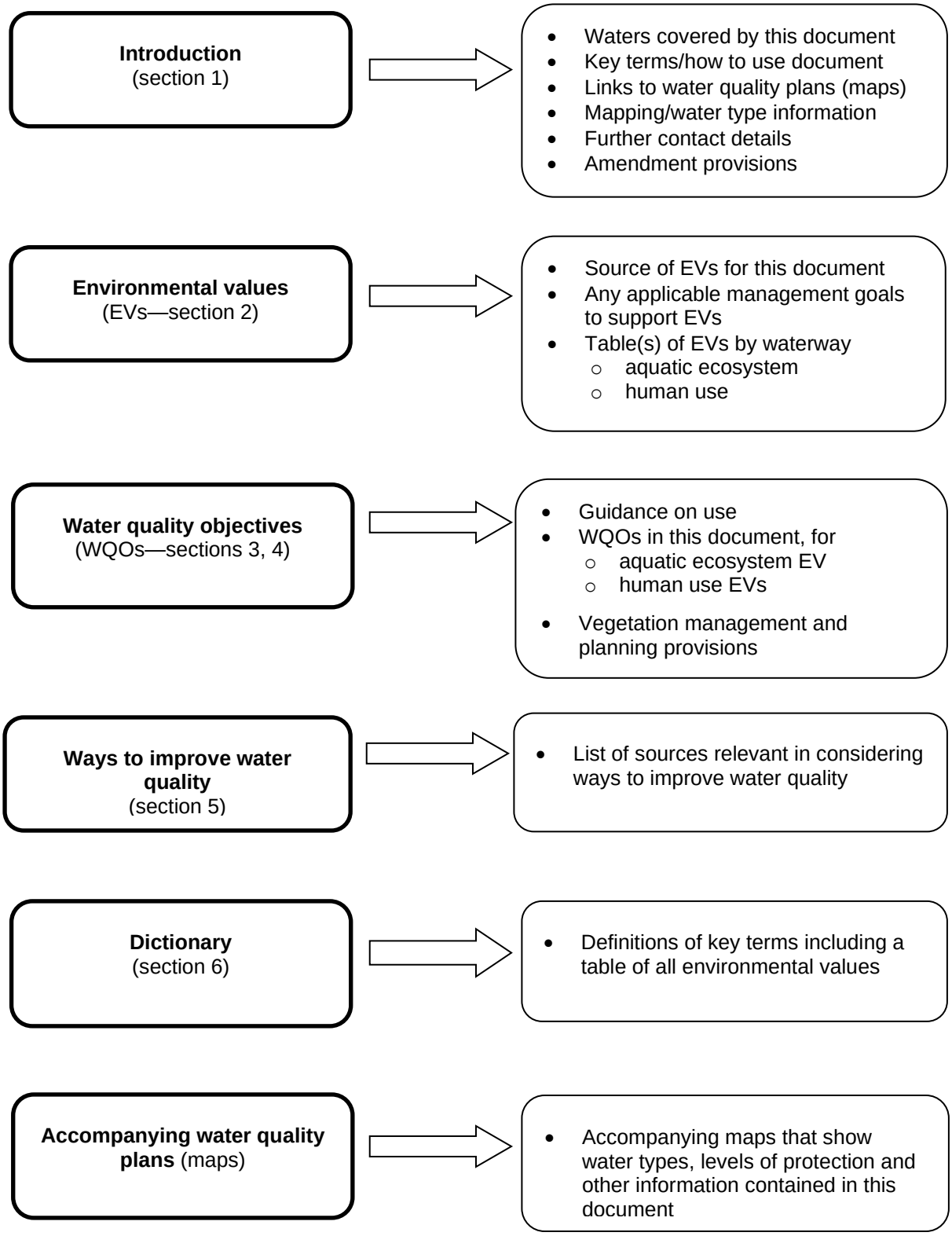
Main parts of this document and what they contain



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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 surface waters in the Jacky Jacky Creek, Olive-Pascoe, Lockhart and Stewart River Basins and adjacent coastal waters, 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 surface waters in the Jacky Jacky Creek, Olive-Pascoe, Lockhart and Stewart River Basins and adjacent coastal waters. 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 and estuarine surface waters draining the Jacky Jacky Creek, Olive-Pascoe, Lockhart and Stewart River Basins (basins 101, 102, 103, 104[1]), and adjacent coastal waters as indicated in the accompanying plans (WQ1011—Jacky Jacky, WQ1021—Olive-Pascoe, WQ1031—Lockhart, WQ1041—Stewart, WQ1010—coastal waters)[2]. Queensland surface waters covered by this document include:

- all Jacky Jacky Creek Basin fresh, estuarine and coastal waters, including Jacky Jacky Creek, Escape River, Harmer Creek, Shelburne Bay dune lakes, Newcastle and Shelburne bays
- all Olive-Pascoe River Basin fresh, estuarine and coastal waters, including Olive and Pascoe Rivers, Kangaroo River, Glennie Creek, Shelburne Bay dune lakes, Temple and Weymouth bays
- all Lockhart River Basin fresh, estuarine and coastal waters, including Claudie, Lockhart, Nesbit and Chester rivers, and Lloyd Bay
- all Stewart River Basin fresh, estuarine and coastal waters, including Stewart River, Massey, Breakfast, Balclutha, and Running creeks
- wetlands, lakes and reservoirs
- coastal and marine waters east to the limit of Queensland coastal waters.

This document does not establish aquifer-specific groundwater EVs or WQOs, however groundwater management intent guidance and links to national guidelines are included in the aquatic ecosystem WQOs table. Refer to the

[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 WQ1011, WQ1021, WQ1031, WQ1041 and WQ1010 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). For further information, email the department at epa.ev@des.qld.gov.au.

EPP (Water and Wetland Biodiversity) sections 6, 8, and 11 for EVs and WQOs applying to waters not included in schedule 1.

1.3 Great Barrier Reef end-of-basin load objectives

Annual end-of-basin load water quality objectives covering all Great Barrier Reef mainland basins have been established pursuant to section 11(4) of the EPP (Water and Wetland Biodiversity) for dissolved inorganic nitrogen and fine sediment across all mainland basins draining to the Great Barrier Reef. These are included in a separate document titled 'Great Barrier Reef River Basins End-of-Basin Load Water Quality Objectives', published by the department in September 2019, and available from the department's website.

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 (previously ANZECC) 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. The range of EVs and the waters to which they can potentially apply are listed below, and further details are provided in the dictionary.

List of EVs and applicable waters

Environmental value (EV)	Potentially applicable to:	
	Tidal waters	Fresh (non-tidal) waters
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 seagrass and 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		✓

GBRMPA WQG means the *Water Quality Guidelines for the Great Barrier Reef Marine Park, Great Barrier Reef Marine Park Authority 2010*, published at the GBRMPA website.

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 tables of this document to support the corresponding EVs for waters identified in the EVs tables.

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 (aquatic ecosystem EV: example only and should not be directly adopted for use) include:

- total phosphorus concentration less than 20 micrograms per litre (µg/L)
- chlorophyll *a* concentration less than 1 µg/L
- dissolved oxygen between 95 per cent and 105 per cent saturation
- family richness of macroinvertebrates greater than 12 families
- exotic individuals of fish less than five per cent.

Water type means groupings of waters with similar characteristics, as shown in the accompanying plans. Water types can include fresh waters (lowland, upland, lakes/reservoirs), wetlands and groundwaters, estuarine waters (lower, middle and upper estuaries), tidal canals, constructed estuaries, marinas and boat harbours, and coastal/marine waters (enclosed coastal, open coastal, midshelf, offshore). 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.

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

For freshwater streams with aquatic ecosystem and drinking water EVs, the respective sulfate WQOs are:

- aquatic ecosystem freshwater stream: less than 25 mg/L
- drinking water: less than 250 mg/L.

In this case the aquatic ecosystem WQO is the more stringent, and its adoption therefore supports both the freshwater aquatic ecosystem and drinking water EVs.

This document also refers to a number of guidelines, codes and other reference sources on water quality. In particular, the QWQG also provide more detailed information on water types, water quality indicators, derivation of local water quality guidelines, application during flood events, monitoring, and comparison of water quality with WQOs.

1.5 Information about mapped areas and boundaries

The boundaries in the accompanying plans WQ1011, WQ1021, WQ1031, WQ1041 and WQ1010 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). For further information, email the department at epa.ev@des.qld.gov.au.

1.6 Water types and basis for boundaries

1.6.1 Water types

Water types are groupings of waters with similar characteristics. Waters in this document have been classified into different water types, as shown in the relevant tables and accompanying plans. The range of applicable water types is listed below (not all water types are present in all areas):

- freshwater streams and rivers, including where applicable a split into:
  - upland freshwaters—small upstream streams, moderate - fast flowing with steeper gradients than lowland freshwaters (above 150 metres altitude, or as otherwise defined)
  - lowland freshwaters—larger slow moving freshwater streams and rivers, (under 150 metres altitude, or as otherwise defined)
- freshwater lakes/reservoirs
- groundwaters
- upper estuary—waters in the upper reaches of estuaries, with limited flushing. This water type is absent from short estuaries, less than 15 kilometres (km) total estuary length
- mid estuary—waters extending the majority of the length of estuaries with a moderate amount of water movement from either freshwater inflow or tidal exchange
- lower estuary/enclosed coastal (LE/EC)—waters occurring at the downstream end of estuaries and including shallow coastal waters in adjacent enclosed bays
- marinas, boat harbours, tidal canals, and constructed estuaries
- wetlands
- open coastal (OC) and other marine waters (e.g. midshelf, offshore)—extending to the seaward limits of Queensland waters.

The water types are based on local water quality studies (refer to the source documents listed after the tables), mapping and definitional rules contained in the QWQG, and the ANZG. Further detail on water types is contained in these sources.

1.6.2 Water type boundaries

The boundaries of different water types have been mapped using a variety of attributes, including:

- geographic coordinates
- catchment or subcatchment boundaries
- highest/lowest astronomical tide
- tidal limiting structure (weirs)
- maritime mapping conventions
- coastline
- surveyed terrestrial boundaries
- altitude
- boundaries based on technical investigations.

Boundaries are shown on the accompanying plans. The boundaries of water 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 waterway or water type boundaries/descriptions
- updates to information/data sources, websites and email contact details, agency/departmental names, other institutional names, references.

ENVIRONMENTAL VALUES AND MANAGEMENT GOALS

2 Environmental values and management goals

2.1 Environmental values

Environmental values (EVs) for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses (refer dictionary to this document for further details). EVs for waters covered by this document are shown in the accompanying tables and plans (WQ1011, WQ1021, WQ1031, WQ1041 and WQ1010):

- Table 1: Jacky Jacky Creek Basin and adjacent coastal waters
- Table 2: Olive-Pascoe River Basin and adjacent coastal waters
- Table 3: Lockhart River Basin and adjacent coastal waters
- Table 4: Stewart River Basin and adjacent coastal waters

2.2 Management goals to support environmental values

2.2.1 Management intent for waters

It is the management intent for Queensland waters that the decision to release waste water 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.

2.2.2 Reef water quality improvement plan

The Reef 2050 Water Quality Improvement Plan 2017–2022 (Reef 2050 WQIP) is a joint commitment of the Australian and Queensland governments that seeks to improve the quality of water flowing from the catchments adjacent to the Great Barrier Reef. The plan identifies how the water quality outcome under the broader Reef 2050 Long-Term Sustainability Plan will be delivered. The long-term (2050) outcome under the Reef 2050 WQIP is that 'Good water quality sustains the outstanding universal value of the Great Barrier Reef, builds resilience, improves ecosystem health and benefits communities'. The Reef 2050 WQIP includes the following commitment, identified as contributing to the delivery of Reef 2050 action 1.2: *Review and update water quality objectives and water quality guidelines at regionally relevant scales under the Environmental Protection Policy (Water) 2009* [remade to become the EPP (Water and Wetland Biodiversity) in 2019].

The Reef 2050 WQIP contains end of basin annual load targets for dissolved inorganic nitrogen and fine sediment across mainland basins draining to the Great Barrier Reef. These have been included in the document titled 'Great Barrier Reef River Basins End-of-Basin Load Water Quality Objectives' (September 2019), pursuant to section 11(4) of the EPP (Water and Wetland Biodiversity), and are available from the department's website.

The Reef 2050 WQIP also contains targets for pesticides such that end of catchment concentrations of pesticides protect 99% of aquatic species. This corresponds to high ecological value level of protection. Further information is available from the reef plan website.

2.2.3 Management goals for human use environmental values

2.2.3.1 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 (noting that water quality requirements may differ by crop type).

2.2.3.2 Farm supply use

The management goal for farm supply use is that the quality of water is suitable for produce preparation and domestic uses other than drinking. (Drinking and other human uses outlined below.)

2.2.3.3 Stock water quality

The management goal for stock watering is that the quality of water provided to stock does not cause deterioration in stock health or condition (noting that water quality requirements may differ by stock type).

2.2.3.4 Aquaculture

The management goal for aquaculture is that the quality of water provided for aquaculture does not cause deterioration in stocked species health or condition (noting that water quality requirements may differ by species).

2.2.3.5 Human consumer

The management goal for human consumers is that the water quality of waters produces aquatic food that is fit for human consumption and does not cause deterioration in human health.

2.2.3.6 Recreational water quality

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

2.2.3.7 Raw water for drinking water consumption

The management goal is 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.

2.2.3.8 Industrial use

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

2.2.3.9 Cultural and spiritual values and uses of water

The management goal is that water is suitable to support identified cultural and spiritual values of waters, including those of Aboriginal people or Torres Strait Islanders. Management goals and objectives specified for aquatic ecosystems and other human water uses (including recreation, human consumption of aquatic foods, and drinking water) will assist in supporting some aspects of cultural and spiritual values of water.

Table 1 Environmental values: Jacky Jacky Creek Basin and adjacent coastal waters

JACKY JACKY CREEK BASIN (refer plans WQ1011 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
JACKY JACKY FRESH WATERS												
North Jacky Jacky Creek – dune lakes	✓					✓			✓			✓
Jacky Jacky Creek	✓					✓	✓5		✓			✓
Escape River	✓					✓			✓			✓
Coastal creeks	✓					✓			✓			✓
Harmer and Little Harmer Creeks	✓					✓			✓			✓
Shelburne Bay dune lakes	✓					✓			✓			✓
Waters in National Parks, conservation estate (where applicable – EVs may vary locally)	✓					✓		✓5	✓			✓

JACKY JACKY CREEK BASIN (refer plans WQ1011 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
JACKY JACKY ESTUARIES, BAYS, COASTAL WATERS												
Estuaries (incl. Jacky Jacky, Escape, Harmer, other)	✓					✓		✓5	✓			✓
Kennedy Inlet and Newcastle Bay	✓				✓	✓		✓5	✓			✓
Shelburne Bay	✓					✓		✓5	✓			✓
Margaret Bay	✓					✓		✓5	✓			✓
Indian Bay	✓					✓		✓5	✓			✓
Jacky Jacky Creek Basin coastal / marine waters	✓				✓	✓	✓5	✓5	✓			✓

Notes:

1. Refer to the accompanying plans WQ1011 and WQ1010 for locations of EVs. EVs shown relate to waters within each unit (for example 'Jacky Jacky Creek') as shown on the plans.

2. ✓ means the EV is selected for protection. Blank indicates that the EV is not chosen for protection.

3. Refer to the dictionary for further explanation of EVs.

4. Refer to sections 3–4 for WQOs applying to the EVs in this table.

5. The selection of recreational and other human use EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to DES Crocodiles, council, Queensland Health, Beachsafe, marine stingers, and other information sources for further details on swimming safety and information on specific waters. Access restrictions may apply in certain locations (e.g. ports, 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.

References:

Cape York Natural Resource Management and South Cape York Catchments (2016) *Draft Eastern Cape York water quality improvement plan*.

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters, draft for consultation,* March.

Table 2 Environmental values: Olive-Pascoe River Basin and adjacent coastal waters

OLIVE-PASCOE RIVER BASIN (refer plans WQ1021 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
OLIVE-PASCOE RIVER BASIN FRESH WATERS												
Shelburne Bay dune lakes	✓					✓			✓			✓
Olive River (incl. Horseshoe, Scorpion creeks)	✓			✓		✓		✓5	✓			✓
Kangaroo River and coastal creeks	✓					✓			✓			✓
Glennie Creek	✓			✓		✓			✓			✓
Hann Creek	✓			✓		✓		✓5	✓			✓
Pascoe - lower, outside National Park (incl. Tin and coastal creeks)	✓		✓	✓		✓			✓			✓
Pascoe - mid (incl. Hamilton Creek)	✓		✓	✓		✓			✓			✓
Pascoe - mid (incl. Garraway, Brown creeks)	✓					✓	✓5	✓5	✓			✓
Pascoe - upper (incl. Yam, One Mile creeks)	✓			✓		✓			✓			✓
Pascoe - headwaters (incl. Little Pascoe, Fall creeks)	✓			✓		✓			✓			✓
Waters in National Parks, conservation estate (where applicable)	✓					✓		✓5	✓			✓

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OLIVE-PASCOE RIVER BASIN (refer plans WQ1021 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
OLIVE-PASCOE ESTUARIES, BAYS, COASTAL WATERS												
Olive River estuary	✓					✓		✓5	✓			✓
Estuaries draining into Temple Bay, Hudson Bay	✓					✓		✓5	✓			✓
Temple Bay and Hudson Bay	✓					✓		✓5	✓			✓
Pascoe River estuary and other estuaries draining into Weymouth Bay	✓					✓		✓5	✓			✓
Weymouth Bay	✓					✓		✓5	✓			✓
Olive-Pascoe River Basin coastal / marine waters	✓					✓	✓5	✓5	✓			✓

Notes:

1. Refer to the accompanying plans WQ1021 and WQ1010 for locations of EVs. EVs shown relate to waters within each unit (for example 'Olive River') as shown on the plans.

2. ✓ means the EV is selected for protection. Blank indicates that the EV is not chosen for protection.

3. Refer to the dictionary for further explanation of EVs.

4. Refer to sections 3–4 for WQOs applying to the EVs in this table.

5. The selection of recreational and other human use EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to DES Crocodiles, council, Queensland Health, Beachsafe, marine stingers, and other information sources for further details on swimming safety and information on specific waters. Access restrictions may apply in certain locations (e.g. ports, 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.

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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.

References:

Cape York Natural Resource Management and South Cape York Catchments (2016) *Draft Eastern Cape York water quality improvement plan*.

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters, draft for consultation,* March.

Table 3 Environmental values: Lockhart River Basin and adjacent coastal waters

LOCKHART RIVER BASIN (refer plans WQ1031 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
LOCKHART RIVER BASIN FRESH WATERS												
Wilson Creek and Portland Road coastal creeks	✓					✓		✓5	✓			✓
Middle and West Claudie Rivers (incl. Gordon, Scrubby creeks)	✓					✓		✓5	✓			✓
Lockhart town and surrounds (incl. dunes)	✓					✓			✓			✓
Claudie River (incl. Deep, Swamp creeks)	✓					✓		✓5	✓			✓
Lockhart River (incl. Eden, Arroto and Scrubby creeks)	✓					✓			✓			✓
Coastal creeks and dunes (north of Nesbit)	✓					✓		✓5	✓			✓
Nesbit River (incl. Leo Creek)	✓					✓		✓5	✓			✓
Chester River (incl. Scrubby Creek)	✓					✓		✓5	✓			✓
Waters in National Parks, conservation estate (where applicable)	✓					✓		✓5	✓			✓

LOCKHART RIVER BASIN (refer plans WQ1031 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
LOCKHART ESTUARIES, BAYS, COASTAL WATERS												
Lockhart, Claudie and adjacent estuaries	✓					✓		✓5	✓			✓
Lloyd Bay	✓					✓		✓5	✓			✓
Nesbit, Chester and adjacent estuaries	✓					✓		✓5	✓			✓
Port of Quintell Beach marine waters	✓					✓		✓5	✓		✓	✓
Lockhart River Basin coastal / marine waters	✓					✓	✓5	✓5	✓			✓

Notes:

1. Refer to the accompanying plans WQ1031 and WQ1010 for locations of EVs. EVs shown relate to waters within each unit (for example 'Lockhart River') as shown on the plans.

2. ✓ means the EV is selected for protection. Blank indicates that the EV is not chosen for protection.

3. Refer to the dictionary for further explanation of EVs.

4. Refer to sections 3–4 for WQOs applying to the EVs in this table.

5. The selection of recreational and other human use EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to DES Crocodiles, council, Queensland Health, Beachsafe, marine stingers, and other information sources for further details on swimming safety and information on specific waters. Access restrictions may apply in certain locations (e.g. ports, 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.

References:

Cape York Natural Resource Management and South Cape York Catchments (2016) *Draft Eastern Cape York water quality improvement plan*.

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters, draft for consultation,* March.

Table 4 Environmental values: Stewart River Basin and adjacent coastal waters

STEWART RIVER BASIN (refer plans WQ1041 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
STEWART RIVER BASIN FRESH WATERS												
Massy Creek, Rocky River	✓					✓	✓5	✓5	✓			✓
Goanna, Breakfast, and Whiphandle creeks	✓			✓		✓		✓5	✓			✓
Stewart River - headwaters outside national park (incl. Little Stewart, Station creeks)	✓			✓		✓			✓			✓
Stewart River, Terrible Creek	✓					✓			✓	✓		✓
Balclutha Creek	✓					✓			✓			✓
Gorge and Running creeks	✓					✓			✓			✓
Waters in national parks, conservation estate (where applicable)	✓					✓		✓5	✓			✓

STEWART RIVER BASIN (refer plans WQ1041 and WQ1010)	Environmental values[1–6]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer [5]	Primary recreation [5]	Secondary recreation[5]	Visual recreation [5]	Drinking water [5]	Industrial use	Cultural and spiritual values
Water												
STEWART ESTUARIES, BAYS, COASTAL WATERS												
Estuaries (incl. Stewart, Rocky, other estuaries)	✓					✓		✓5	✓			✓
Princess Charlotte Bay	✓					✓		✓5	✓			✓
Stewart River Basin coastal / marine waters	✓					✓	✓5	✓5	✓			✓

Notes:

1. Refer to the accompanying plans WQ1041 and WQ1010 for locations of EVs. EVs shown relate to waters within each unit (for example 'Stewart River') as shown on the plans.

2. ✓ means the EV is selected for protection. Blank indicates that the EV is not chosen for protection.

3. Refer to the dictionary for further explanation of EVs.

4. Refer to sections 3–4 for WQOs applying to the EVs in this table.

5. The selection of recreational and other human use EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to DES Crocodiles, council, Queensland Health, Beachsafe, marine stingers, and other information sources for further details on swimming safety and information on specific waters. Access restrictions may apply in certain locations (e.g. ports, 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.

References:

Cape York Natural Resource Management and South Cape York Catchments (2016) *Draft Eastern Cape York water quality improvement plan*.

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters, draft for consultation,* March.

WATER QUALITY OBJECTIVES TO PROTECT ENVIRONMENTAL VALUES

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, 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 freshwater streams with aquatic ecosystem and drinking water EVs, the respective sulfate WQOs are:

- aquatic ecosystem freshwater stream: less than 25 mg/L
- drinking water: less than 250 mg/L.

In this case the aquatic ecosystem WQO is the more stringent, and its adoption therefore supports both the freshwater 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 recreation, 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 5: Freshwaters (by basin): including nutrients, algal, water clarity
- Table 6: Fresh waters (by basin): other ions and related indicators
- Table 7: Fresh water dune lakes: water quality ranges
- Table 8: Estuarine, coastal and marine waters (all basins, by water type): physico-chemical (nutrients, algal, water clarity, etc.), biological, including seasonal split where indicated.

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.

No aquatic ecosystem WQOs are specified for groundwaters, however management intent guidance and links to national guidelines are included in the table.

WQOs for metals and other toxicants, where not stated in this document, are referred to in the ANZG guidelines (2018, as amended). In the case of aluminium, reference is made to a peer reviewed study of toxicity of aluminium in marine waters by Golding et al. (2015). This study used ANZECC protocols to derive a marine guideline value of 24 µg/L of aluminium (that applies to the measured concentration of seawater that passes through a 0.45 µm filter) to protect 95% of species (with a 99% species protection value of 2.1 µg/L). This supersedes the existing low reliability guideline of 0.5 µg/L which was derived using conservative safety margins from limited data.

[Source: Golding, LA, Angel, BM, Batley, GE, Apte, SC, Krassoi, R and Doyle, CJ (2015) Derivation of a water quality guideline for aluminium in marine waters, Environ Toxicol Chem., 34: 141-151.]

3.1.1 Comparison of test data with WQOs

The following protocols are recommended when comparing fresh, estuarine or coastal/marine water quality (at a ‘test’ site) with the corresponding aquatic ecosystem water quality objective (WQO). For concentration-based indicators (e.g. nutrients) and turbidity (NTU), the intent is for test site water quality value to be less than or equal to the corresponding WQO. For WQO indicators where a range is specified (e.g. pH, DO), the intent is that the test

site water quality median value falls within the specified WQO range. For Secchi measurements (typically used in estuarine, coastal and marine waters), the intent is for the test site water quality value to be greater than or equal to the stated WQO. Further detail is provided in the QWQG.

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: 65–100–125 ug/L), the 20^{th}–50^{th}–80^{th} percentile distributions of the test data should meet the specified range of values. 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 DO and pH, test sample median values are compared with, and should fall within, the specified percentile range.
- Where a single WQO value is provided, the median value of preferably five or more independent samples at a monitoring (test) site should be compared against the corresponding aquatic ecosystem WQO.

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, but where a WQO 20^{th}–50^{th}–80^{th} percentile range is provided, the 50^{th} percentile WQO value may be used.)
- For DO and pH, test sample median values are compared with, and should fall within the specified range.

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 recommends that the 95^{th} 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.

For comparisons of toxicants in sediments, refer to ANZG.

Great Barrier Reef coastal/marine waters: Further to the above, some parameters in Great Barrier Reef waters have WQO values specified as an annual (or seasonal) mean, rather than as a median or percentile range. For these waters, the mean water quality value of a number of independent samples at a particular monitoring ('test') site should be compared against the applicable WQO. The sample number is preferably five or more samples for within season comparison, and five or more samples taken during each of the wet and dry seasons for annual mean comparisons. However, more samples may be required depending on the inherent variability in the measurement data (Queensland Monitoring and Sampling Manual; Section 1.9.1).

Refer to notes after the WQOs tables for further details on marine water season splits.

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

AQUATIC ECOSYSTEM WATER QUALITY OBJECTIVES

JACKY JACKY CREEK, OLIVE-PASCOE, LOCKHART and STEWART RIVER BASINS

Table 5 Aquatic ecosystem water quality objectives – freshwaters: physico-chemical (nutrients, algal, water clarity, etc.) (baseflow except where noted)

Water area/type (Source: s1–s4)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS [1–3] (refer plans WQ1011, WQ1021, WQ1031, WQ1041) Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted)											
		Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources											
		Amm N (µg/L)	**Oxid N** (µg/L) **Partic N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L) **Partic P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**DO[2]** (% sat)	**Turb** (NTU) **Colour (C)** (hazen)	**SS** (mg/L)	**pH**	**Conductivity[3]** (µS/cm)	**Sulfate** (mg/L)
Note: Information on lakes, wetlands, toxicants, temperature, and State Planning Policy (water quality state interest) provided at end of table. Information on additional ionic indicators provided in separate table.													
JACKY JACKY BASIN (refer plan WQ1011) (Single figure = 50th percentile) (no gauging station)													
Jacky Jacky Basin fresh waters - all catchments (s1)	**BASEFLOW (all seasons)** (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)												
	All – maintain current condition	10*	10*	150*	5*	20*	ID	60–100*	2.0–2.9–3.6 C: 32	4.0	5.6–7.0	Flow>nil: <75µS/cm	<0.8

Water area/type (Source: s1–s4)	Management intent /Level of protection	Amm N (µg/L)	Oxid N (µg/L) Partic N (µg/L)	Total N (µg/L)	FRP (µg/L) Partic P (µg/L)	Total P (µg/L)	Chl-a (µg/L)	DO[2] (% sat)	Turb (NTU) Colour (C) (hazen)	SS (mg/L)	pH	Conductivity[3] (µS/cm)	Sulfate (mg/L)
JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS [1–3] **(refer plans WQ1011, WQ1021, WQ1031, WQ1041)**													
Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted)													
Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources												
OLIVE-PASCOE BASIN (refer plan WQ1021) (Single figure = 50th percentile)													
Olive catchment fresh waters (s1)	**All - maintain current condition**	**BASEFLOW (all seasons)** (no gauging station) (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)											
		10*	10*	150*	5*	20*	ID	60–100*	3.0–4.4–7.0 C: 31	5.0	5.6–7.0	Flow>nil: <90µS/cm	<0.5
Pascoe catchment fresh waters (s1)	**All - maintain current condition**	**BASEFLOW DRY SEASON <13m³/s (cumecs) at gauge 102102A – Pascoe River at Garraway gauge**											
		5	5	100	5	10	ID	80–100	1.0–2.0–3.0 C: 7–11–21	2.0–5.0–10.0	6.5–7.5	Fall Ck flow<0.5m³/s: 120–200 µS/cm flow>0.5m³/s: <120µS/cm	1.0–1.4–2.0
		BASEFLOW WET SEASON <30m³/s (cumecs) at gauge 102102A – Pascoe River at Garraway gauge											
		6–8–9	6–14–22	150–200–235	<1–<1–<1	<20–<20–<20	ID	80–100	8–17–36 C: ID	4–10–19	6.5–7.5	Garraway Ck Flow>nil: <100µS/cm	ID
		EVENT FLOW >30m³/s (cumecs) at gauge 102102A – Pascoe River at Garraway gauge (Note: event flow thresholds vary. Event flows can include any flows during/immediately following heavy rainfall when overland flow has a major impact on water quality.)											
		6–7–10	14–35–61 Partic N: 50–105–230	270–375–530	<1–<1–<1 Partic P: <20–<20–30	10–20–40	ID	ID	ID	20–35–67	6.5–7.5	ID	ID

Water area/type (Source: s1–s4)	Management intent /Level of protection	**JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS** [1–3] **(refer plans WQ1011, WQ1021, WQ1031, WQ1041)** **Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted)** **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources											
		Amm N (µg/L)	**Oxid N** (µg/L) **Partic N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L) **Partic P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**DO**[2] (% sat)	**Turb** (NTU) **Colour (C)** (hazen)	**SS** (mg/L)	**pH**	**Conductivity**[3] (µS/cm)	**Sulfate** (mg/L)
LOCKHART BASIN (refer plan WQ1031) (Single figure = 50th percentile)													
Claudie catchment fresh waters (s1, s2)	**All - maintain current condition**	**BASEFLOW (all season)** (no gauging station) (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)											
		10*	10*	150*	5*	20*	ID	60–100*	3.0 C: 17.5	3.5	6.5–7.5	Flow>nil: <320µS/cm (low rel)	ID
Lockhart catchment fresh waters (s1)	**All - maintain current condition**	**BASEFLOW (all season)** (no gauging station) (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)											
		10*	10*	150*	5*	20*	ID	60–100*	3.0 C: 13.0	5.0	6.5–7.5	Flow>nil: <250µS/cm (low rel)	1.3

Water area/type (Source: s1–s4)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS [1–3] (refer plans WQ1011, WQ1021, WQ1031, WQ1041) Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted) **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources											
		Amm N (µg/L)	**Oxid N** (µg/L) **Partic N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L) **Partic P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**DO[2]** (% sat)	**Turb** (NTU) **Colour (C)** (hazen)	**SS** (mg/L)	**pH**	**Conductivity[3]** (µS/cm)	**Sulfate** (mg/L)
STEWART BASIN (refer plan WQ1041) (Single figure = 50th percentile)													
Stewart catchment fresh waters (s1)	**All - maintain current condition**	**BASEFLOW (all season)** (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)											
		10*	10*	150*	5*	20*	ID	60–100*	2.0–3.0–5.0 C: 5.0–7.0–14.0	3.0–6.0–10.0	6.5–8.0	Telegraph Rd <1.4m³/s: 150–275 µS/cm >1.4m³/s: <150µS/cm	ID
Massie catchment fresh waters (s1)	**All - maintain current condition**	**BASEFLOW (all season)** (Note: * nutrient WQOs derived from Jacky Jacky, Olive-Pascoe, Lockhart, Stewart and Jeannie rivers data. To be used as interim value until further data is available.)											
		10*	10*	150*	5*	20*	ID	60–100*	ID	ID	6.5–8.0	Flow>nil: <100µS/cm (low rel)	ID
ALL BASINS (as applicable)													
Dune lakes	**All – maintain current condition**	Refer to Table 7. There are around 200 dune lakes on the east coast of Cape York Peninsula. They occur in four main areas (from north to south): Somerset to Ussher Point; adjacent to Shelburne Bay; around Cape Grenville (which contains about half the lakes); and in the Cape Flattery-Cape Bedford area north of Cooktown (Timms, 1986). Their water quality characteristics are typical of dune lakes, with low ionic concentrations and low pH, although there is variation between lakes. The WQOs in Table 7 are expressed as indicative water quality ranges. Management intent for these HEV lakes is to retain current (natural) condition.											
Other lakes / reservoirs	**All – maintain current condition**	Note: there is insufficient information available to establish local WQOs for other lakes / reservoirs. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.											

<table>
<tr><th rowspan="4">Water area/type (Source: s1–s4)</th><th rowspan="4">Management intent /Level of protection</th><th colspan="11">JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS [1–3]
(refer plans WQ1011, WQ1021, WQ1031, WQ1041)

Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted)</th></tr>
<tr><td colspan="11">Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details).

Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD).

HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data

Sources: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources</td></tr>
<tr><td>Amm N
(µg/L)</td><td>Oxid N
(µg/L)

Partic N
(µg/L)</td><td>Total N
(µg/L)</td><td>FRP
(µg/L)

Partic P
(µg/L)</td><td>Total P
(µg/L)</td><td>Chl-a
(µg/L)</td><td>DO[2]
(% sat)</td><td>Turb
(NTU)

Colour (C)
(hazen)</td><td>SS
(mg/L)</td><td>pH</td><td>Conductivity[3]
(µS/cm)</td><td>Sulfate
(mg/L)</td></tr>
<tr><td></td><td></td><td colspan="11">TOXICANTS (INCLUDING METALS, BIOCIDES)</td></tr>
<tr><td>All basins: HEV, SD fresh waters:

Toxicants (s1, s3)</td><td>HEV</td><td colspan="11">• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in:
o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended
o The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant):
▪ Biocides: King et al (2017, as amended) (vol 1 and 2) Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area (available from Queensland Government publications)
• Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'
• Anti-fouling: Comply with Anti-fouling and in-water cleaning guidelines (2015, as amended)</td></tr>
<tr><td>All basins: fresh waters not mapped as HEV, SD:

Toxicants (s1, s3)</td><td>SMD / HEV</td><td colspan="11">• Toxicants (including metals, biocides) in water:
o Waters outside developed reaches (low level of disturbance): refer to 99% species protection values contained in sources below
o Waters within developed reaches: refer to 95% species protection values (or 99% species protection values for those toxicants identified in ANZG as having bioaccumulation potential) contained in sources below
▪ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended
▪ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant)
- Biocides: King et al (2017, as amended) (vol 1 and 2) Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area (available from Queensland Government publications)
• Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'
• Anti-fouling: Comply with Anti-fouling and in-water cleaning guidelines (2015, as amended)</td></tr>
</table>

Water area/type (Source: s1–s4)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS [1–3] (refer plans WQ1011, WQ1021, WQ1031, WQ1041) Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted) **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources											
		Amm N (µg/L)	**Oxid N** (µg/L) **Partic N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L) **Partic P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**DO[2]** (% sat)	**Turb** (NTU) **Colour (C)** (hazen)	**SS** (mg/L)	**pH**	**Conductivity[3]** (µS/cm)	**Sulfate** (mg/L)
		TEMPERATURE											
All basins - fresh waters	**All**	Temperature varies daily and seasonally, is depth-dependent and highly site specific. Refer to QWQG for details on how to establish a range (20th – 80th %iles) for temperature. From an ecological effects perspective, daily maximum temperature and daily variation in temperature are key indicators, and seasonal variations also need to be identified.											
		STATE PLANNING POLICY, RIPARIAN, WETLANDS, GROUNDWATERS											
State Planning Policy	**All**	Refer to section 3.2											
Riparian	**All**	Refer to section 3.2											
Wetlands, mangroves	**All**	Refer to section 3.2 Note: there is insufficient information available to establish local WQOs for wetlands. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.											

Water area/type (Source: s1–s4)	Management intent /Level of protection	**JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS – FRESH WATERS** [1–3] **(refer plans WQ1011, WQ1021, WQ1031, WQ1041)** **Aquatic ecosystem water quality objectives: physico-chemical (baseflow except where noted)** **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources											
		Amm N (µg/L)	**Oxid N** (µg/L) **Partic N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L) **Partic P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**DO**[2] (% sat)	**Turb** (NTU) **Colour (C)** (hazen)	**SS** (mg/L)	**pH**	**Conductivity**[3] (µS/cm)	**Sulfate** (mg/L)
Groundwaters (s2, s3)	**HEV**	No WQOs specified in this document. Groundwaters should be maintained within the natural range of water quality (20th, 50th and 80thpercentiles), established through baseline characterisation of water quality by aquifer chemistry zone. Refer to QWQG for details on how to establish local WQOs. Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters. Refer to Water Quality Australia (Guidelines for groundwater quality protection in Australia) and ANZG (2018) for further details: *'Protection of groundwater quality is imperative to ensure the protection of healthy ecosystems and maintenance of environmental values as well as for future economic and population growth' (Australian Government, 2013; 1)* *'Groundwater quality protection also applies to groundwater that extends under coastal waters.' (Australian Government, 2013; 5).*											

Abbreviations: ANZG – Australian and New Zealand guidelines for fresh and marine water quality; QWQG – Queensland water quality guidelines; ID – insufficient data. Will be updated if information becomes available; na – not applicable; * – limited data. To be used as interim value until further data is available.

Indicators: FRP – filterable reactive phosphorus; Chl-a – chlorophyll-a; DO – dissolved oxygen; SS – total suspended solids.

Units: µg/L – micrograms per litre; % sat – percent saturation; NTU – nephelometric turbidity units; mg/L – milligrams per litre; µS/cm – microsiemens/centimetre; m^3/s – cubic metres/second ('cumecs')

Management intent: For eastern Cape York waters in relatively good (i.e. unmodified or slightly disturbed) condition, particularly under baseflow conditions, the WQOs are set to maintain current water quality. Under event flow conditions, WQOs are set to maintain current water quality or, for specified parameters, to improve water quality (where event data were available. Due to lack of event data event WQOs were not established for most rivers.). Unless otherwise indicated, WQOs apply to all Queensland waters within the specified water area (e.g. a catchment identified in column 1). This may also include areas shown as 'HEV' or 'SD' on the accompanying plans (e.g. national parks, conservation areas). Where areas are mapped as HEV or SD, there may be local variations in condition of waters. An HEV management intent does not preclude the need for management actions to address historical or ongoing threats to those values. For some indicators (e.g. toxicants), the relevant WQOs are based on national (e.g. ANZG 2018, as amended) or other guidelines, with a corresponding level of species protection, as outlined in the table.

Notes:

1. Nutrients:

Oxidised N = NO_2 + NO_3. Dissolved inorganic N (DIN) = Amm N + oxidised N.

Except where specified for event conditions, nutrient guidelines do not apply during high flow events in fresh and estuarine waters. During periods of low flow and particularly in smaller creeks, build-up of organic matter derived from natural sources (e.g. leaf litter) can result in increased organic N levels (generally in the range of 400 to 800µg/L). This may lead to total N values exceeding the WQOs. Provided that levels of inorganic N (i.e. NH_3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the WQOs, provided this is due to natural causes. See QWQG (section 5 and Appendix D) for more information on applying guidelines under high flow conditions.

2. Dissolved oxygen (DO): Dissolved Oxygen (DO) guidelines apply to daytime conditions. Lower values will occur at night in most waters. In estuaries, reductions should only be in the region of 10–15 per cent saturation below daytime values. In freshwaters, night-time reductions are more variable. Following significant rainfall events, reduced DO values may occur due to the influx of organic material. In estuaries post-event values as low as 40 per cent saturation may occur naturally for short periods but values well below this would indicate some anthropogenic effect. In freshwaters, post-event DO reductions are again more variable. In general, DO values consistently less than 50 per cent are likely to impact on the ongoing ability of fish to persist in a water body while short term DO values less than 30 per cent saturation are toxic to some fish species. Very high DO (supersaturation) values can be toxic to some fish as they cause gas bubble disease. DO values for fresh waters should only be applied to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50 per cent saturation.

3. Conductivity (EC): Based on locations at which monitoring data was available and analysed (refer Moss and Howley, 2017). Accuracy of these figures may be reduced with increasing distance from monitoring site, and with influences from tributaries joining main stream.

Sources / references:

ANZG (2018, as amended) *Australian and New Zealand guidelines for fresh and marine water quality*.

Australian Government (2015) *Anti-fouling and in-water cleaning guidelines*, Department of Agriculture, Canberra. CC BY 3.0

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.

Cape York Natural Resource Management and South Cape York Catchments (2016) *Draft Eastern Cape York water quality improvement plan*.

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters*, March.

Department of Environment and Heritage Protection (2009) *Queensland Water Quality Guidelines*, Version 3, ISBN 978-0- 9806986-0-2 (republished July 2013).

Moss, A and Howley, C (2017) *Water quality guidelines for fresh and estuarine waters of eastern Cape York*. Technical report for the Cape York water quality improvement plan, February

Timms, B.V. (1986). Reconnaissance Limnology of Some Coastal Dune Lakes of Cape York Peninsula, Queensland. ***Aust. J. Mar. Freshw. Res.,*** 1986, ***37,*** 167-76

Unpublished water quality datasets

Table 6 Aquatic ecosystem water quality objectives – freshwaters: other ions and related indicators (baseflow except where noted)

Water area/type (Source: s1–s4)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS FRESH WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041) Aquatic ecosystem water quality objectives: other ions and related indicators (baseflow) **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources							
		Alkalinity (mg/L $CaCO_3$)	**Hardness** (mg/L $CaCO_3$)	**Sodium adsorption ratio (SAR)**	**Ca** (mg/L)	**Mg** (mg/L)	**K** (mg/L)	**Na** (mg/L)	**Cl** (mg/L)
JACKY JACKY BASIN (refer plan WQ1011): baseflow (all seasons) (Single figure = 50th percentile) (no gauging station)									
Jacky Jacky Basin fresh waters (s1)	**All - maintain current condition**	4.7	3.2	1.7	0.1	0.7	0.3	7	11
OLIVE-PASCOE BASIN (refer plan WQ1021): baseflow (all seasons) (Single figure = 50th percentile) **Pascoe baseflow: <30m³/s (cumecs) at gauge 102102A – Pascoe River at Garraway gauge**									
Olive catchment fresh waters (s1)	**All - maintain current condition**	6.0	5.1	1.6	0.1	0.8	0.4	7.6	11
Pascoe catchment fresh waters (s1)	**All - maintain current condition**	10.0–12.0–15.4	9.3–10.0–12.0	1.6–1.8–2.2	1.3–1.5–2.0	1.48–1.7–1.9	1.2–1.4–2.0	12–13–17	17–20–26

Water area/type (Source: s1–s4)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS FRESH WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041) Aquatic ecosystem water quality objectives: other ions and related indicators (baseflow) **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians of test data are compared against the WQO (refer to section 3 text for more details). Unless otherwise specified, WQOs apply to all relevant Queensland surface waters within the listed catchments (i.e. including those mapped as HEV, SD). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: ANZG (2018); S4: other sources							
		Alkalinity (mg/L $CaCO_3$)	**Hardness** (mg/L $CaCO_3$)	**Sodium adsorption ratio (SAR)**	**Ca** (mg/L)	**Mg** (mg/L)	**K** (mg/L)	**Na** (mg/L)	**Cl** (mg/L)
LOCKHART BASIN (refer plan WQ1031): baseflow (all seasons) (Single figure = 50th percentile) (no gauging station)									
Claudie catchment fresh waters (s1)	**All - maintain current condition**	80.0	82.5	ID	ID	ID	ID	ID	ID
Lockhart catchment fresh waters (s1)	**All - maintain current condition**	31	31	ID	ID	ID	ID	ID	ID
STEWART BASIN (refer plan WQ1041): baseflow (all seasons)									
Stewart catchment fresh waters (s1)	**All - maintain current condition**	21.2–27.5–39.2	13.0–20.5–24.8	1.5–1.7–1.9	2.82–4.05–5.32	ID	ID	ID	ID
Massie catchment fresh waters (s1)	**All - maintain current condition**	ID	ID	ID	ID	ID	ID	ID	ID

Abbreviations: ANZG – Australian and New Zealand guidelines for fresh and marine water quality; QWQG – Queensland water quality guidelines; ID – insufficient data. Will be updated if information becomes available; na – not applicable; * – limited data. To be used as interim value until further data is available.

Indicators: Ca – Calcium; Mg – Magnesium; K – Potassium; Na – Sodium; Cl – Chlorine

Units: mg/L – milligrams per litre

Sources: Derived from:

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters*, March.
Moss, A and Howley, C (2017) *Water quality guidelines for fresh and estuarine waters of eastern Cape York*. Technical report for the Cape York water quality improvement plan, February.
Unpublished water quality datasets

Table 7 Aquatic ecosystem water quality objectives (indicative ranges) – fresh water dune lakes

Ranges of indicator values recorded in Cape York dune lakes (refer plans for locations)[1, 2] **Sources: s1: Timms (1986); s2: Howley (2007, unpublished)**							
Ions (*mg/L*)							**pH**
Na (s1)	**K (s1)**	**Ca (s1)**	**Mg (s1)**	**Cl (s1)**	**SO_4 (s1)**	**Salinity (s1)**	**pH (s1)**
7–30	0.2–1.2	1.3–4.6	0.5–3.4	9–50	1–10	30–100	4.0–6.0
Nutrients (*µg/L N or P*)							
Total P	**FRP**	**NH_3**	**Oxidised N**	**Total N**			
<5	<2	10–20	<5–120	400–1000			

Indicators: Na – Sodium; K – Potassium; Ca – Calcium; Mg – Magnesium; Cl – Chlorine; SO_4 – Sulfate; FRP – filterable reactive phosphorus; NH_3 – Ammonia-N

Units µg/L – micrograms per litre, mg/L – milligrams per litre

Notes:

1. There are around 200 dune lakes on the east coast of Cape York Peninsula. They occur in four main areas (from north to south): Somerset to Ussher Point, adjacent to Shelburne Bay, around Cape Grenville (which contains about half the lakes), and in the Cape Flattery-Cape Bedford area north of Cooktown (Timms, 1986). Refer WQ plans for mapped locations. Their water quality characteristics are typical of dune lakes, with low ionic concentrations and low pH, although there is variation between lakes. Management intent for these HEV lakes is to retain current (natural) condition

2. The table shows indicative ranges of some indicators in dune lakes, based on limited data from Timms (1986) and Howley (2007, unpublished). The data is insufficient to derive specific local objectives for these lakes but if test data from an individual dune lake was found to be well outside these ranges, this would be a trigger for further investigation. Nutrient data is very limited but like other dune lakes, soluble P levels appear to be extremely low everywhere while inorganic N levels are somewhat higher, and more variable.

Sources

Department of Environment and Heritage Protection (2017) *Draft environmental values and water quality objectives for eastern Cape York waters*, March.

Nutrients (s2): Howley, C (unpublished, 2007)

Ions and pH (s1): Timms, B.V. (1986) Reconnaissance Limnology of Some Coastal Dune Lakes of Cape York Peninsula, Queensland. ***Aust. J. Mar. Freshw. Res.,*** 1986, ***37,*** 167-76

Table 8 Aquatic ecosystem water quality objectives: estuarine, coastal and marine waters

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) Aquatic ecosystem water quality objectives [1–5]															
		Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**SS** (mg/L)	**pH**
Note: Information on wetlands, toxicants, temperature, and State Planning Policy (water quality state interest) provided at end of table.																	
MID – LOWER ESTUARY WATERS: baseflow																	
Mid-lower estuary waters	**All**	Insufficient data to derive local WQOs. Refer to QWQG for details on how to establish local WQOs. 'Limited or no data exists for estuaries in northeastern Cape York…Endeavour estuary guidelines should be used with caution as interim guidelines for other eastern Cape York estuaries (with the exception of Normanby). Further sampling is required to establish estuarine guidelines for the remaining estuaries' (Moss, Howley, 2017; 8-9)															
ENCLOSED COASTAL WATERS – Jacky Jacky, Olive-Pascoe, Lockhart: baseflow wet season (Nov-Apr except where stated)																	
HEV and SD enclosed coastal waters (s1, s2)	**HEV**	WQOs are based on enclosed coastal (EC) water quality data from the Olive-Pascoe Basin, and are relevant for use in enclosed coastal waters of the adjacent Jacky Jacky and Lockhart basins, until local data is available for EC waters in these basins. Refer to QWQG for details on how to establish local WQOs. Stewart River Basin WOOs are provided separately below.															
		2–2–3	<1.0–1.5–4.0	ID	87–94–118	95–106–142	2.0–3.0–3.5	ID	4–5–6	5–7–10	0.5–0.7–1.2	118–485–1000	75–105 (s2)	4–8–22	2–3–5	4–4–8	6.5–8.4 (s2)
Port waters (enclosed coastal)	**SMD**	Applies to port berthing facilities, docks, other intensive activities within port enclosed coastal waters under applicable season. • Nutrients, sediments, Secchi: adopt 50th percentile WQO, as expressed in the enclosed coastal row above • DO, pH: adopt 20-80th percentile range values as indicated in enclosed coastal water row above • Toxicants: refer separate row entry in this table [Note: For other enclosed coastal port waters within GBRMP zones, enclosed coastal WQOs as outlined in the above table row apply.]															

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) Aquatic ecosystem water quality objectives [1–5] **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)															
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**SS** (mg/L)	**pH**
ENCLOSED COASTAL WATERS – Stewart River Basin: baseflow wet season **(Nov-Apr except where stated)**																	
HEV and SD **enclosed coastal waters** (s1, s2)	**HEV**	2–2–4	1.0–1.5–3.0	ID	96–115–129	113–130–154	<2–2.0–3.0	ID	4–5–6	5–7–10	0.3–0.4–0.8	514–720–770	75–105 (s2)	ID	1.6–3.1–4.6	3–5–6	6.5–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	Amm N (µg/L)	Oxid N (µg/L)	Partic N (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a (µg/L)	Silicate (µg/L)	DO (% sat)	Turb (NTU)	Secchi (m)	SS (mg/L)	pH
JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010)																	
Aquatic ecosystem water quality objectives [1–5]																	
Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)																
OPEN COASTAL WATERS – all basins																	
HEV and SD Open coastal waters (HEV waters seaward of GBR plume line; SD waters landward of plume line) (s2, s3, s4)	**HEV**	**ANNUAL (BASEFLOW)**															
		0–1–3 (s4)	0.14–0.35–1.05 (s4)	15–18–24 (s4)	52–80–100 (s4)	75–100–122 (s4)	0.31–1.40–2.64 (s4)	1.9–2.6–3.5 (s4)	2–6–12 (s4)	5–9–16 (s4)	0.21–0.36–0.61 (s4)	50–100–180 (s4)	95–105 (s2)	0.6–0.9–1.7 (s4)	≥10 [6] (mean) (s3)	1.1–1.9–2.5 (s4)	8.1–8.4 (s2)
	HEV	**DRY SEASON (MAY-OCT EXCEPT WHERE STATED)**															
		0–1–3 (annual) (s4)	0.14–0.32–1.05 (s4)	≤16 (seasonal mean) (s3, s4)	50–80–100 (s4)	70–100–120 (s4)	0.62–1.86–2.74 (s4)	≤2.3 (seasonal mean) (s3, s4)	3–7–13 (s4)	8–10–14 (s4)	0.16–0.25–0.46 (s4)	60–115–190 (s4)	95–105 (s2)	0.6–0.9–1.8 (s4)	≥10 [6] (annual mean) (s3)	≤1.6 (season-al mean) (s3, s4)	8.1–8.4 (s2)
	HEV	**WET SEASON (NOV – APR EXCEPT WHERE STATED)**															
		0–1–3 (annual) (s4)	0.20–0.45–0.98 (s4)	14–20–26 (s4)	55–80–105 (s4)	75–105–130 (s4)	0.16–0.93–1.86 (s4)	2.2–3.0–3.9 (s4)	2–5–12 (s4)	5–10–20 (s4)	0.30–0.46–0.78 (s4)	50–98–180 (s4)	95–105 (s2)	0.5–0.8–1.5 (s4)	≥10 [6] (annual mean) (s3)	1.1–1.7–2.2 (s4)	8.1–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) Aquatic ecosystem water quality objectives [1–5] **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)															
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**SS** (mg/L)	**pH**
MIDSHELF WATERS – all basins																	
HEV Midshelf waters (s2, s3, s4)	**HEV Maintain**	0–1–3 (s4)	0.17–0.35–0.84 (s4)	14–18–22 (s4)	60–80–110 (s4)	75–100–130 (s4)	0.16–0.62–2.02 (s4)	1.5–2.0–2.8 (s4)	3–7–10 (s4)	6–9–15 (s4)	0.18–0.27–0.45 (s4)	40–80–135 (s4)	95–105 (s2)	0.3–0.5–1.5 (s3, s4)	≥10 (annual mean) (s3)	0.9–1.5–2.3 (s4)	8.1–8.4 (s2)
OFFSHORE WATERS – all basins																	
HEV Offshore waters (s2, s3, s4)	**HEV Maintain**	0–0–1 (s4)	0.16–0.42–1.30 (s4)	10–16–25 (s4)	50–70–90 (s4)	90–100–120 (s4)	0.16–0.39–1.40 (s4)	1.1–1.9–2.8 (s4)	2–4–7 (s4)	5–8–10 (s4)	0.17–0.26–0.39 (s4)	25–45–70 (s4)	95–105 (s2)	0.3–0.5–1.5 (s3, s4)	≥17 (annual mean) (s3)	0.3–0.5–1.0 (s4)	8.1–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) Aquatic ecosystem water quality objectives [1–5]

Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details).

HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data

Sources: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)

Amm N (µg/L)	Oxid N (µg/L)	Partic N (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a (µg/L)	Silicate (µg/L)	DO (% sat)	Turb (NTU)	Secchi (m)	SS (mg/L)	pH

ESTUARINE, COASTAL AND MARINE WATERS: TOXICANTS (INCLUDING METALS, BIOCIDES)

All basins: Estuaries mapped as HEV, SD:
 	
Toxicants (s1,s5)
	HEV	• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in:
		  ○ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended
		  ○ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant):
		  ▪ Biocides: King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications)
		
		Note: For information on the application of toxicant guidelines in estuaries, refer to ANZG Guideline values for other water types
		• Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'
		• Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.)
		• Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)

All basins: Estuaries not mapped as HEV, SD:
 	
Toxicants (s1, s5)
	SMD / HEV	• Toxicants (including metals, biocides) in water:
		  ○ Waters outside developed reaches (low level of disturbance): refer to 99% species protection values contained in sources below
		  ○ Waters within developed reaches: refer to 95% species protection values (or 99% species protection values for those toxicants identified in ANZG as having bioaccumulation potential) contained in sources below
		  ▪ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended
		  ▪ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant)
		  - Biocides: King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications)
		
		Note: For information on the application of toxicant guidelines in estuaries, refer to ANZG Guideline values for other water types
		• Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) Aquatic ecosystem water quality objectives [1–5] **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)															
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**SS** (mg/L)	**pH**
		• Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
Coastal and marine waters outside ports, marinas, spoil grounds: toxicants (s1,s3, s5, s6)	**HEV**	• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in: ○ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended ○ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant): ▪ Biocides: - GBRMPA (2010) *Water quality guidelines for the Great Barrier Reef Marine Park 2010* - King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications) ▪ Aluminium: <2.1 µg/L (99% species protection. Applies to the measured concentration in seawater that passes through a 0.45 µm filter) [Source: Golding et al. (2015)] • Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality' • Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
Coastal and marine waters in ports, marinas, spoil grounds: toxicants (s1, s3, s5, s6)	**SMD / HEV**	• Toxicants (excluding biocides – see below) in water: refer to 95% species protection values (or 99% species protection values for those toxicants identified in ANZG as having bioaccumulation potential) contained in: ○ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended ○ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant): ▪ Aluminium: <24 µg/L (95% species protection. Applies to the measured concentration in seawater that passes through a 0.45 µm filter) [Source: Golding et al. (2015)] • Biocides in water: refer to 99% species protection values (tributyltin: apply 95% species protection values) contained in: ○ ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended ○ The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant):															

<table>
<tr><th rowspan="4">Water area/type (Source: s1–s6)</th><th rowspan="4">Management intent /Level of protection</th><td colspan="15">JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010)
Aquatic ecosystem water quality objectives [1–5]</td></tr>
<tr><td colspan="15">Note: WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details).
HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data
Sources: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)</td></tr>
<tr><td>Amm N (µg/L)</td><td>Oxid N (µg/L)</td><td>Partic N (µg/L)</td><td>Total Diss N (µg/L)</td><td>Total N (µg/L)</td><td>FRP (µg/L)</td><td>Partic P (µg/L)</td><td>Total Diss P (µg/L)</td><td>Total P (µg/L)</td><td>Chl-a (µg/L)</td><td>Silicate (µg/L)</td><td>DO (% sat)</td><td>Turb (NTU)</td><td>Secchi (m)</td><td>SS (mg/L)</td><td>pH</td></tr>
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• Toxicants in sediments: refer to ANZG ‘toxicant default guideline values for sediment quality’
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• Anti-fouling: Comply with Anti-fouling and in-water cleaning guidelines (2015, as amended)</td></tr>
<tr><td>Coastal and marine waters</td><td>All</td><td colspan="15">Temperature (s3): Increases of no more than 1°C above long-term (20 year) average maximum. (GBRMPA, 2010)</td></tr>
<tr><td>Coastal waters: biological (s1)</td><td>All (where applicable)</td><td colspan="15">Seagrass
Light requirements are specified as a photosynthetic active radiation (PAR) moving average, depending on seagrass species. Levels specified here are derived to support the health of all species present either as the dominant species or as one of a suite of species that are known to occur in the region. It does not reflect requirements for macroalgae or other organisms.
• Deep water areas (>10m) 2.5 mol m^{-2} day^{-1} over a rolling 7 day average # (Collier et al 2016; Chartrand et al 2014; Rasheed et al 2014; York et al 2015)
• Shallow inshore areas (<10m): 6 mol m^{-2} day^{-1} over a rolling 14 day average # (Collier et al 2016; Chartrand et al, 2012)
Note: # Absolute light requirements for seagrass may vary between sites. Values described here provide a conservative guide to the levels of light likely to support seagrass growth. Locally derived absolute thresholds ideally should be obtained for management of specific activities likely to impact on the light environment.</td></tr>
</table>

Water area/type (Source: s1–s6)	Management intent /Level of protection	JACKY JACKY, OLIVE-PASCOE, LOCKHART, STEWART BASINS - ESTUARINE, COASTAL, MARINE WATERS (refer plans WQ1011, WQ1021, WQ1031, WQ1041, WQ1010) **Aquatic ecosystem water quality objectives** [1–5] **Note:** WQOs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to section 3 text for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data **Sources**: S1: Local datasets/reporting (applies to all WQOs except where indicated); S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)															
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		STATE PLANNING POLICY, RIPARIAN, WETLANDS, GROUNDWATERS															
State Planning Policy	**All**	Refer to section 3.2															
Riparian	**All**	Refer to section 3.2															
Wetlands, mangroves	**All**	Refer to section 3.2 Mangroves: No loss of mangrove area (refer section 3.2). Note: there is insufficient information available to establish local WQOs for wetlands. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles. In the absence of local information, the ANZG provides default values for wetlands.															
Groundwaters (s2, s5)	**HEV**	No WQOs specified in this document. Groundwaters should be maintained within the natural range of water quality (20th, 50th and 80thpercentiles), established through baseline characterisation of water quality by aquifer chemistry zone. Refer to QWQG for details on how to establish local WQOs. Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters. Refer to Water Quality Australia (Guidelines for groundwater quality protection in Australia) and ANZG (2018) for further details: *'Protection of groundwater quality is imperative to ensure the protection of healthy ecosystems and maintenance of environmental values as well as for future economic and population growth' (Australian Government, 2013; 1)* *'Groundwater quality protection also applies to groundwater that extends under coastal waters.' (Australian Government, 2013; 5).*															

Abbreviations: ANZG – Australian and New Zealand guidelines for fresh and marine water quality; QWQG – Queensland water quality guidelines; ID – insufficient data. Will be updated if information becomes available; na – not applicable; * – limited data. To be used as interim value until further data is available.

Indicators: FRP – filterable reactive phosphorus; Chl-a – chlorophyll-a; DO – dissolved oxygen; SS – total suspended solids.

Units: µg/L – micrograms per litre; % sat – percent saturation; NTU – nephelometric turbidity units; m – metres; mg/L – milligrams per litre

Notes to Table (where applicable):

1. Nutrients:

Oxidised N = NO_2 + NO_3. Dissolved inorganic N (DIN) = Amm N + oxidised N.

Except where specified for event conditions, nutrient guidelines do not apply during high flow events in fresh and estuarine waters. During periods of low flow and particularly in smaller creeks, build-up of organic matter derived from natural sources (e.g. leaf litter) can result in increased organic N levels (generally in the range of 400 to 800µg/L). This may lead to total N values exceeding the WQOs. Provided that levels of inorganic N (i.e. NH_3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the WQOs, provided this is due to natural causes. See QWQG (section 5 and Appendix D) for more information on applying guidelines under high flow conditions.

2. Suspended solids: Suspended solids (and hence turbidity and Secchi depth) levels in coastal waters are naturally highly variable depending on wind speed/wave height and in some cases on tidal cycles. The values in this table provide guidance on what the long term values of turbidity, Secchi depth or TSS should comply with. However, these values will often be naturally exceeded in the short term during windy weather or spring tides. They therefore should not be used for comparison with short term data sets. Where assessable coastal developments are proposed, proponents should carry out site specific intensive monitoring of these indicators (or equivalent light penetration indicators) and use these as a baseline for deriving local guidelines and for comparison with post development conditions.

3. Dissolved oxygen (DO): Dissolved Oxygen (DO) guidelines apply to daytime conditions. Lower values will occur at night in most waters. In estuaries, reductions should only be in the region of 10–15 per cent saturation below daytime values. In freshwaters, night-time reductions are more variable. Following significant rainfall events, reduced DO values may occur due to the influx of organic material. In estuaries post-event values as low as 40 per cent saturation may occur naturally for short periods but values well below this would indicate some anthropogenic effect. In freshwaters, post-event DO reductions are again more variable. In general, DO values consistently less than 50 per cent are likely to impact on the ongoing ability of fish to persist in a water body while short term DO values less than 30 per cent saturation are toxic to some fish species. Very high DO (supersaturation) values can be toxic to some fish as they cause gas bubble disease. DO values for fresh waters should only be applied to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50 per cent saturation.

4. Open coastal/marine waters – GBR plume line: The GBR plume discharge area is derived from a smoothed version of the 'high' and 'very high' risk classes of modelled outputs from the risk assessment element of the Reef Plan Scientific Consensus Statement 2013 (Waterhouse et al. 2013).

5. Open coastal/marine waters - seasonal splits: While seasonal means are estimated based on biotic responses, the relationship is not as strong as it is for annual mean values. They are provided here as indicative objectives to allow comparison with single season collected data sets. Wet and dry seasons can start and end at different times of the year. Seasonal dates indicated are generally applicable. Applying these values for any management action should take both of these matters into account.

6. Open coastal/marine waters – Secchi depth. For waters shallower than the specified Secchi depth of ≥10m the depth to seafloor is the WQO.

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Unpublished water quality datasets

3.2 Vegetation management and planning provisions

This following is provided for information on habitat management and planning matters. While it is current at time of publication, readers should refer to relevant Queensland websites and legislation to ensure they are referring to current materials.

3.2.1 Riparian vegetation

The clearing of native vegetation in Queensland is regulated by the *Vegetation Management Act 1999*, the *Planning Act 2016* and associated policies and codes. This includes the regulation of clearing within a defined distance of watercourses and drainage features.

For vegetation management relating to waterways, reference should be made to:

- State Development Assessment Provisions (SDAP) State Code 16: Native vegetation clearing. This code requires clearing of native vegetation to meet performance outcomes relating to the protection of wetlands, watercourses and drainage features. The code outlines buffer areas where clearing cannot occur within a specified distance of watercourses or drainage features. If clearing within these buffers cannot be reasonably avoided, an offset must be provided to counterbalance any significant residual impact to a wetland, watercourse or drainage feature. For more information on SDAP State code 16, refer to the 'Queensland's Planning System' website.
- SDAP State Code 9: Great Barrier Reef wetland protection areas
- The relevant Accepted Development Vegetation Clearing Codes (ADVCC) under the *Vegetation Management Act 1999*. These codes allow self-assessable clearing for certain purposes in particular land tenures and regional ecosystems. It is a requirement across all codes for landholders to use best practice methods when clearing vegetation to prevent soil erosion and instability and to prevent increased sediment run-off entering a wetland, watercourse or drainage feature. The codes also contain riparian protection zones to prevent clearing within a defined distance of a wetland, a stream ordered watercourse or a drainage feature. Where a code permits clearing within these areas, there are additional requirements to rehabilitate the area or (for clearing of regulated regrowth vegetation) to legally secure an exchange area to counterbalance the impact. For more information on the ADVCCs and guidance material, refer to the Department of Natural Resources, Mines and Energy website.

Clearing of native vegetation in a watercourse may also require a riverine protection permit under the *Water Act 2000*. Further information is available at www.business.qld.gov.au.

Local Government Planning schemes under the *Planning Act 2016* may also specify riparian buffers (for example under catchment protection or waterway codes). Refer to the Department of State Development, Manufacturing, Infrastructure and Planning website and relevant local government websites for further information about planning schemes.

3.2.2 Wetlands

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 defines environmental values for wetlands.

The State assesses impacts from earth works that may have impacts on freshwater wetlands of High Ecological Significance in Great Barrier Reef Catchments against State Development Assessment Provisions (SDAP) State Code 9: Great Barrier Reef wetland protection areas.

This includes performance requirements to ensure:

- adverse effects on hydrology, water quality and ecological processes of a wetland are avoided or minimised
- any significant adverse impacts on matters of state environmental significance and on riparian areas or wildlife corridors in strategic environmental areas are avoided.

3.2.3 Marine protected areas

In Queensland, declared fish habitat areas (under the *Fisheries Act 1994*) protect the State's key estuarine and coastal fish habitats from development impacts to support sustainable fishing.

Works within declared fish habitat areas may be assessable development for which a development approval is required under the *Planning Act 2016,* or be accepted development under the *Fisheries (General) Regulation 2019.* The State assesses building work or operational development that may have impacts on declared fish habitat areas against the State Development Assessment Provisions (SDAP) State code 12: Development in a declared fish habitat area. (For more information on SDAP State codes, refer to the 'Queensland's Planning System' website.

Performance outcomes for all assessable development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)
  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- development maintains or improves water quality
- development likely to cause disturbance to potential or actual acid sulfate soil, prevents the release of contaminants.

In most cases a resource allocation authority is also required under the *Fisheries Act 1994* before assessable development can proceed. The Department of Environment and Science website contains further information on approvals, accepted development requirements and other aspects relating to declared fish habitat areas.

Marine parks (under the *Marine Parks Act 2004*) protect tidal lands and waters to conserve the marine environment while allowing for sustainable use. Depending on the zone, activities can occur "as of right" or with permission. For more information about declared fish habitat areas and marine parks, see the department's website.

3.2.4 Marine plants (including mangroves)

Marine plants grow on or adjacent to tidal lands. They include tidal plants such as mangroves, seagrass, saltcouch, algae, samphire (succulent) vegetation and seasonally connected adjacent plants, such as melaleuca (paper barks) and casuarina (coastal she-oaks). Marine plants support local fish populations, fish catches and general aquatic health, and for this reason they are protected under the *Fisheries Act 1994*.

A material change of use, reconfiguring of a lot, and operational work that will remove, damage or destroy a marine plant is either assessable development for which a development approval is required under the *Planning Act 2016,* or accepted development under the *Fisheries (General) Regulation 2019.* Work types that are described as accepted development must comply with the relevant Accepted Development Requirements in all respects. If all requirements are not met, then the development is assessable and must be applied for.

The State assesses development applications that may have impacts on marine plants using the State Development Assessment Provisions (SDAP) State code 11: Removal, destruction or damage of marine plants. For more information on SDAP State codes, refer to the 'Queensland's Planning System' website.

Performance outcomes for all development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)
  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- development likely to cause drainage or disturbance to acid sulfate soils, prevents the release of contaminants and impacts on fisheries resources and fish habitats.

A marine plant is a matter of state environmental significance under the *Environmental Offsets Act 2014* and an environmental offset may be required for any significant residual impact that is approved.

The Department of Agriculture and Fisheries website contains further information on approvals, accepted development requirements and other aspects relating to marine plants.

3.2.5 Waterways providing for fish passage

Waterway barrier works may inhibit the free movement of fish along waterways and onto floodplains, injure fish or affect fish health and habitat. Many native fish need to access a range of habitats for food, breeding and refuge and move or migrate to complete their lifecycle.

Adequate fish passage must be provided at any proposed waterway barrier. Operational work that is to construct or raise a waterway barrier is assessable development for which a development approval is required under the *Planning Act 2016,* or is accepted development under the *Fisheries (General) Regulation 2019.* Work types that are described as accepted development must comply with the relevant Accepted Development Requirements in all respects. If all requirements are not met, then the development is assessable and must be applied for. The State assesses development applications that may have impacts to fish passage using the State Development Assessment Provisions (SDAP) State code 18: Constructing or raising waterway barrier works in fish habitats. For more information on SDAP State codes, refer to the 'Queensland's Planning System' website.

Performance outcomes for all development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)
  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- sufficient water exchange and flow is maintained and provided to sustain and where necessary restore, water quality and the health and condition of fisheries resources, ecological functions and fish passage
- development likely to cause drainage or disturbance to acid sulfate soils, prevents the release of contaminants and impacts on fisheries resources and fish habitats.

A waterway providing for fish passage is a matter of state environmental significance under the *Environmental Offsets Act 2014* and an environmental offset may be required for any significant residual impact that is approved.

The Department of Agriculture and Fisheries website contains further information on approvals, accepted development requirements and other aspects relating to waterway barrier works and fish passage.

3.2.6 State planning policy – (state interest – water quality)

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

Water quality is a state interest. The SPP (state interest – water quality) seeks to ensure that 'the environmental values and quality of Queensland waters are protected and enhanced'. It includes provisions relating to receiving waters, acid sulfate soils and water supply buffer areas.

The provisions of the SPP are applied through their 'integration' into local government planning schemes. Planning schemes adopt measures prescribed in the SPP that ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of environmental values and meet the water quality objectives identified in the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. This is achieved by:

- ensuring land zoned for urban purposes is located and constructed to avoid adverse impact on water quality; and
- development meeting stormwater management design objectives during construction and post construction phase.

Stormwater management design objectives for construction include developments using measures to manage the velocity of stormwater flows and prevent erosion, sediment, litter and other contaminates entering waterways while construction is occurring. Post construction stormwater management design objectives generally apply to lots over 2500m^2 that results in six or more dwellings or lots. The objectives seek to limit the amount of nutrients and litter, including nitrogen, phosphorus and suspended sediments, entering waterways from the operation of the development.

The SPP (state interest – water quality) is supported by the State Planning Policy—state interest guidance material – Water quality. The SPP (including SPP code) and guideline are available from the Department of State Development, Manufacturing, Infrastructure and Planning 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.

4.1 Human use EVs water quality objectives

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

Table 9 Human use EVs water quality objectives

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
Suitability for drinking water supply	All fresh waters including groundwaters	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 10. 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 for oystering	Estuarine and coastal waters	As per ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended. (refer Food Standards Australia New Zealand website)
Protection of the human consumer	Fresh waters, estuarine and coastal waters	As per ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended.
Protection of cultural and spiritual values	Fresh waters (including groundwaters), estuarine and coastal waters	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
Suitability for industrial use	Fresh waters, estuarine and coastal waters	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	Fresh waters, estuarine and coastal waters	As per: • Tables 11–13 • ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended
Suitability for irrigation	All fresh waters including groundwaters	Pathogens and metal WQOs are provided in Tables 14 and 15 (based on ANZG). For all other indicators, such as salinity, sodicity, sodium adsorption ratio (SAR), and herbicides, refer ANZG.
Suitability for stock watering	All fresh waters including groundwaters	As per ANZG, including median faecal coliforms <100 organisms per 100 mL. For total dissolved solids and metals, refer Tables 16 and 17, based on ANZG. For other indicators, such as cyanobacteria and pathogens, see ANZG.
Suitability for farm supply/use	All fresh waters including groundwaters	As per ANZG.
Suitability for primary contact recreation	Fresh waters, estuarine and coastal waters	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	Fresh waters	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

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
		in NHMRC (2008) and Table 18.
	Estuarine, coastal waters	• cyanobacteria/algae: Recreational water bodies should not contain ≥ 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers[2]. Further details are contained in NHMRC (2008) and Table 18.
Suitability for secondary contact recreation	Fresh waters, estuarine and coastal waters	As per NHMRC (2008), including: • intestinal enterococci: refer primary recreation above • cyanobacteria/algae—refer primary recreation, NHMRC (2008) and Table 18.
Suitability for visual recreation	Fresh waters, estuarine and coastal waters	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 18.

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).
2. The NHMRC states that its guidelines are concerned 'only with risks that may be associated with recreational activities in or near coastal and estuarine waters. This includes exposure through dermal contact, inhalation of sea-spray aerosols and possible ingestion of water or algal scums, but does not include dietary exposure to marine algal toxins.' (NHMRC, 2008; 121).

Sources:

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

- Technical review and advice from Queensland Health and Department of Natural Resources, Mines and Energy (2020)
- 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)

4.2 Drinking water EV water quality objectives

Table 10 Drinking water EV: Priority water quality objectives for drinking water supply in the vicinity of off-takes, including groundwater, 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))

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).

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).

4.3 Aquaculture EV water quality objectives

The following tables outline WQOs for aquaculture, depending on water type and species.

Table 11 Aquaculture EV: General water quality objectives for tropical aquaculture

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

WATER QUALITY TARGET 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 13 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.

4.4 Irrigation EV water quality objectives

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

Table 14 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. Refer to ANZG (2018, as amended) for updates to irrigation guidelines.

Table 15 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. Refer to ANZG (2018, as amended) for updates to irrigation guidelines.

4.5 Stock watering EV water quality objectives

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

Table 16 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, as amended) for further details.

Table 17 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, as amended) for further details.

4.6 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 18 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].
Coastal and estuarine waters		
Karenia brevis		
≤ 1 cell/mL	> 1– < 10 cells/mL	≥ 10 cells/mL
Lyngbya majuscula, Pfiesteria spp.		
History but no current presence of organism	Present in low numbers	Present in high numbers. (For *Lyngbya majuscula* this involves the relatively widespread visible presence of dislodged algal filaments in the water and washed up onto the beach)
Nodularia spumigena: See NHMRC, Chapter 6 (Cyanobacteria and algae in fresh water) for details.		

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 the DSDMIP website and council websites

Regional plans, studies

- Cape York Queensland Regional Plan, Queensland Government (2014)
- Draft Eastern Cape York water quality improvement plan (WQIP, 2016), available from Cape York Natural Resource Management

State plans, policies, guidelines, agreements

- Reef 2050 long-term sustainability plan
- Reef 2050 Water Quality Improvement Plan 2017–2022
- Cape York Water Plan
- State Planning Policy (state interest – water quality), including SPP code – water quality, and supporting SPP guidelines

Water quality guidelines

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018, as amended)
- Queensland Monitoring and Sampling Manual, available from the department's website
- Queensland Water Quality Guidelines (QWQG), accessible from the department's website
- Water quality guidelines for the Great Barrier Reef Marine Park 2010, available on the Great Barrier Reef Marine Park Authority's website

Other supporting technical information

- Information on PFAS in Queensland, including access to PFAS national environmental management plan
- Salinity Management Handbook – available on the Queensland Government Publications website
  - Chapter 10 – Waters
  - Chapter 11 – Water Quality
- Soil conservation guidelines for Queensland – available on the Queensland Government Publications website
  - Chapter 10 – Land management on flood plains
  - Chapter 11 – Stream stability
  - Chapter 13 – Gully Erosion
- Fish habitat guidelines available from the DAF website, including Design of stream crossings (FHG 001), Restoration of fish habitats: Marine areas (FHG 002), Fish habitat buffer zones (FHG 003), and Mangrove nurseries: Construction, propagation and planting (FHG 004)
- Healthy Waterways Incorporated – Water by Design: resources and information available on the Water by Design website, including content on the Reef Urban Stormwater Management Improvement Group (RUSMIG)

6 Dictionary

AMTD means the adopted middle thread distance which is the distance in kilometres, measured along the middle of a watercourse, that a specific point in the watercourse is from the watercourse's mouth or junction with the main watercourse (definition based on Water Regulation 2002).

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).

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.

Highest astronomical tide (HAT) (defined in Marine Parks (Declaration) Regulation 2006) means the highest level of the tides that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.

High water mark (defined in *Coastal Protection and Management Act 1995*) means the ordinary high water mark at spring tides.

Mean high water spring refer high water mark.

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 19 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.	

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Environmental values and definitions	ICON (as shown on plans)
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.	
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).